Conducting a Full Chemical Cleanout in Schools

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Northeast Waste Management Officials' Association

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Introduction

Introduction

Purpose:

- Train NYS DEC employees to conduct a full chemical cleanout of science classrooms at K-12 schools

Goal:

- NYS DEC employees will be able to take what they learned today and apply it to workshops targeted at schools

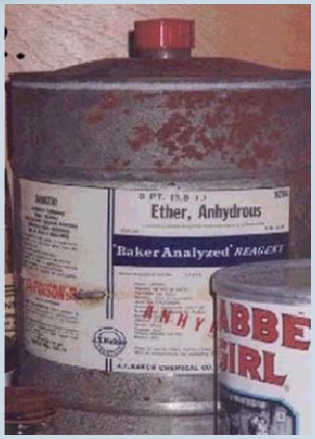
Ultimate Audience:

- Science Teachers, School Administrators, School Health and Safety Coordinators, and Facilities Personnel

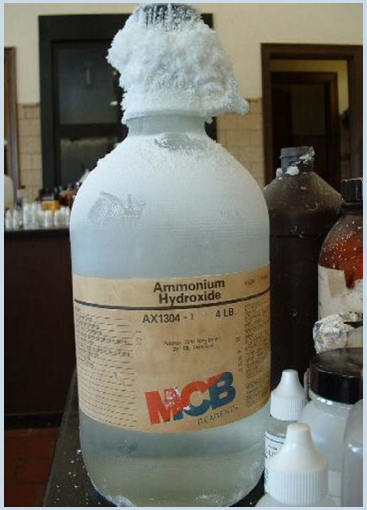
The Problem

Why do chemicals pose a problem for schools?

The Problem



Many Dangerous Situations!



Chemical Spills

- Chemical spills can be costly and difficult to clean up
- They put students, faculty, and school staff at risk
- Large spills can have a detrimental effect on the surrounding environment

Photo Source: Rhode Island DEM

Chemical Spills – New York

- There were 188 chemical spills in New York schools from 1993-2006
- Of these, 90 resulted in school evacuations and over 1,000 injured students, employees, and responders
- The majority of the spills were due to "human error"

Mercury Spills – New York

- There were 39 mercury spills in New York schools between 1993-2006
- Of these spills, 14 were large enough that the school had to be evacuated
- The majority of spills occurred from elemental mercury released from mercury devices

Case Study - Nevada

January 2003

Pau-Wa-Lu Middle School
Gardnerville, Nevada

- Small vial of liquid elemental mercury
- School closed over 2 weeks
- Total clean-up cost over $100,000

Photo Source: EPA Region 9 “On Scene Coordinator”

Case Study - Mississippi

September 2003
Hancock High School; Kiln, Mississippi

- Mercury air concentrations were found above EPA levels
- School buses were also contaminated
- Total cleanup costs $200,000

Case Study – Washington DC

Photo Source: EPA Superfund

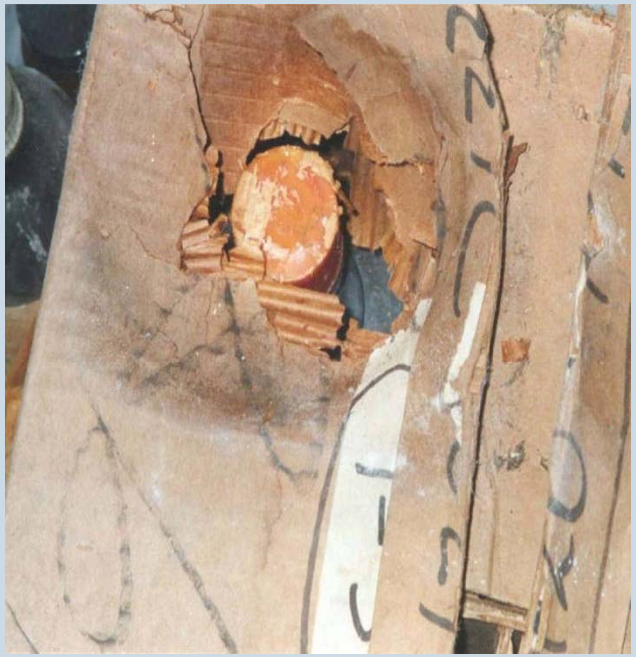
October 2003

Ballou High School Washington DC

- 250 ml of liquid elemental mercury
- School closed for 35 days
- Total clean-up cost $1,500,000

Chemical Reactions

Unintended chemical reactions can cause fires, explosions, and produce harmful vapors.



Cyanide and Nitric Acid

Case Study - Ohio

March 1999
High School; Dayton, Ohio

- Nitric acid, acetic acid, and ammonia fell off a shelf, mixed, and reacted
- School closed for 4 days
- Total cleanup costs $150,000

The Main Problem

The real problem is the unmanaged chemical stockpiles found in school science classrooms.

Roots of the Problem

- School Administrators are often unaware of the quantity and toxicity of chemicals.
- Most staff are not trained to manage the risks of hazardous chemicals.
- Few schools have the proper budget for chemical storage space and equipment, staff time for chemical management, or hazardous waste disposal.

The Solution

Proper Chemical Management!!!

The Solution

Why should schools conduct a chemical cleanout?

- Regulatory Obligation
- Health and Safety

NYS Regulations

There are regulations governing the use, storage, and disposal of chemicals in schools in New York…

- NYS Dept. of Environmental Conservation
- NYS Dept. of Education
- NYS Dept. of Health

Chemical Storage Guidelines

New York State Education Law (1989)
‘305(19) Chapter 627

- Chemicals must be stored in locked and secure storage rooms
- Schools must conduct and maintain an annual inventory of all chemicals

Hazardous Waste Regulations

6 NYCRR Parts 370 Series

- Regulatory requirements are based on generator status
- Chemicals must be stored in appropriate containers and labeled (name, date)
- Waste must be disposed of at a licensed destination facility

Universal Waste Rule

6 NYCRR Subpart 374-3

- Pertains to mercury-containing devices and chemical pesticides
- Chemicals must be stored in appropriate containers and labeled (name, date)
- Waste must be disposed of through a licensed handler or destination facility

Health and Safety Considerations

- Children are more vulnerable to toxic effects
- Spills are a common occurrence, and can be costly to clean-up
- Chemical stockpiles increase the risk of explosions, fires, or dangerous reactions

Health Risks

The risks associated with exposure to a chemical depend on…

- **Chemical hazard level**
- **Route of exposure**
- **Duration of exposure**

Getting Started

Chemical Cleanout Process

There are 5 basic steps to achieving proper chemical cleanout in schools:

1. Training
2. Inventory
3. Storage
4. Disposal
5. Ongoing Chemical Management

Form a Team

The Cleanout Project Team:

- School administrators
- Teachers
- Facilities and maintenance personnel

Team Building

Potential Partners include:

- State Agencies
  - NYS Dept. of Environmental Conservation
  - NYS Dept. of Health
  - NYS Dept. of Education
- Hazardous waste handlers
- Local fire, police, and emergency response

Project Champion

- Establishing a project "Champion" is a key part of a successful chemical cleanout campaign
- They are responsible for leading the cause at the school, district, and state levels
- If possible, make this a paid position

Program Styles

Administrative support is critical.

1. **Individual School Program**
2. **District Program –** (multiple schools)

Training

Mandatory training for teachers, administrators, and staff involved in the chemical cleanout process

Employee "Right to Know"

OSHA's *Right to Know Law* ("HAZCOM") CFR 1910.1200.

- Employees have a right to know what chemicals they are working with or are in their workplace
- All chemicals in the workplace must be evaluated for health and physical hazards and that information must be made available to all employees

Material Safety Data Sheet

- A Material Safety Data Sheet (MSDS) contains information on the proper procedures for handling, storing, and disposing of chemicals
- All chemicals and chemical kits should have an MSDS

Safety First

Safety

One of the most important aspects when conducting a chemical cleanout program is SAFETY

Photo Source: DRD Training

Personal Protective Equipment

At a Minimum…

- Latex or Nitrile Gloves
- Safety Goggles
- Lab Apron
- Close-toed Shoes

Photo Source: Wright State University

Personal Protective Equipment

What NOT to wear:

- Watches or Jewelry
- Contact Lenses
- Synthetic Fingernails

Safety Equipment

Science Labs should be equipped with:

- Eyewash Station
- Safety Shower (1 per school)
- Fire Extinguisher
- Chemical Spill Kits

Photo Source: Guardian Equipment

Pre-Inventory Screening

- Identify the location, quantities, types, and conditions of chemicals stored in the school building
- Immediately identify and remove all imminent hazards
- Make recommendations for disposal
- Estimate the costs of clean-out

Safety Prescreen Checklist

This checklist was developed by Massachusetts DEP.

- **Use as part of the pre-inventory screening process**
- **Covers storage and container conditions**

Identify “Imminent Hazards”

- Incompatible groupings of chemicals
- Unstable or compromised chemicals
- Corroded or unstable containers
- Corroded shelving or support systems
- Sources of ignition, water, and heat that may pose a dangerous situation

Incompatible Chemicals

The following groups of chemicals should be separated:

- Acids and Bases
- Flammable Liquids and Corrosives
- Organic Acids and Inorganic Acids
- Strong Oxidizers or Pyrophorics and Flammables
- Strong Oxidizers and Corrosives
- Water Reactive Chemicals and Aqueous Sources

Incompatible Chemicals

Ammonia and Bleach

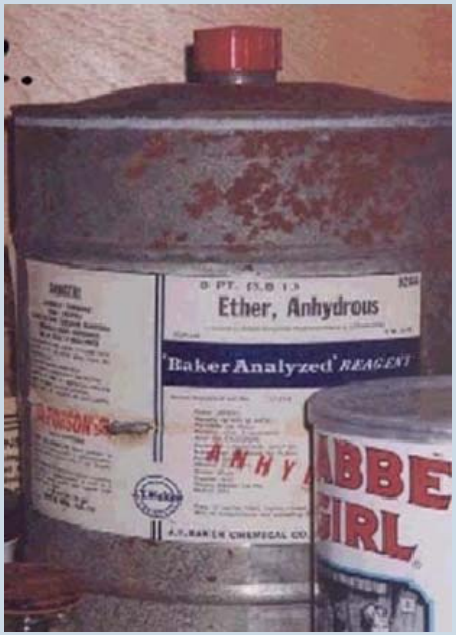
Potassium Dichromate, Acetone, and Perchloric Acid

Photo Source: University of Kentucky

Bleach and Hydrochloric Acid

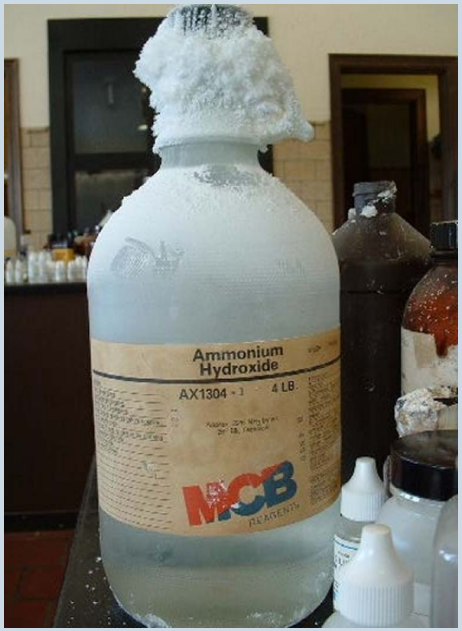
Photo Source: University of Kentucky

Unstable Chemicals



Anhydrous Ether

White Phosphorous



Ammonium Hydroxide

Unstable Containers

Improper Storage of Elemental Mercury

Unstable Storage Structure

Corroded Shelving

Sources of Ignition

Matches

Chemicals stored next to the heater

Handling the Chemicals

- Persons should not handle the chemicals during the pre-inventory screening assessment
- A technical expert may remove any imminent hazards during this assessment

Spill Response

In the event of a chemical spill or other accident, contact the New York State Spill Response Hotline at:

(800) 457-7362

Conducting an Inventory

Conducting the Inventory

Basic information to be recorded:

- Name of chemical or product
- Container size and fullness
- Number of containers
- Location of containers
- Concentration of chemical solutions (%)
- Hazardous characteristic information
- Expiration dates
- Usage (how often)

Conducting the Inventory

In most cases, schools should conduct two separate chemical inventories.

1. Short Term Inventory

- Disposal Purposes

2. Long Term Inventory

- Ongoing Chemical Management (Tracking)

Short-Term Actions

1. **Identify Hazards**
2. **Conduct Inventory of all Chemicals**
3. **Remove and Dispose of Chemicals**
   - Excess or overstocked
   - Highly hazardous
   - Outdated
   - No longer used or needed

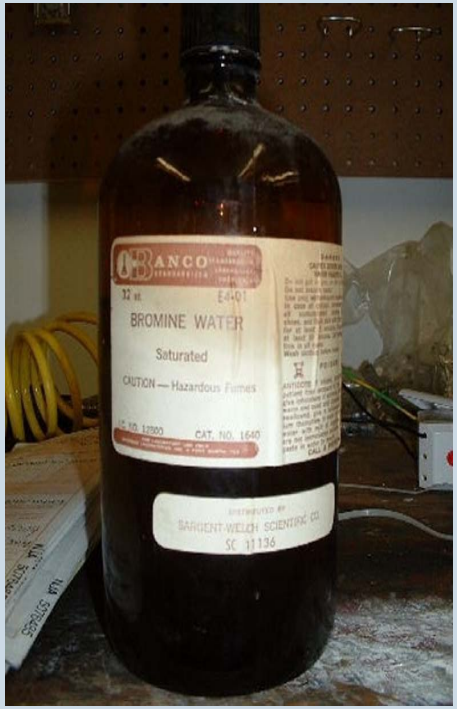
Excess Chemicals

Overstocked Mercury Oxide

Large Quantity of Elemental Mercury

Expired Chemicals

Antique Pesticides and Oils – 30 yrs old



Bromine – dated 9/15/79

Short-Term Chemical Inventory

This inventory was developed by the Vermont DEC.

- **Use for chemicals to be disposed of**
- **May want to indicate chemical hazard or handling instructions in the "comments"**

Long-Term Management

For the inventory of chemicals remaining in the school:

1. Maintain MSDS for all chemicals
2. Maintain inventory tracking system – update annually
3. Develop a chemical management system for chemical use, storage, and disposal

Long-Term Chemical Inventory

This inventory was developed by the Vermont DEC.

- **Use for chemicals remaining onsite**
- **May want to add a column for the percent fullness of each container or indicate this in the "comments"**

Mercury Inventory - Devices

This inventory was developed by the NYS DEC and NYS Dept. Health.

- **Use specifically for mercury and mercury-containing devices**
- **Includes a section on non-mercury replacement equipment**

Chemical Characteristics

Common Chemicals in Schools

1. Toxics – Mercury, Lead, Cyanide
2. Corrosives – Strong Acids and Bases
3. Chlorinated Solvents
4. Heavy Metals
5. Explosives
6. Flammables

Toxic Chemicals in Schools

Toxic		
ammonium metavanadate	caffeine	colchicine
lead compounds	mercury	mercury compounds
nicotine	sodium azide	cyanide salts
thioacetamide	thiourea	brucine sulfate
unsealed radioactive sources	o-toluidine	ammonium oxalate
antimony	antimony trioxide	arsenic trichloride
arsenic trioxide	barium chloride	calcium fluoride
chloretone	chloroform	chromium oxide
chromium potassium sulfate	cobalt nitrate hexahydrate	cylcohexane
p-Dichlorobenzene	dichloromethane	lead arsenate
lead carbonate	lead chloride	lead nitrate
lithium nitrate	methylene chloride	nickel powder
selenium	silver nitrate	sodium arsenate, dibasic
sodium fluoride	sodium oxalate	stannic chloride
uranyl acetate	uranyl nitrate	wood's metal (lead alloy)
thorium nitrate	uranium tetrachloride	

Carcinogenic Chemicals in Schools

Carcinogens		
arsenic	carbon tetrachloride	benzene
formaldehyde	chloroform	aniline
lead acetate	acetamide	acrylamide
antimony trioxide	arsenic and compounds	beryllium & compounds
cadmium & compounds	calcium chromate	carbon black
chromium & compounds	cobalt & oxides	lead phosphate
mercury alkyl compounds	methyl chloride	nickel & soluble compounds
thorium & compounds	titanium dioxide	o-tolidine
o-toluidine	trypan blue	acrylonitrile
ammonium chromate	ammonium dichromate	aniline hydrochloride
ethylene dichloride	hematoxylin	potassium chromate
sodium chromate tetrahydrate	sodium dichromate	sudan IV
talc	tannic acid	thioacetamide

Explosive Chemicals in Schools

Explosive/fire hazard		
potassium chlorate	benzoyl peroxide	carbon disulfide
collodion	cyclohexene	1,4-dioxane
ethyl ether	isopropyl ether	tetrahydrofuran
styrene	phosphorus pentoxide	yellow/white phosphorus magnesium powder
formic acid (aged)	anhydrous aluminum chloride	lauryl peroxide
potassium metal	nitroglycerin	nitrogen trioxide
2,4-dinitrophenol	2,4-dinitrophenolhydrazine	perchloric acid
low flash point solvents	aged & excessive oxidizers	thermit
picric acid	leaking gas cylinders	sodium metal
lithium metal	divinyl acetylene	vinylidene chloride
sodium amide	acetalmethyl i-butyl ketone	ethylene glycol
dimethyl ether (glyme)	vinyl ethers	dicyclopentadiene
diacetylene	methyl acetylene	cumene
tetrahydronaphthalene	methylcyclopentane	t-butyl alcohol
butadiene	tetrafluoroethylene	vinyl acetylene
vinyl acetate	vinyl chloride	vinyl pyridine
chlorobutadiene/chloroprene	indene	furan
all peroxides	all isocyanates	picramide
isoprene	all aliphatic ethers	aminoguanidine nitrate
ammonium dichromate	calcium carbide	cylcohexane
methyl ethyl ketone	methyl methacrylate	petroleum ether
phosphorus, red	potassium chlorate	sodium azide
sodium sulfide	toluene	xylenes

Reactive Chemicals in Schools

Reactives		
bromine	hydrofluoric acid	titanium tetrachloride
osmium compounds	aluminum chloride	antimony trichloride
lead nitrate	lithium, metal	lithium chloride
potassium, metal	potassium chlorate	sodium, metal
potassium permanganate	sodium chlorate	sodium chromate tetrahydrate
sodium dichromate	sodium nitrite	sodium sulfide
stannic chloride	nitric acid	sulfuric acid
hydrochloric acid	uranyl nitrate	

Top 40 Hit List

1. Acetic Acid
2. Acetyl Chloride
3. Adipoyl Chloride
4. Aluminum Chloride
5. Ammonium Hydroxide
6. Aniline
7. Antimony Pentachloride
8. Antimony Trichloride
9. Arsenic Trioxide
10. Benzene
11. Benzoyl Chloride
12. Benzoyl Peroxide
13. Benzyl Alcohol
14. Bromine
15. Butyric Acid
16. Cadmium
17. Calcium Carbide
18. Carbon Disulfide
19. Dioxane
20. Ether

Top 40 Hit List

21. Formaldehyde
22. Hydrochloric Acid
23. Hydrogen Peroxide
24. Lithium metal
25. Magnesium
26. Magnesium Perchlorate
27. Mercury
28. Nitric Acid
29. Perchloric Acid
30. Phosphorus
31. Picric Acid
32. Potassium
33. Potassium Cyanide
34. Potassium Permanganate
35. Sebacoyl Chloride
36. Sodium
37. Sodium Azide
38. Sodium Cyanide
39. Sodium Peroxide
40. Sulfuric Acid

Chemical Characteristics

There are 4 characteristics of hazardous chemicals under RCRA:

1. Ignitability (D001)
2. Corrosivity (D002)
3. Reactivity (D003)
4. Toxicity (D004-D043)

Ignitability

- Liquid has a flash point less than 140 degrees F
- Solid capable of causing fire through friction, absorption of moisture, and chemical charges
- Ignitable compressed gas
- Oxidizer

Corrosivity

- pH is less than or equal to 2 or greater than or equal to 12.5 on the pH scale
- Corrodes steel at a rate greater than 6.35 mm (.25 inches) per year

Reactivity

- Normally unstable
- Reacts violently with water
- Generates toxic gases
- Capable of detonation and explosion

Toxicity

- Contains the maximum chemical concentration when tested using the Toxicity Characteristic Leaching Potential (TCLP)

Toxic Chemical List

EPA HW No.[1]	Contaminant	Regulatory Level (mg/L)	EPA HW No.[1]	Contaminant	Regulatory Level (mg/L)
D004	Arsenic	5	D035	Methyl ethyl ketone	200
D005	Barium	100	D036	Nitrobenzene	2
D018	Benzene	0.5	D037	Pentrachlorophenol	100
D006	Cadmium	1	D038	Pyridine	[35]
D019	Carbon tetrachloride	0.5	D010	Selenium	1
D020	Chlordane	0.03	D011	Silver	5
D021	Chlorobenzene	100	D039	Tetrachloroethylene	0.7
D022	Chloroform	6	D015	Toxaphene	0.5
D007	Chromium	5	D040	Trichloroethylene	0.5
D023	o-Cresol	[4200]	D041	2,4,5-Trichlorophenol	400
D024	m-Cresol	[4200]	D042	2,4,6-Trichlorophenol	2
D025	p-Cresol	[4200]	D017	2,4,5-TP (Silvex)	1
D026	Cresol	[4200]	D043	Vinyl chloride	0.2
D016	2,4-D	10	D032	Hexachlorobenzene	[30.13]
D027	1,4-Dichlorobenzene	7.5	D033	Hexachlorobutadiene	0.5
D028	1,2-Dichloroethane	0.5	D034	Hexachloroethane	3
D029	1,1-Dichloroethylene	0.7	D008	Lead	5
D030	2,4-Dinitrotoluene	[30.13]	D013	Lindane	0.4
D012	Endrin	0.02	D009	Mercury	0.2
D031	Heptachlor	0.008	D014	Methoxychlor	10

Special Case: Mercury

Mercury

There are 3 forms of Mercury:

1. **Elemental (liquid)**
2. **Inorganic**
3. **Organic**

Elemental Mercury

- Most common form
- Shiny liquid metal
- Found in mercury-containing devices
- Impacts the central nervous system

Inorganic Mercury

- Usually white, except cinnabar is red
- Found in science labs as mercury compounds
- Impacts the kidney, GI tract, and central nervous system

Photo courtesy: Cuoco and Cormier

Organic Mercury

- Common form in the environment is methyl mercury (found in fish)
- Damages the central nervous system; causes birth defects, neurological problems, and developmental delays

Mercury-Containing Devices

- Mercury thermometers
- Mercury barometers
- Molecular motion devices with liquid mercury
- Mercury spectral tubes
- Mercury sling-psychrometers / hygrometers
- Mercury hydrometers
- Mercury manometers
- Used mercury spill clean-up kits

Mercury Thermometers

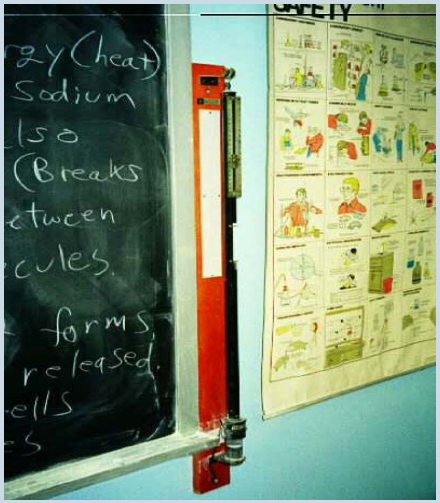
Lab Thermometers

3 grams Hg

Mercury Barometers

Barometers

500 grams Hg



Molecular Motion Devices

Molecular Motion Devices

100-200 grams Hg

Mercury Spectral Tubes

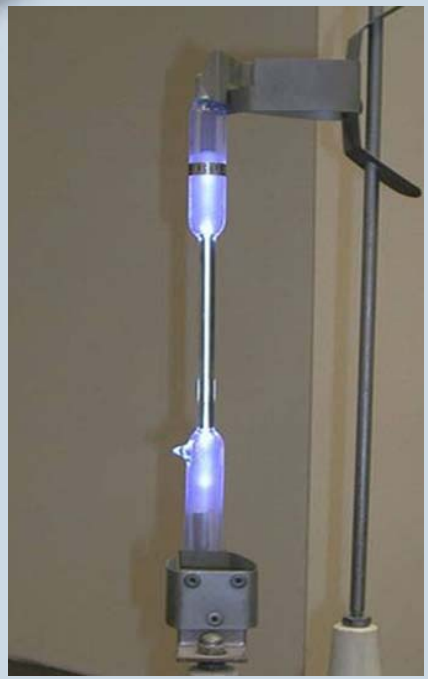


Photo courtesy: Cuoco & Cormier

Mercury
Spectral Tubes

0.5 grams Hg

Mercury Psychrometers

Mercury Sling Psychrometer

6 grams Hg

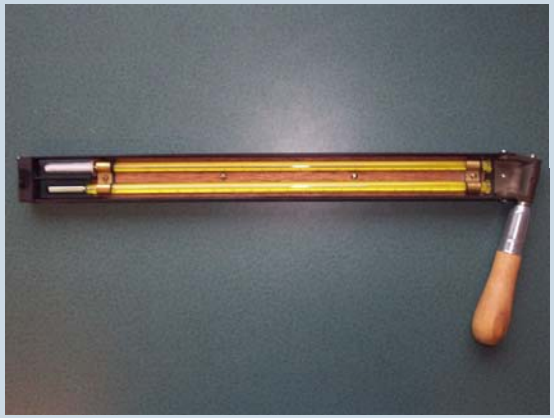
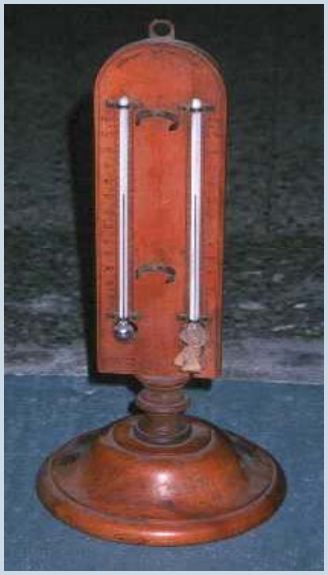


Photo Source: Wikipedia

Mercury Hygrometer

6 grams Hg



Mercury Hydrometers

Mercury Hydrometer

250 grams Hg

Mercury Manometer

Mercury Manometer

500 grams Hg

Mercury Vacuum Gauge

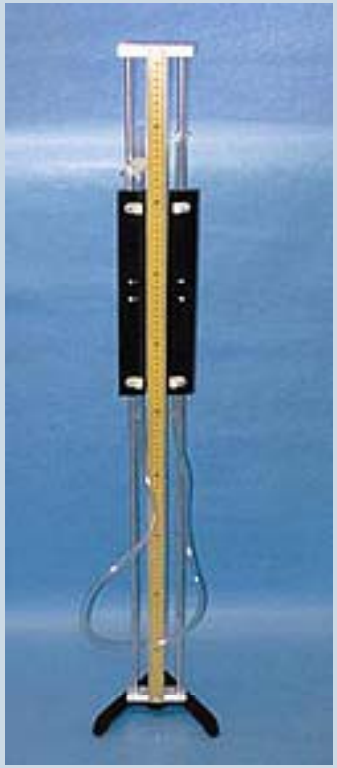
McLeod Vacuum Gauge

Other Mercury Devices

Photo Source: eBay

Charles Law Apparatus

Photo Source: Fisher Scientific



Boyles Law Apparatus

USED Mercury Spill Clean-up Kits

Photo Source: Durham Geo Slope Indicator

USED Mercury Spill Clean-up Kits

- Recovered Mercury
- Rubber Gloves
- Index Cards
- Tape
- Cloths or Rags

Other Common Chemicals

Non-Hazardous Chemicals

Not all substances found in school science labs are "hazardous".

Photo Source: Target

Photo Source: Walgreens

Hazardous Chemicals

A hazardous substance is any chemical or material in a quantity or form that may pose an unreasonable risk to health, safety, or the environment when transported, used, stored, or released.

Hydrochloric Acid

- Colorless or slightly yellow liquid
- Commonly used in school science lab experiments
- Corrosive to the eyes, skin and mucous membranes

Photo Source: Wikipedia

Sulfuric Acid

- Dense, oily liquid with a strong odor – may range in color from colorless to dark brown
- Strong corrosive, reacts violently with water
- Causes irritation or burns to the eyes, skin, and respiratory tract

Photo Source: University of Wisconsin

High Hazard Chemicals

Chemicals designated as "high hazard" should not be used in schools.

These include chemicals that are…

- Carcinogenic
- Bio-accumulative
- Acutely toxic

High Hazard Chemicals

Hazard risks outweigh the educational potential:

- Barium chloride
- Benzene
- Carbon disulfide
- Carbon tetrachloride
- Cyanide
- Formaldehyde
- Hydrofluoric acid
- Mercury
- Picric acid
- Potassium metal
- Sodium metal
- Thermite

Carbon Tetrachloride

- Colorless liquid with a "sweet" smell
- Formally used as a solvent in synthetic chemistry research
- No longer widely used because of toxicity

Cyanide

- Cyanide can be a colorless gas or in crystal form
- Cyanide compounds are used in organic chemistry
- Extremely toxic

Photo Source: University of Melbourne

Mercury

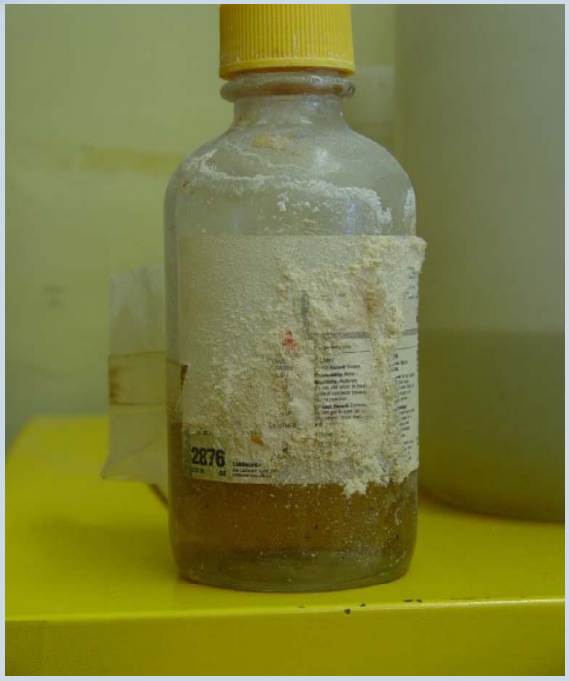
- Elemental mercury and mercury compounds are considered high hazard chemicals because of their toxicity

Other Problem Chemicals

Some chemicals require special handling or disposal procedures:

- Formaldehyde with specimens
- Radioactive chemicals
- Pharmaceuticals

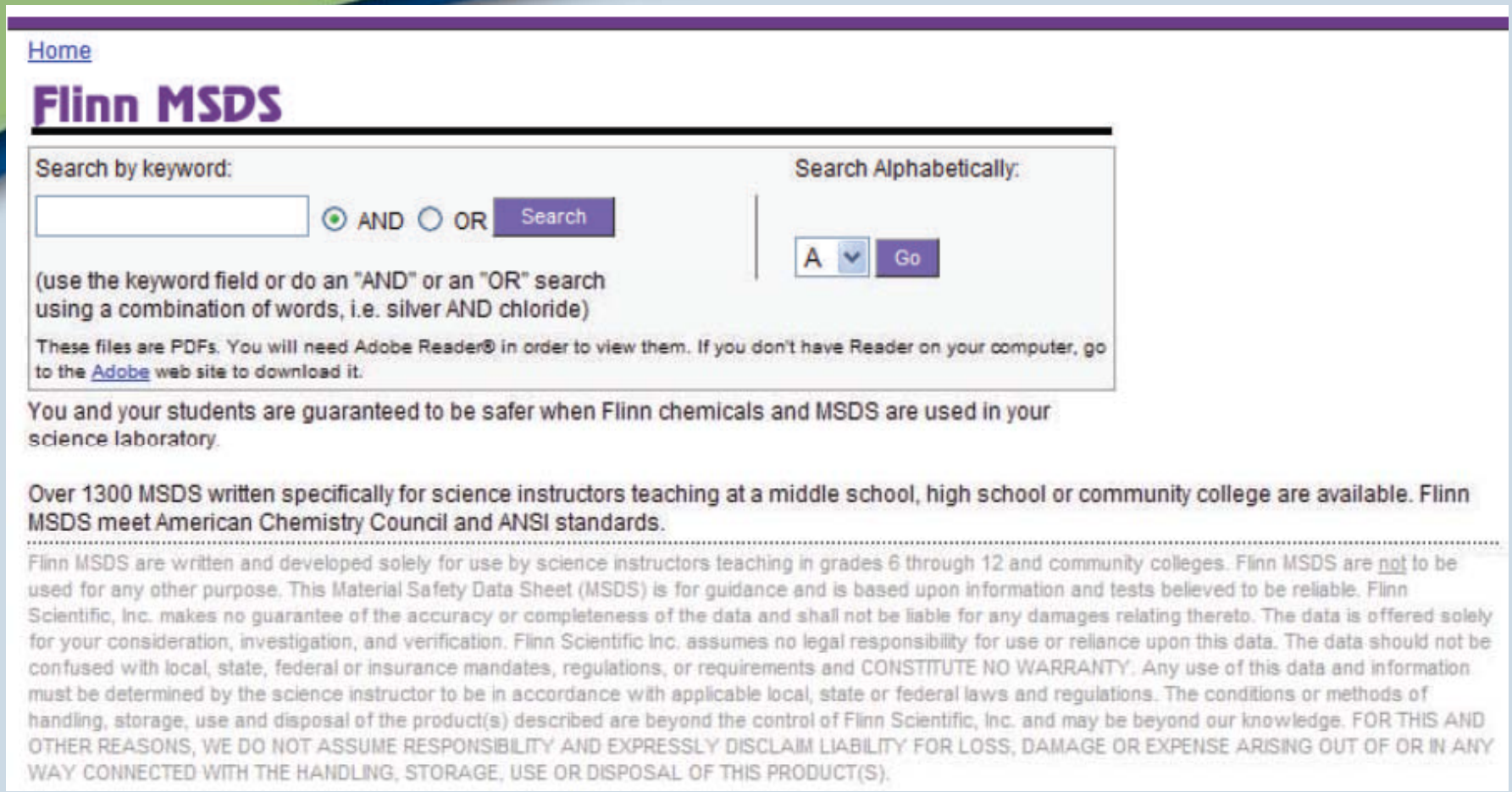
Unmarked or Mislabeled Chemicals



Label is corroded

Methyl “something”

Unusual Chemicals



Home

Flinn MSDS

Search by keyword: AND OR Search

(use the keyword field or do an "AND" or an "OR" search using a combination of words, i.e. silver AND chloride)

Search Alphabetically: A Go

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Removal and Disposal

Safety

- Wear appropriate Personal Protective Equipment
- Make sure emergency equipment is available
- Employ the help of technical professionals
- Use a “buddy system”

Collection and Storage

Use the inventory to determine the number of drums, lab packing supplies, and personnel necessary to safely and properly collect and store these chemicals.

Containers

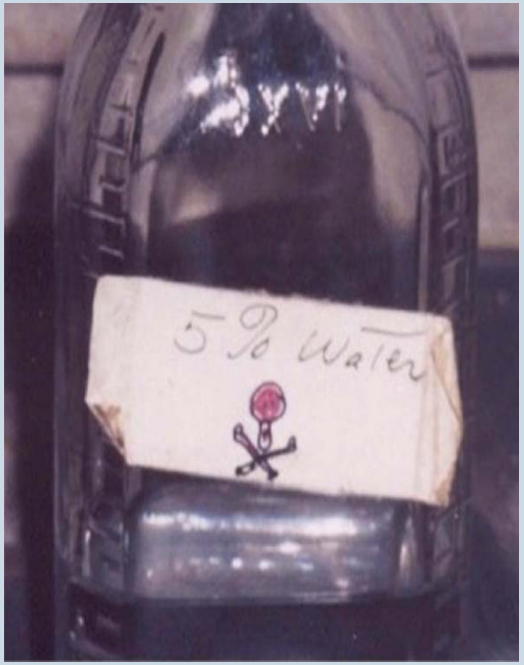
Chemicals should be packed in appropriate-sized containers with plastic liners

Packing

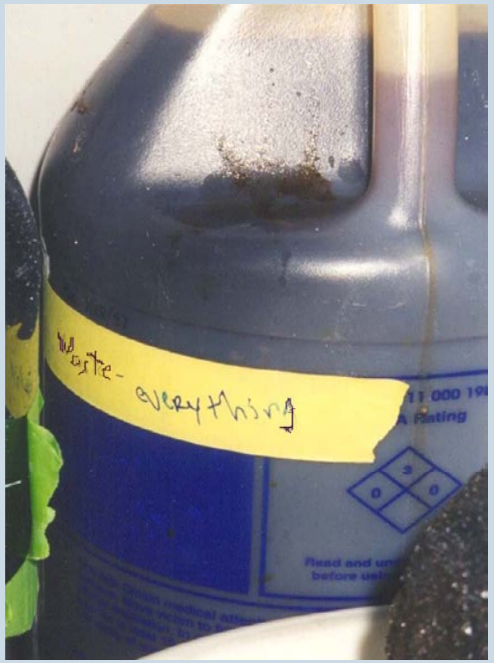
Use Styrofoam, packing peanuts, or newspaper to cushion material

Labels

Contents must be specified.

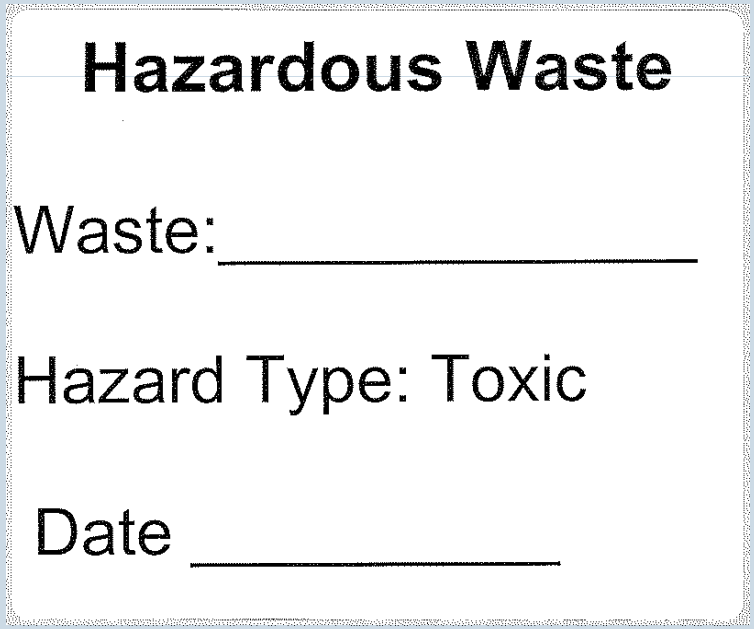


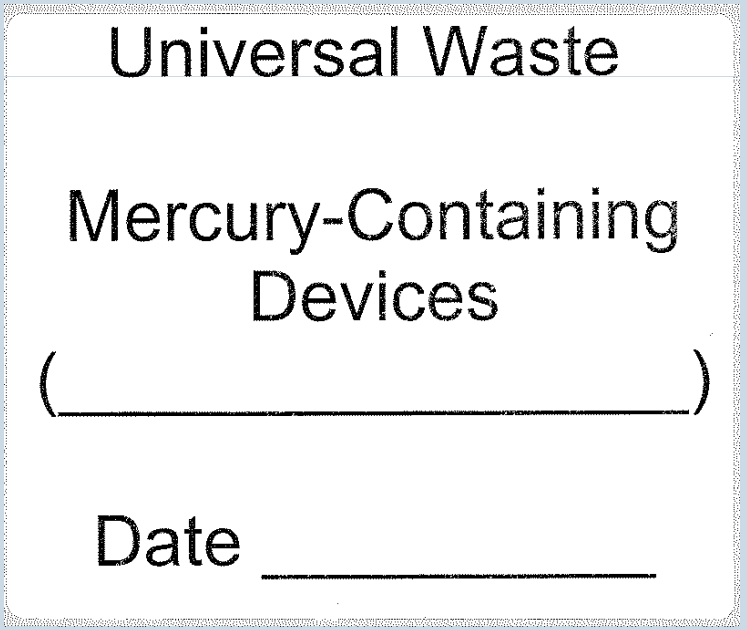
"5% Water"



"Waste – everything"

Basic Labels





Other Labels

Additional labels to show chemical characteristics.

Department of Transportation Regulations
Title 49 CFR

Chemical Compatibility

- Be aware of chemical compatibility when packing chemicals
- Never store incompatible chemicals in the same container
- Identify and label all chemicals packed in a container

Mercury Compounds

Mercury compounds must be packed separately from elemental mercury and mercury-containing devices

Mercury Devices

Mercury Thermometer in a 5-gallon bucket

Fiber 85 Drum

Temporary Storage

- Find a secure area to store the packed chemicals
- Make sure the area is locked and can be accessed by trained personnel only

Removal and Disposal

Identify the type of waste:

1. **Non-hazardous solid waste**
2. **Hazardous waste**
   - Acute hazardous waste
3. **Universal waste**

Non-Hazardous Waste

Non-hazardous chemical waste must be neutralized and solidified before disposing of in the regular trash

- Sugars/Starches
- Vegetable Oil
- Animal Fat
- Enzymes
- Wax/Paraffin
- Food Products
- Dyes/Stains*
- Buffer Mixes
- Soap/Detergents
- Household Products*

Hazardous Waste

Hazardous chemical waste must be disposed of according to the NYS Hazardous Waste Regulations

- Strong Acids*
- Strong Bases*
- Flammable Liquids
- Combustible Liquids
- Oxidizers
- Heavy Metals
- Cyanides
- Sulfides
- Chlorinated Solvents

Acute Hazardous Waste

Acutely hazardous waste presents a substantial hazard even when managed properly and has been shown to be fatal to humans in low doses

- P-listed Waste
  - arsenic, cyanides, some mercury compounds, etc.
- Some F-listed Waste
  - F020 - F027

Hazardous Waste Generator Status

1. **Conditionally Exempt Small Quantity Generator (CESQG)**
   Generates no more than 220 lbs of HW in a month
2. **Small Quantity Generator (SQG)**
   Generates more than 220 lbs, but less than 2,200 lbs of HW in a month
3. **Large Quantity Generator (LQG)**
   Generates 2,200 lbs or more of HW in a month OR at least 2.2 lbs of Acute HW in a month

CESQG - Overview

- Contain HW in appropriate containers with labels (name, date)
- May send HW to consolidation points
- May self-transport up to 220 lbs of HW in 1 month
- Conform to DOT requirements

SQG - Overview

In addition to the CESQG requirements…

- **Obtain and use an EPA ID Number**
- **Arrange for proper disposal or recycling within 180 days**
- **Must use an authorized destination facility**

LQG - Overview

In addition to the SQG requirements…

- **May not store HW onsite for more than 90 days**
- **Must maintain records of all shipments received or sent offsite for 3 years**

Universal Waste

Universal chemical waste must be disposed of according to the NYS Universal Waste Rule

- Mercury-containing devices
  - thermometers, barometers, manometers, etc.
- Pesticides

Universal Waste Handler

1. **Small Quantity Handler (SQH)**
   Accumulates less than 11,000 lbs of total UW onsite at any time

2. **Large Quantity Handler (LQH)**
   Accumulates 11,000 lbs or more of total UW onsite at any time

SQH - Overview

- Contain UW in appropriate containers with labels (name, date)
- Train employees on handling
- May accumulate UW for 1 year
- May send to another UW handler or destination facility
- May self-transport 500 lbs

LQH - Overview

In addition to the SQH requirements…

- **Obtain and use an EPA ID Number**
- **Maintain records of all shipments received or sent offsite for 3 years**

Recycling

If recycling of a material is feasible, it is always preferable to disposal

Example: Mercury can be reclaimed and recycled for use in other products

Disposal Options

- Make arrangements through your municipality
- Coordinate with another municipality to save on transportation and labor costs
- Hire a hazardous waste contractor

Household Hazardous Waste

Depending on the location, schools may be able to partner with a household hazardous waste facility to save on disposal costs.

Permanent facilities and collection events:
http://www.dec.ny.gov/chemical/8780.html

Disposal

<u>Never</u> pour chemicals down the drain!

Costs

Costs associated with a full chemical cleanout include:

- Administrative costs
- Staff time
- Preparation of chemicals for disposal
- Removal and disposal of chemicals
- Training
- Prevention-related activities

Cost Estimates

- EPA estimated that disposal costs only ranged from $2,000-$5,000 per school (2004)
- Vermont estimated total costs of $1,450 per school (2002)

Cost Relief Options

If the costs of conducting a full chemical cleanout seems too much for a school, there are options to alleviate their financial burden.

1. **Stepwise approach**
   - Complete the inventory the first year, then focus on other program aspects over the following years
2. **Remove one chemical**
   - Concentrate on removing one priority chemical the first year (e.g. mercury)

Chemical Management

Ongoing Chemical Management

- Minimize the volume and toxicity of chemicals purchased, used, and stored
- Develop a system for staff to safely purchase, use, manage, and dispose of chemicals
- Identify, prevent, and manage chemical hazards
- Develop a system for responding to emergencies
- Ensure that the school complies with environmental, health, and safety regulations
- Promote responsible chemical management

School Assessment Checklist

This checklist was developed by EPA.

- **Pages 14-15 focus on science classrooms**
- **Covers chemical hazards, storage, safety and emergency response, personal protective equipment, and ventilation**

Safety – Chemical Hygiene Plan

A "Chemical Hygiene Plan" should include guidelines for:

- Chemical Handling
- Inventory
- Storage
- Spills
- Disposal

***Emergency Response: (800) 457-7362**

Safety – Emergency Response

Create a written emergency response plan for chemicals and products that covers…

- What to do in the event of a spill or release
- Who to contact
- The locations of spill management supplies and equipment

Spill Clean-up Kits – Small Spill

Chemical Spill Kit

Photo Source: University of Delaware

Mercury Spill Kit

Photo Source: Durham Geo Slope Indicator

Storage Area

- Chemical storage area(s) should be ventilated, locked, and fire resistant
- Storage cabinets should be labeled as “hazardous chemical storage”
- Individual containers should also be labeled with chemical information

Storage Areas

3 Types of Storage Areas:

1. **General Classroom**
   Short term, small quantity, and low hazard

2. **Science Classroom / Laboratories**
   Specific cabinets/areas for limited storage

3. **Storage / Prep Room**
   Long term and bulk storage

Storage Area Guidelines

Each of the 3 storage areas have a specific set of guidelines for…

- Placement and Spacing of Chemicals
- Arrangement
- Ventilation
- Fire and Emergency Equipment

http://www.emsc.nysed.gov/ciai/mst/pub/chemstorguid.html

Storage Containers

- Keep MSDS for every chemical stored
- Check containers periodically for rust, corrosion, and leakage
- Check containers for formation of peroxides (crystals)

Storage Containers

Secondary Containment

Photo Source: Flinn Scientific

Fire-Proof Cabinet

Storage - Shelving

- Use wood shelving for corrosives
- Use metal shelving for flammables

Photo Source: Rehab the Lab, King County, Washington

Storage - Shelving

- DO NOT store chemicals higher than eye level
- DO NOT store containers of chemicals more than 2 feet deep on the shelf
- DO NOT store containers of chemicals on shelving or equipment stacked more than 2 feet off the floor

Storage - Refrigeration

DO NOT store chemicals with food or drinks!

Storage - Chemical Compatibility

<u>DO NOT</u> store chemicals alphabetically!

Chemical Inventory Tracking

Schools should maintain a complete and current inventory of all chemicals including…

- Storage location
- Chemical name(s)
- Amount
- Date of entrance into school

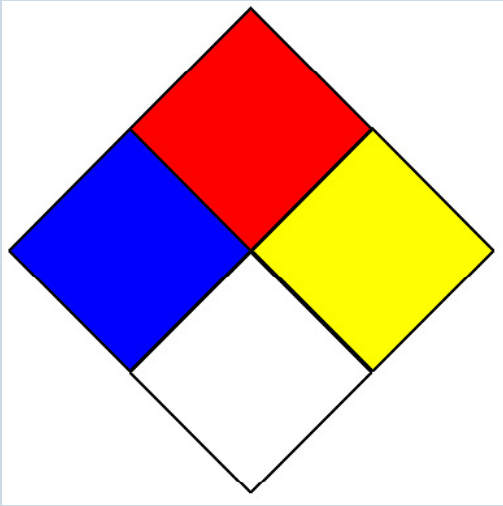
Labeling

- Label all chemicals with the date they are received
- Label peroxide-forming chemicals with the date they are opened and the date they expire
- Use color-coded labels to distinguish characteristics and/or compatibility

Codes / Labels

It is important to pick one coding system and stick with it.

Blue = Health Hazard
Red = Flammable
Yellow = Reactive
White = Contact Hazard



Chemical Purchasing

- Institute a Chemical Purchasing Policy
- Create a specific position for school chemical purchasing
- If possible, order chemicals in polyethylene bottles or plastic-coated glass bottles
- Whenever possible, look for a less hazardous alternative

Purchasing Policy

Key elements of a chemical purchasing plan should include:

- Accountability for types and quantities of chemicals ordered
- Purchasing and receiving protocol
- Tracking system
- Promotion of less toxic alternatives
- List of acceptable chemicals
- Life cycle cost analysis

Mercury-Added Consumer Products

NY Environmental Conservation Law Article 27 Title 21

September 4, 2004 – no primary or secondary school in New York State may use or purchase elemental mercury

Health and Safety Criteria

- **Flammability or Reactivity rating of 4**
- **Chemicals that are explosive/unstable as they age**
  Example: peroxides, ethyl ether, picric acid
- **Health rating of 3 or 4**
  Example: mercury, lead
- **Chemicals with special storage requirements**
  Example: explosion-proof refrigerator
- **Compressed gas cylinders (explosive)**

Bulk Purchasing

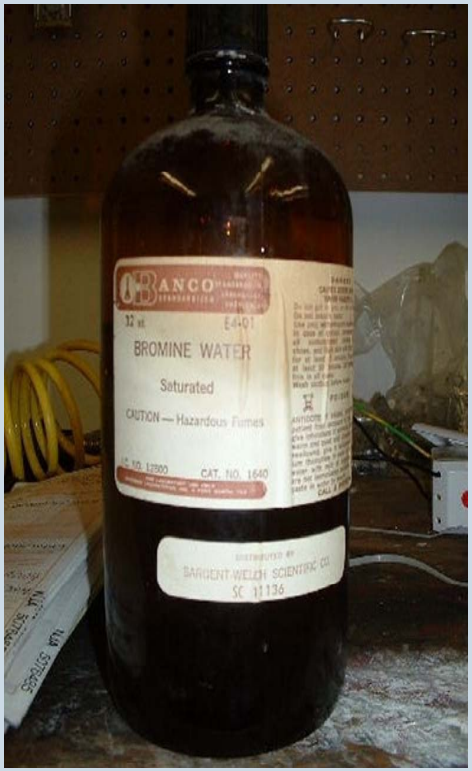
- Avoid purchasing bulk quantities of chemicals
- Even if it seems like a good deal at the time, it could end up costing more

Expiration Dates

- Some chemicals are only effective for a short time
- Others become more dangerous as they age or expire

Chemical Donations

- Chemicals are sometimes donated to the school
- Schools are often eager to accept these “free” donations without first assessing the need



Evaluate Chemical Donations

- **Evaluate the type, quantity, and condition of the chemical offered**
- **Consider the container condition**
  - Labels, compatible contents, etc.
- **Consider hidden costs**
  - Disposal, storage requirements, safety, etc.

Pollution Prevention

Pollution Prevention Options

- Micro-scale Chemistry
- Virtual Chemistry
- Classroom Demonstrations
- Green Chemistry, including Chemical Alternatives

Alternative Chemistry Options

UTAH SCHOOL CHEMICAL CLEANOUT

CHECK LIST FOR ALTERNATIVE OPTIONS (P2)

To be completed by _____

SCIENCE LAB: ALTERNATIVE OPTIONS (REDUCED SCALE CHEMISTRY)	Yes	No
1. Hazardous chemicals substituted with less toxic alternatives.		
2. Microscale experiments utilizing smaller quantities of chemicals frequently used.		
3. Chemicals recycled by performing cyclic experiments (i.e. product of reaction becomes starting material).		
4. Interactive teaching software, demonstration videos or classroom demonstrations used in lieu of experiments that generate large amounts of chemical waste or utilize hazardous chemicals.		
5. Premeasured chemical packets used to reduce bulk chemical disposal problems.		
6. Containers dated upon arrival to track rate of use.		
7. Older chemicals used before opening new containers of same compound.		
8. Suppliers utilized that offer "chemical take back" program to annually dispose unused chemicals.		
9. Chemicals purchased in smallest quantity needed, reducing waste and leftover materials.		
10. Detoxification or waste neutralization steps utilized.		
11. Accurate inventory of all chemicals kept on-site to prevent expiration or loss of product and accumulation of chemical stockpiles.		

Micro-scale Chemistry

Micro-scale chemistry is a method of performing chemical processes using small quantities of chemicals without compromising the quality and standard of applications.

Micro-scale Chemistry

Micro-scale chemistry is performed using:

- Drastically reduced amounts of chemicals
- Safe and easy manipulative techniques
- Miniature lab ware and high quality skills

Micro-scale Chemistry - Benefits

- Smaller quantities of waste
- Safe – decreased risk of fire and explosion, reduced exposure to harmful vapors
- Economical
- Easier to store – less bulky

Green Chemistry

Green chemistry is the redesign of chemical transformations and processes to reduce or eliminate the use of materials that are hazardous to human health and the environment.

Green Chemistry

12 principles of Green Chemistry:

1. Prevent waste.
2. Design safer chemical products.
3. Design less hazardous chemical syntheses.
4. Use renewable feedstocks.
5. Use catalysts, not stoichiometric reagents.
6. Avoid chemical derivatives.
7. Maximize atom economy.
8. Use safer solvents and reaction conditions.
9. Increase energy efficiency.
10. Design chemicals and products to degrade after use.
11. Analyze in real time to prevent pollution.
12. Minimize the potential for accidents.

Green Chemistry - Benefits

- Reduced chemical hazards
- Reduced disposal costs – less waste, less regulatory burden
- Safe – fewer accidents, safer products
- Economical - energy efficient

Chemical Alternatives

Toxic Chemicals	Substitutions
• Methyl orange or methyl red	• Bromophenol blue or bromothymol blue
• Lead chromate	• Copper carbonate
• p-Dichlorobenzene	• Lauric acid
• Dichromate/sulfuric acid	• Detergents/enzymatic
• Potassium hydroxide	• Detergents/enzymatic

Mercury Alternatives

Hg Compounds

- Mercury chloride
- Mercury iodine
- Mercury nitrate
- Mercury oxide
- Mercury sulfate

Alternatives

- Magnesium chloride or zinc
- Formalin
- Freeze drying
- Phenate method
- Ammonia, copper sulfate, Neosporin, mycin copper catalyst, silver nitrate, potassium, or chromium sulfate

Non-Mercury Devices

Non-mercury Thermometers

Alcohol

Enviro-Safe

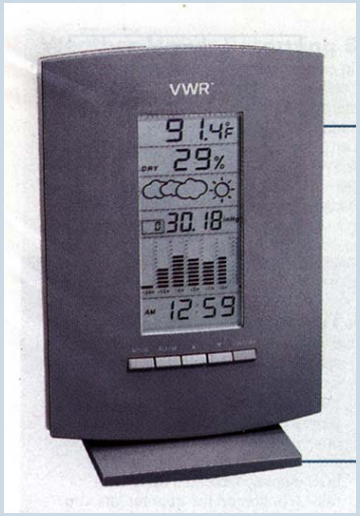
Digital

Photo Source: Sargent-Welch

Non-Mercury Devices

Non-Mercury Barometers

Eco-celli liquid gas silicon



Digital

Photo Source: Sargent-Welch

Non-Mercury Devices

Non-Mercury Manometer

Photo Source: Sargent-Welch

Non-Mercury Vacuum Gauge

Photo Source: Ace Glass

Conclusion

Conclusion

- Chemicals are used daily in both the maintenance of schools and the curriculum taught. They help students to perform experiments and learn new skills.

- However, when managed improperly, chemicals can pose serious risks to students and staff.

Bottom Line

It is critical to conduct regular (e.g. annual) chemical inventories to ensure that history does not repeat itself in the form of another chemical stockpile.

Or worse – a spill or other chemical accident.

Next Steps

- Apply this information to conduct chemical cleanouts for New York school science labs
- Seek assistance from local experts, such as hazardous waste contractors
- Engage schools (i.e. workshops)

Ideas for Future Work

- Maintain contact with schools by sponsoring additional workshops on emerging chemical management topics (e.g. micro-scale chemistry)
- Make resources available to schools (e.g. bulletins, fact sheets, tool kit)

References

- **EPA's School Chemical Cleanout Campaign**

www.epa.gov/epaoswer/osw/conserve/clusters/schools/index.htm

- **VT DEC School Chemical and Mercury Cleanout**

www.mercvt.org/PDF/finalreport.pdf

- **MA DEP School Chemical Management Manual**

www.mass.gov/dep/service/schlchem.pdf

- **Utah's Clean Schools Toolkit**

www.deq.utah.gov/Schools/index.htm

Other Helpful Resources

- **NIOSH School Chemistry Lab Safety Guide**

www.cdc.gov/niosh/docs/2007-107/pdfs/2007-107.pdf

- **EPA Chemical Management Resource Guide**

www.epa.gov/oppt/pubs/chemmgmt/resourceguide.pdf

- **Pollution Prevention Measures for Safer School Laboratories**

www.epa.gov/region8/humanhealth/children/1PreventiveMeasuresToolKit.pdf

Questions???

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