



Science Safety

Inventory, storage and disposal management

Dave Waddell

Local Hazardous Waste Mgmt Program in King County

206-263-3069 dave.waddell@kingcounty.gov

How can hazards be controlled?



Routes of exposure



Swallow It



Breathe It



Touch It

One tequila

Two tequila
tequila

Three



One tequila

Two tequila
tequila

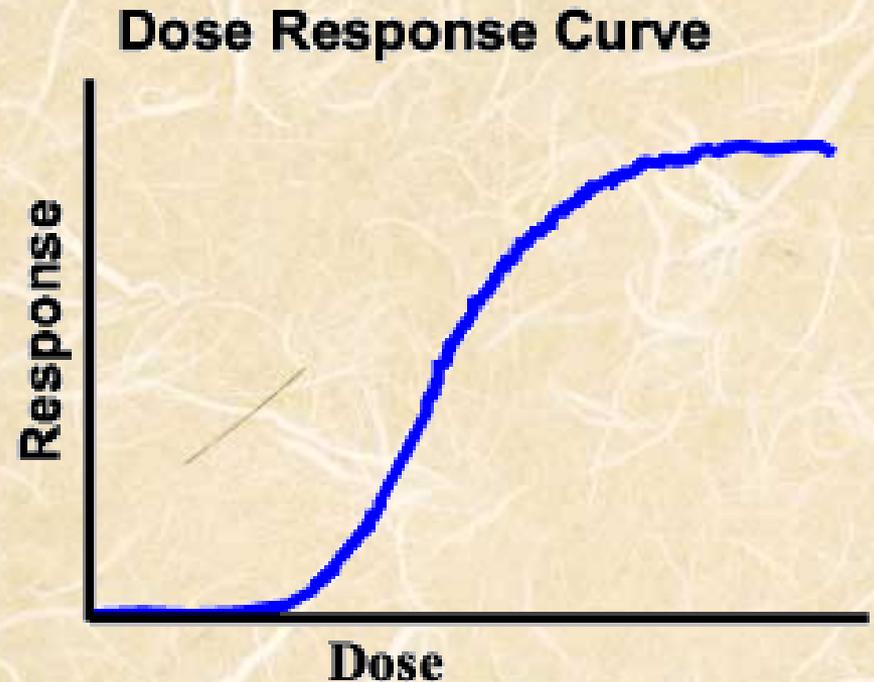
Three



FLOOR

Dose and response

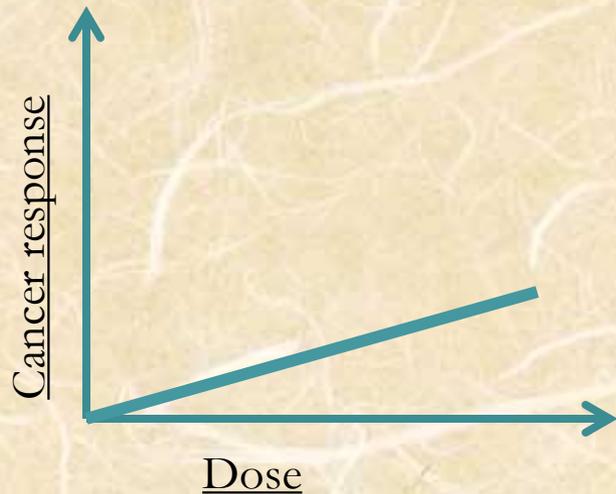
- Low doses are safe; there is no response
- Above a certain dose, response won't increase
- That response could be death, of course...



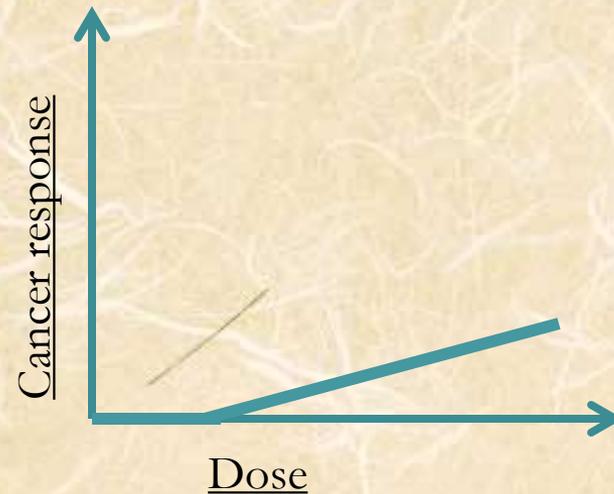
Effects of size on response



Two Models for Carcinogens



No safe dose –
assumed by EPA



Safe dose possible –
more recent studies

Hierarchy of hazard control

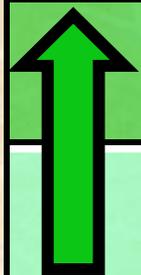
Elimination

Substitution

Engineering

Administrative controls

Personal protective equipment



Most effective



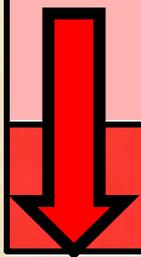
Don't use hazardous stuff

Use safer substitutes

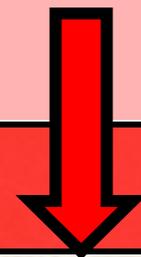
Suck hazardous vapors, dusts and fumes
away from you

Keep your stockroom/classroom clean

Putting barriers between hazardous stuff
and you



Least effective



Using less hazardous stuff

 **Local Hazardous Waste Management Program**
in King County, Washington

Search LHWMP website
Local Governments for Health and the Environment
King County, City of Seattle, Sound Cities Association

Hazardous Waste Environment & Health Newsroom Documents Extranet About Contact

Safely Dispose or Recycle Business Household
Paints, Televisions, Pesticides, etc.

HAZARDOUS CHEMICALS IN SCHOOLS

[Home](#) >> [Resources for Schools](#) >> [Schools Chemical List](#)

--- Download results ---

Page 1 of 103 | 1,029 records |

Chemical Name	Acute Exposure Hazard	Chronic Exposure Hazard	Environmental Toxicity	Hazard Rank	Lowest Grade Level Allowed	Storage Category	Experiments Where Used
Abscisic Acid	No acute toxicity data reported	No confirmed human disease-related or reproductive hazard data reported	No fish toxicity data	1	Elementary demos only	O-1	Botany - effects of plant hormones
Acetal	Explosion risk from peroxide formation. Flammable. Slightly toxic by ingestion & skin contact. Irritant.	No confirmed human disease-related or reproductive hazard data reported	No fish toxicity data	5	Ban Candidate	O-3 Flam Cabinet	NONE
Acetaldehyde	Explosion risk from peroxide formation. Flammable. Slightly toxic by inhalation, ingestion and skin contact. Irritant to eyes.	Liver function impairment	Toxic to fish	5	Ban Candidate	O-3 Flam Cabinet	NONE. Formerly used as: Organic substrate in organic reactions.
Acetamide	Slightly toxic by ingestion	No confirmed human disease-related or reproductive hazard data reported	Non-toxic to fish	2	Middle School	O-2	Melting points. Heat of fusion (enthalpy) experiments.

School Chemicals Database

Designed to improve lab safety

- Inventory spreadsheet
- Prioritizes chemicals for removal
- Links chemicals to grade level
- Describes hazards & storage codes

www.schoolchemlist.org

HAZARDOUS CHEMICALS IN SCHOOLS

[Home](#) >> [Resources for Schools](#) >> [Schools Chemical List](#)

--- Download results as... --- 

Page 1

<u>Chemical Name</u>	<u>Acute Exposure Hazard</u>	<u>Chronic Exposure Hazard</u>
Acrylamide	Neurotoxin by ingestion & skin contact	Carcinogen
Acrylonitrile	Flammable. Poison by inhalation and skin contact. Toxic by ingestion.	Carcinogen. Teratogen.
Aminodiphenyl, 4-	Toxic by ingestion. Irritant.	Carcinogen. Mutagen.
Ammonium Chromate	Oxidizer. No acute toxicity data reported. Irritant.	Carcinogen

Tips on Use

- Search partial words:
 - “**Carc**” gets carcinogens
 - “**Explo**” gets explosive & explodes
- Download to Excel
- Click header titles to sort by category
- Click on a name for in-depth info

Then play with it as you see fit

	A	B	C	D	E	F
1	Chemical Name	Acute Exposure Hazard	Chronic Exposure Hazard	Environmental Toxicity	Hazard Rank	Lowest Grade Le
2	Acetal	Explosion risk from peroxide formation. Flammable. Slightly toxic by ingestion & skin contact. Irritant.	No confirmed human disease-related or reproductive hazard data reported	No fish toxicity data	5	Ban Candidate
3	Acetaldehyde	Explosion risk from peroxide formation. Flammable. Slightly toxic by inhalation, ingestion and skin contact. Irritant to eyes.	Liver function impairment	Toxic to fish	5	Ban Candidate
4	Acetyl Chloride	Water reactive. Flammable. Corrosive. Poison by inhalation.	No confirmed human disease-related or reproductive hazard data reported	No fish toxicity data	5	Ban Candidate
5	Acrolein	Flammable. P-listed. Extremely hazardous. Poison by inhalation. Lachrymator.	Mutagen	Poisonous to fish.	5	Ban Candidate
6	Acrylamide	Neurotoxin by ingestion & skin contact	Carcinogen	Non-toxic to fish	5	Ban Candidate
7	Acrylic Acid	Explosive if stored at room temperature. Flammable. Corrosive. Poison by ingestion. Toxic by skin contact.	Teratogen	Non-toxic to fish	5	Ban Candidate
8	Acrylonitrile	Flammable. Poison by inhalation and skin contact. Toxic by ingestion.	Carcinogen. Teratogen.	Slightly Toxic to fish	5	Ban Candidate
9	Adrenaline	P-List. Extremely hazardous. Reported as poison by ingestion, inhalation or skin contact. Drug Precursor. Theft risk.	Teratogen. Sensitizer.	No fish toxicity data	5	Ban Candidate
10	Adrenaline Chloride Solution	Highly diluted (1000:1). Pure compound is regulated by DOT as poison by ingestion.	Teratogen	Non-toxic to fish by inference	5	Ban Candidate
11	Alkaline Iodide Azide	Corrosive. Poison by ingestion.	No confirmed human disease-related or reproductive hazard data reported	Toxic to fish by inference	5	Ban Candidate
12	Allyl Chloride	Peroxide forming compound. Flammable. Toxic by inhalation. Slightly toxic by ingestion & skin contact.	Mutagen	Slightly Toxic to fish	5	Ban Candidate
		Radioactive. Reported poison by	Likely to cause cancer by inhalation since it is a bone-seeking long-lived			

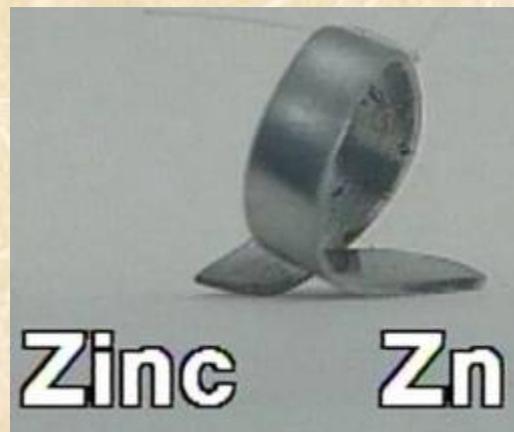
Haz Rankings Link to Grade Levels

- Hazard Rank 0
 - Safe for all grades
 - 26 chemicals



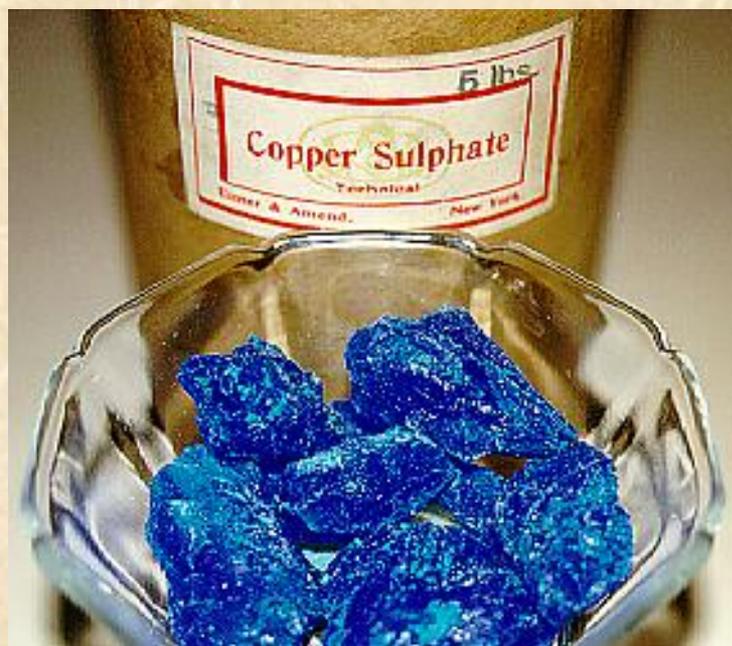
Hazard Rank 1

- Elementary demos & above
- 19 chemicals



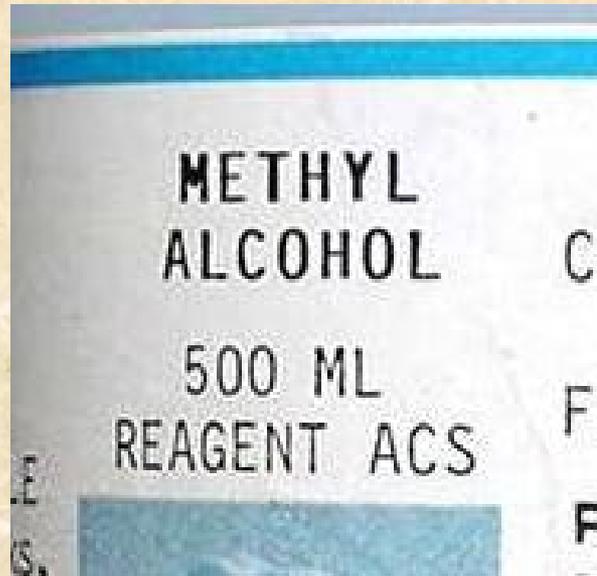
Hazard Rank 2

- Middle school & above
- 353 chemicals



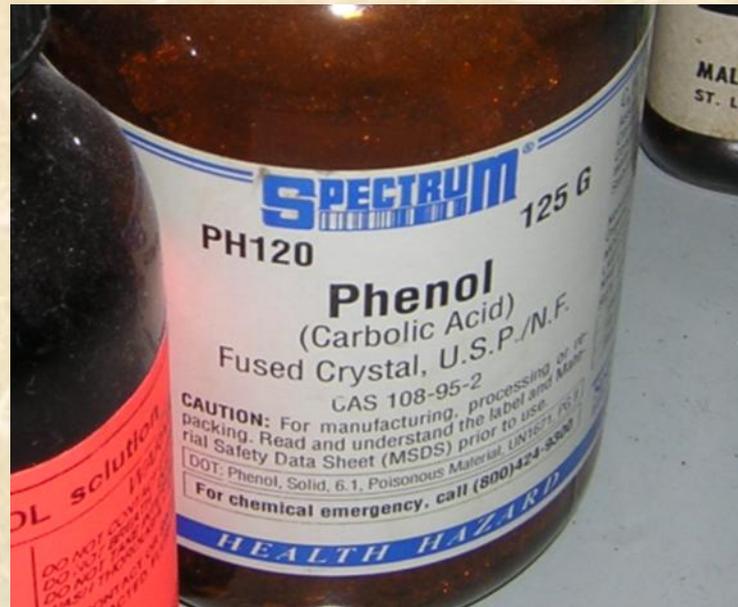
Hazard Rank 3

- High school & above
- 254 chemicals

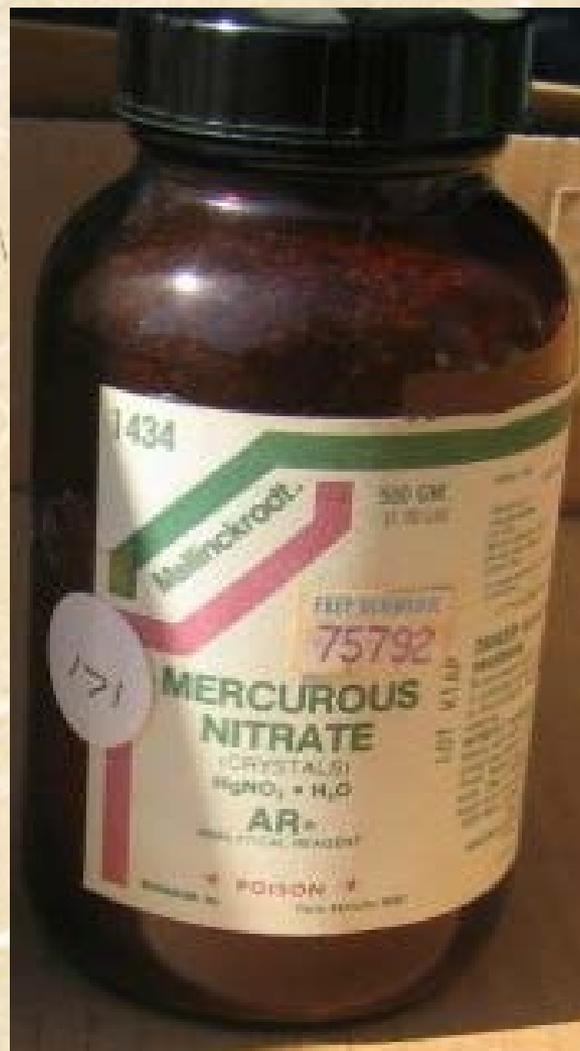
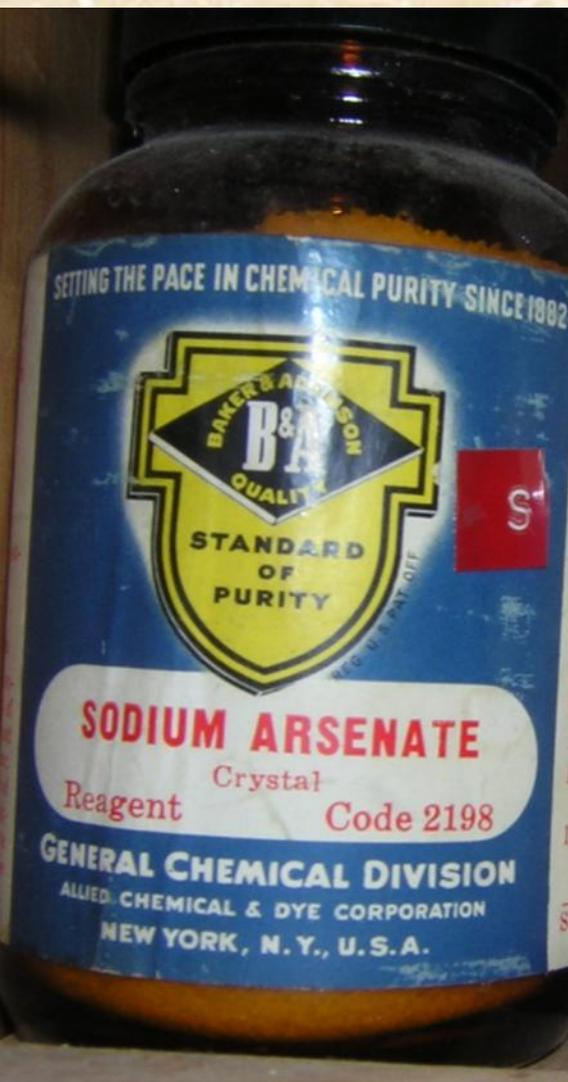


Hazard Rank 4

- Advanced placement chem
- 119 chemicals w/ limited utility & high hazards
- Needs chem hygiene plan & an OK
- Suggest quantity restrictions



Level 5 – Ban Candidates



What's needed? **vs.** What's cool?



We used a third party to decide

- Washington Science Teachers Association
 - Decide if it is **Needed**
- School chemical suppliers
 - See if they even sell it any more

WASHINGTON SCIENCE TEACHERS ASSOCIATION



Ban Candidates

Your first priority for removal

- High hazard
- Not sold by Flinn, Carolina Bio Supply, etc
- Unnecessary per WSTA for teaching
- Already banned



Chemical inventories are required



SCIENCE CLASSROOM & LAB REFERENCE for environmental, health and safety guidance

	Recom- mended	Required	WAC or other Reference	Inspection Checklist: Check if compliant. Report problems to administration.
<ul style="list-style-type: none"> Science laboratories shall have an inventory list of all chemicals. This list must be updated periodically. (Recommendation is annually or more frequently.) 		X	WAC 296-800-17005 WAC 296-800-17010 RCW 28A.320.125(3)(b) Prudent Practices 2.D.4	
<ul style="list-style-type: none"> Science laboratories shall have a written Chemical Hygiene Plan that is available to all students and staff members. It shall be reviewed annually and updated when necessary. (New science teachers shall review the CHP as part of their Employee Safety Orientation.) 		X	WAC 296-828-20005 Prudent Practices 2.B	
<ul style="list-style-type: none"> Emergency eyewash and shower stations shall be provided when there is a potential for exposure to corrosives, strong irritants or toxic chemicals. They shall be located within 50 feet or ten seconds walking distance from all lab science work stations. 		X	WAC 246-366-140(2) WAC 296-800-15030 ANSI Z 358.1 Prudent Practices 7.F.2.5	
<ul style="list-style-type: none"> Emergency showers shall deliver water to cascade over the user's entire body at a minimum rate of 20 gallons (75 liters) per minute for 15 minutes or more. 		X	WAC 296-800-15030 ANSI Z 358.1 Prudent Practices 7.F.2.5.1	
<ul style="list-style-type: none"> Eye-wash stations and emergency showers shall be handicap accessible and operable "hands-free" so that the user can hold both eyes open. Hand-held showers and eye-wash equipment do not meet current L & I WISHA rules (except as auxiliary or extra protection). 		X	WAC 296-800-15030 ANSI Z 358.1 Prudent Practices 7.F.2.5 ADA Title III	
<ul style="list-style-type: none"> Eye wash stations shall provide 0.4 gallons (1.5 liters) per minute for 15 minutes or more. In some areas with high water pressure, flow regulators may be required on the eye wash stations. 		X	WAC 296-800-15030 ANSI Z 358.1 Prudent Practices 6.F.2.5 ADA Title III	
<ul style="list-style-type: none"> Emergency showers and eye wash units shall be inspected and tested for proper operation annually. Plumbed emergency eye washes must be activated weekly. Written documentation of tests shall be maintained on site. 		X	WAC 296-800-15035 Prudent Practices 7.F.2.5	



www.nap.edu/openbook.php?record_id=4911



Prudent
Practices
in the
Laboratory



*Handling and Management
of Chemical Hazards*

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

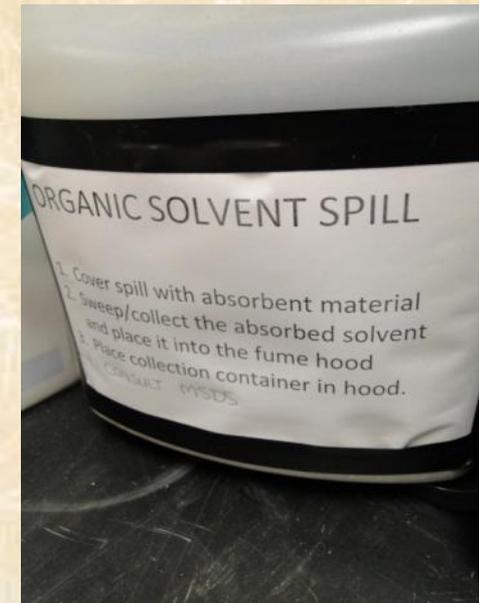
Preparing to do an inventory

- Have at least one assistant
- Don appropriate personal protective gear
- Have someone check on you periodically



Items to have nearby

- Spill supplies
- Fire extinguisher handy and operative
- Telephone, eyewash and shower



Put a sign on the door



Four step process

- Find the chemicals
- Track via an inventory list
- Decide what to keep
- Prep the rest to go



Finding the chemicals

Look everywhere



Thinning the unnecessary

- Is it being used?
- Dispose of useless chemicals
- Remove ban candidates first



Set aside chemicals for later disposal



But not like this



Isolate them on existing shelves
One sides goes, other stays



Initial inventory = initial inspection

- Identify unsafe situations
- Take corrective steps
- Set up long-term systems



Protect yourself during the lab inspection

- Lab coat/long-sleeve shirt
- Goggles & glasses
- Closed-toed shoes
- Gloves
- Camera
- Partner
- Well rested senses



Helpful tools

- Parafilm
- Disposable gloves
- Paper
- Slide lock bags (large)
- Ban candidate list



Start by evaluating the room

- Safety equipment functional?
- Ventilation in place?
- Odd or harsh odors?
- Itchy eyes?
- Do staff have concerns?



Photo: Dave Waddell

Hmm, What's this mean?



Photo: Dave Waddell

Leaking acids or iodine
Probably poor ventilation
Open the acid cabinet carefully



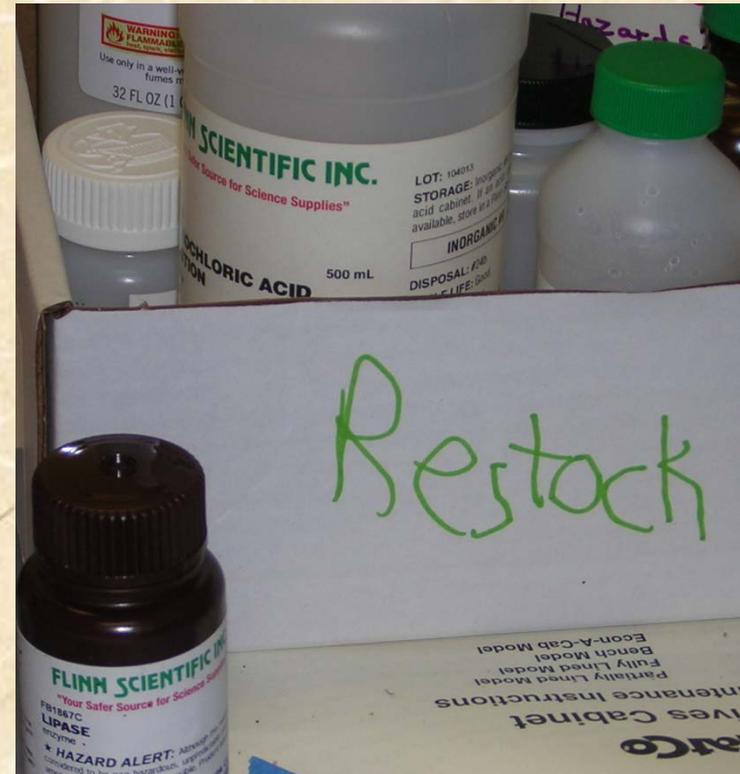
Photo: Dave Waddell

Put Parafilm over glass stoppers



3 Tips for Easier Inventorying

- Do it electronically
- Track as full containers
- Put empty bottles in the restock box
 - If replaced, no change



Situations to Photo Document Spills not cleaned up



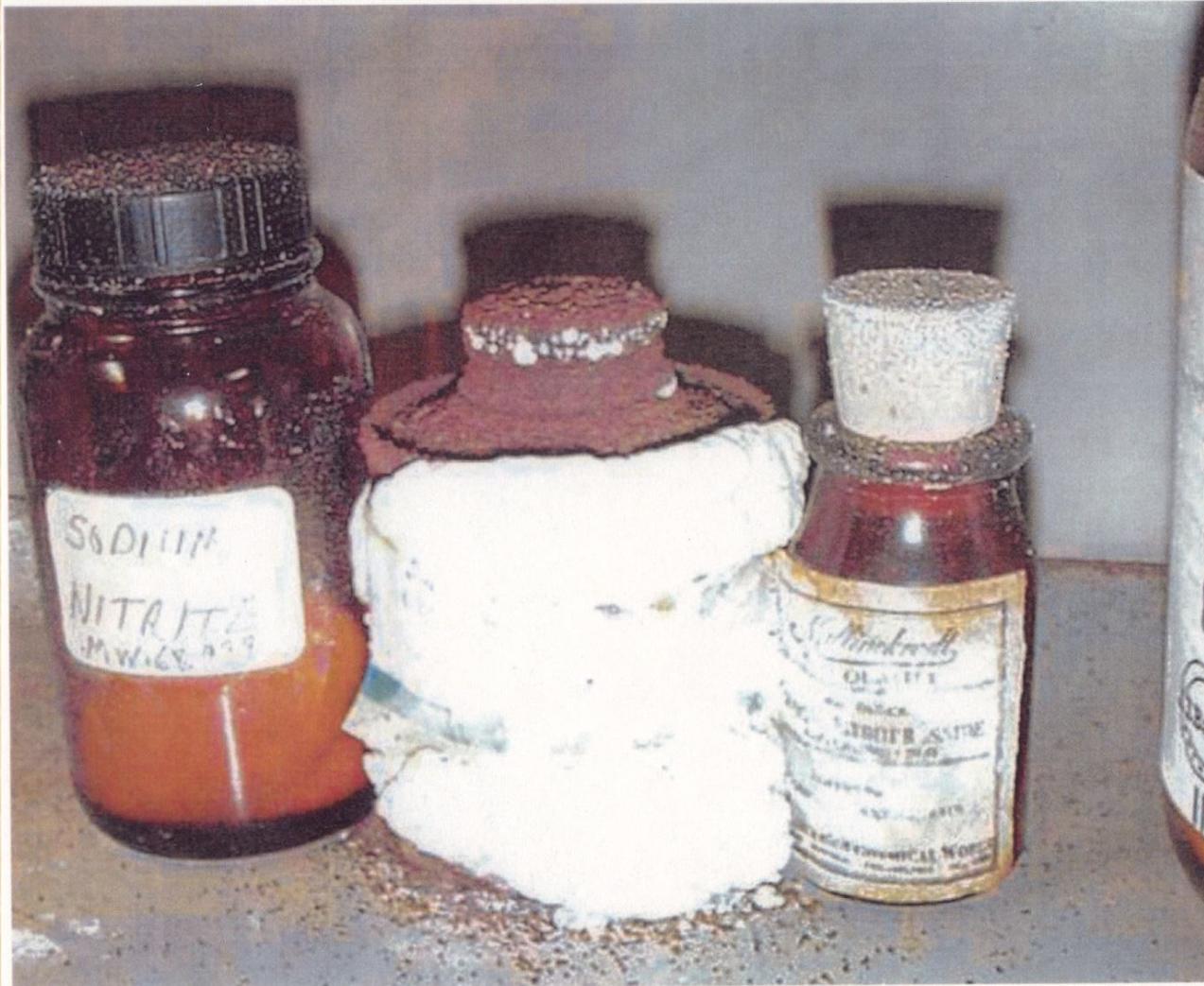
Degraded Cabinets



Degraded/contaminated PPE



Degraded/Leaking Containers



Chemical Storage in Fume Hood



Inadequate safety shower



Malfunctioning Eye Wash



Improper Disposal Practices



A man in a white dress shirt and a dark tie with gold square patterns is holding a yellow sign with the words "BREAK TIME" written in a dark red, blocky font. He is sitting at a dark granite desk with a white mug to his left. The background is a light-colored wall with a subtle pattern.

**BREAK
TIME**

Chemical Storage Problems



Four Primary Goals

- Don't store what you won't use
- Keep things from degrading
- Keep incompatibles apart
- Protect human health & environment



Tour of Common Storage Issues Science Lab Kits



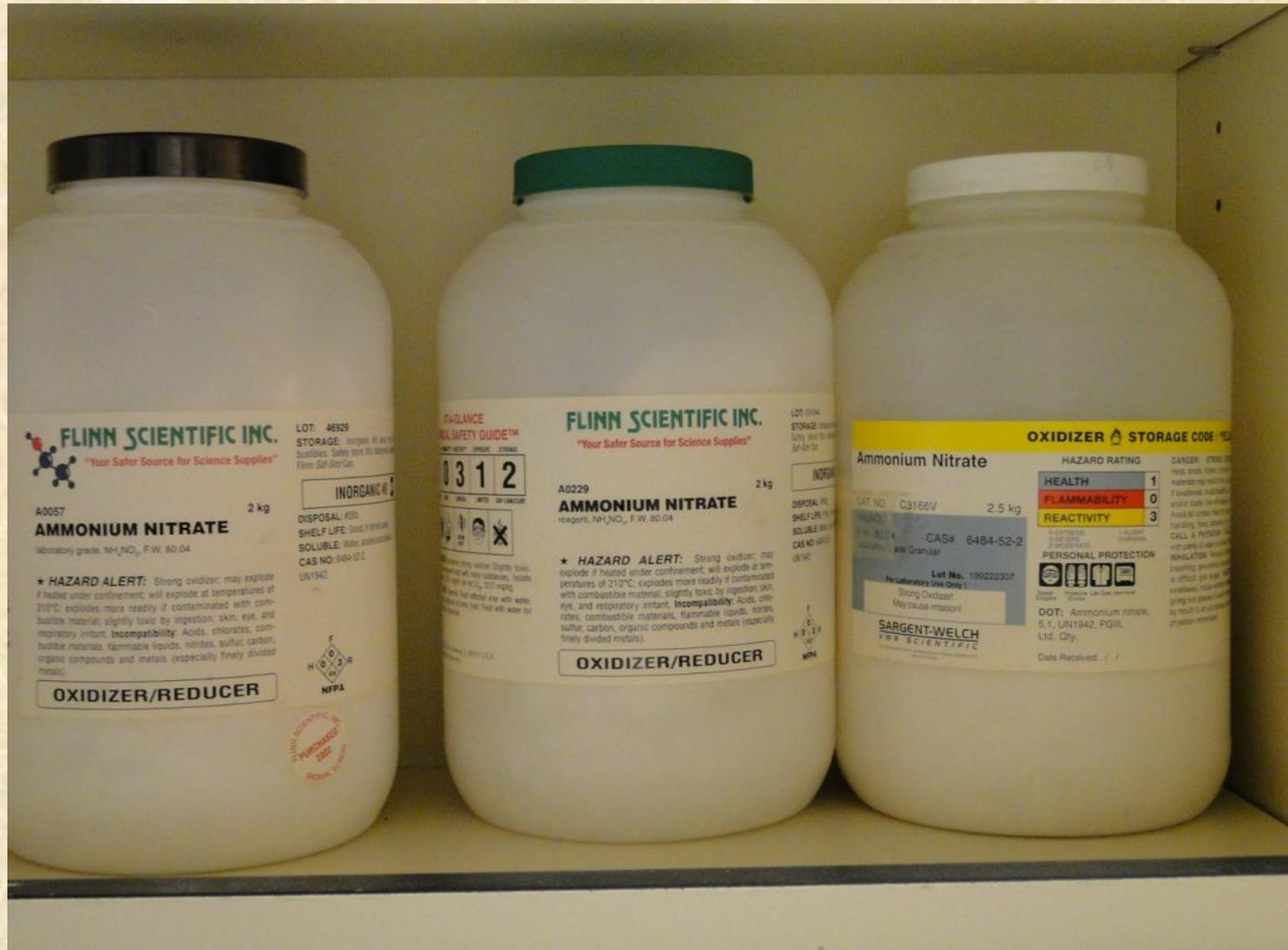
Remove acids over 1.0 molar



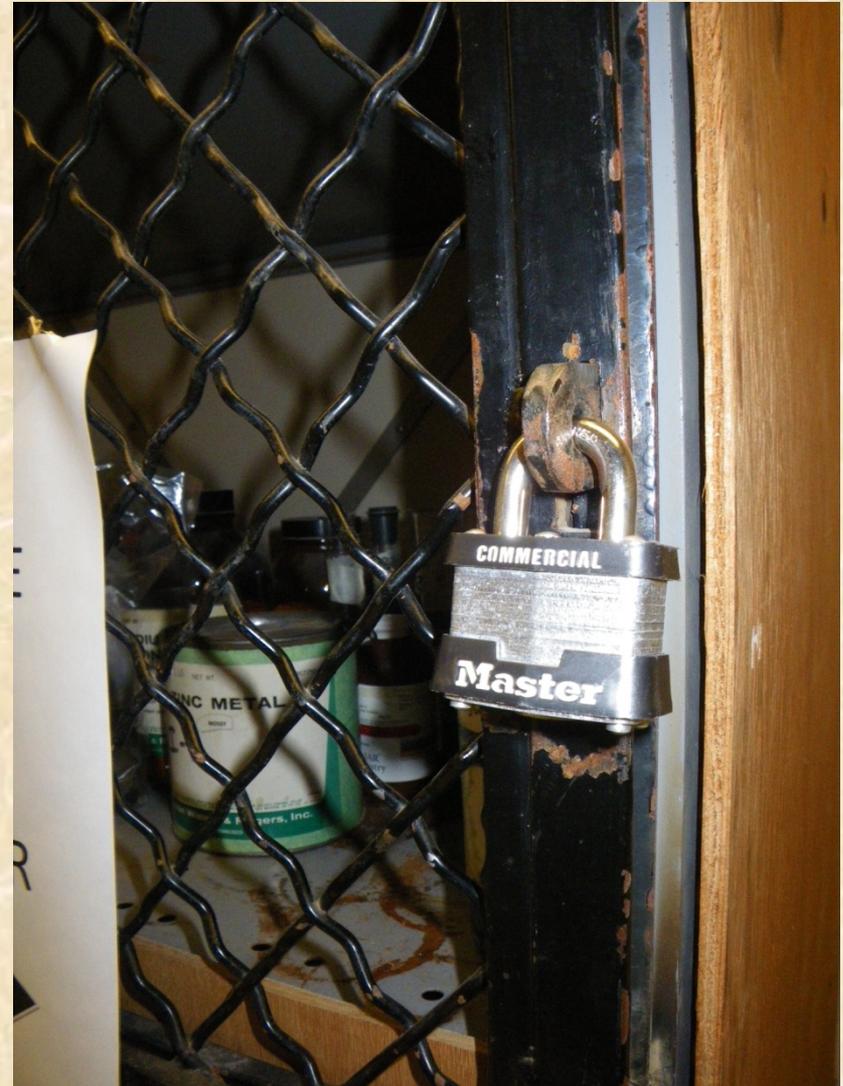
Remove all flammables



Excess chemicals (6 kilos)



Keep Chemicals Secure Under Lock & Key



Hmmm... may be a problem here



No chemical storage by drains



CAUTION
NON POTABLE WATER
DO NOT DRINK



Cup sink drain

Metal acid cabinets look nice



Until you open them





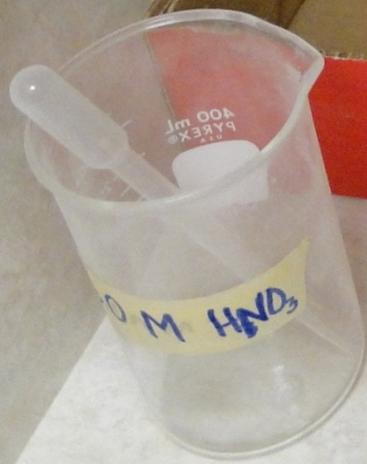
\$1,300
worth of rust
in 7 years

SciMatCo cabinets are metal free

- More expensive, but last a much longer time
- Identify as Corrosive **Acid** or Corrosive **Base**







Office DEPOT
white copy paper

Flammable Storage in Labs



Combustible Liquids Only

No solids, no water reactives

- Upside down
- Tipped bottle
- Unknown solid





FLINN SCIENTIFIC INC.
Lot: 7844
STORAGE: ...
DISPOSAL: ...
SHELF LIFE: ...
SOLUBLE IN: ...
CAS NO: 1310-70-4
MODERATELY TOXIC

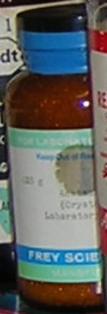
FLINN SCIENTIFIC INC.
Lot: 20662
STORAGE: ...
DISPOSAL: ...
SHELF LIFE: ...
SOLUBLE IN: ...
CAS NO: ...
INORGANIC #1

FLINN SCIENTIFIC INC.
Lot: 22074
STORAGE: ...
DISPOSAL: ...
SHELF LIFE: ...
SOLUBLE IN: ...
CAS NO: ...
BICARBONATE
500 g
Slightly toxic by ingestion.

FLINN SCIENTIFIC INC.
Lot: ...
STORAGE: ...
DISPOSAL: ...
SHELF LIFE: ...
SOLUBLE IN: ...
CAS NO: ...
LEAD NITRATE

30233
INORGANIC #1

SciMa
Division of Flinn



No Flammables in Refrigerators

Check for alcohol in biology room freezer



Venting of
flammables
cabinets is not
recommended





Excellent storage room

- Locking cupboards
- Labeled with contents
- Dilute solutions for use in secondary containment

Use Secondary Containment

Holds 110% of largest container



Storage area 7
top shelf:

Inorganic 9

acids (weak and/or powdered)
[see also area 1]

Inorganic 10

sulfur, arsenic
phosphorus (and P pentoxide)

bottom shelf:

Inorganic 6

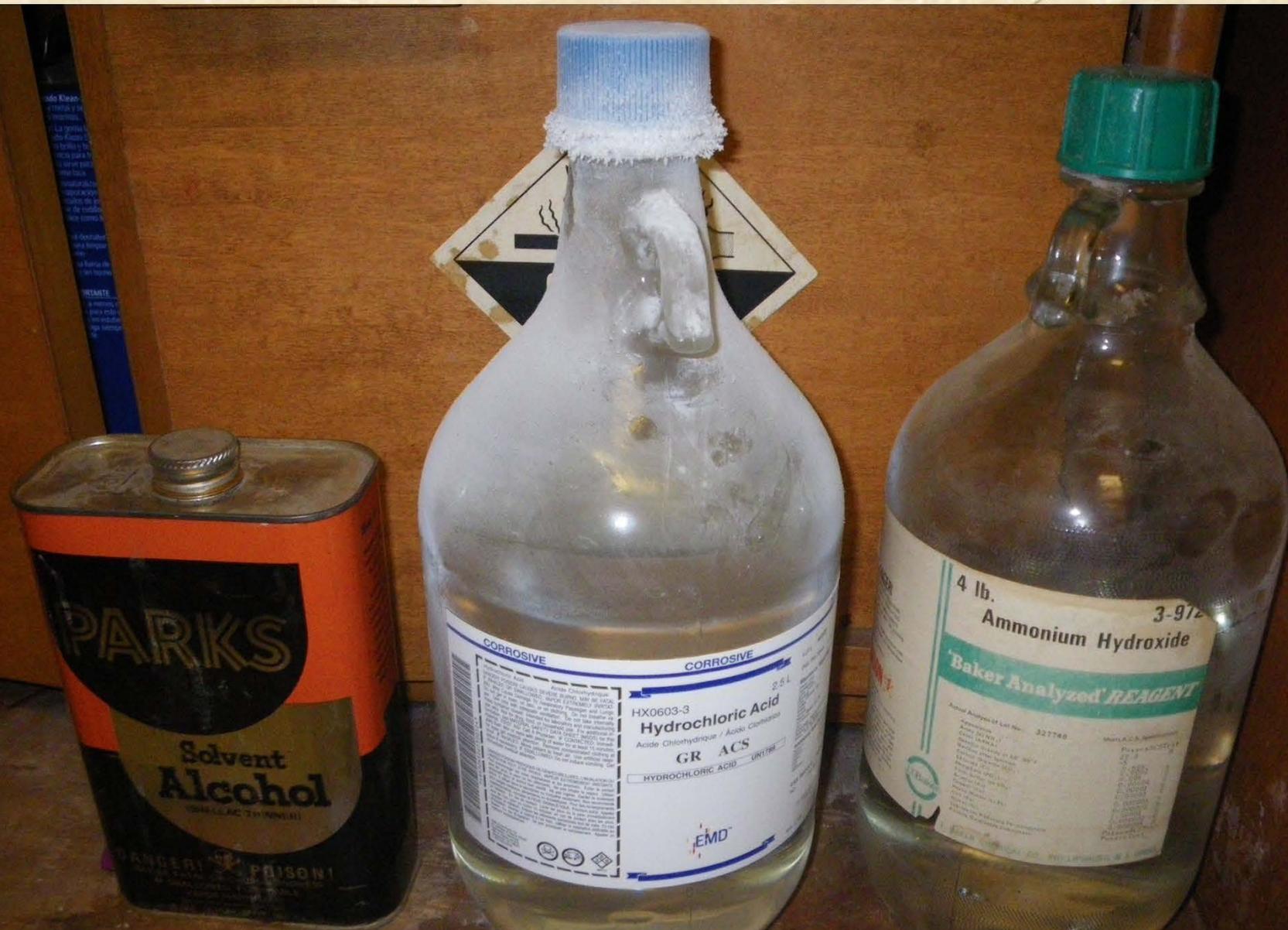
chlorates, perchlorates, chlorites
perchloric acid, hypochlorites
peroxides (except hydrogen ^{peroxide in Area R})
~~[see also area 6]~~ bromates

Good
labeling

Storage Pattern for Chemicals Where Space is Limited

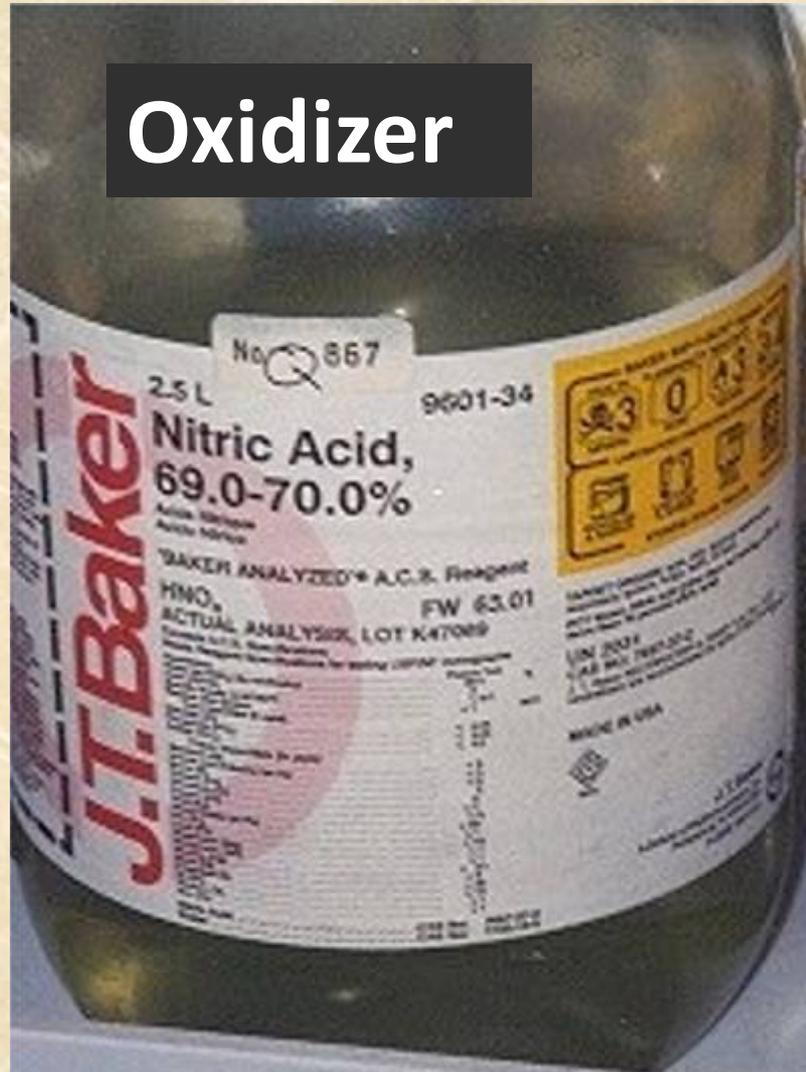
Inorganic Reactives & Metals (I-1, I-10) Sulfur, Phosphorus (double packaged), Arsenic, Solid Metals, Hydrides, Lithium, Sodium	Organic Toxins (O-5, O-7) Epoxy Compounds, Isocyanates, Sulfides, Polysulfides
Inorganic Salts (I-2) Chlorides, Iodides, Fluorides, Bromides, Sulfates, Sulfites Thiosulfates, Phosphates.	Organic Reactives #6 Peroxides, Azides, Hydroperoxides
Inorganic Oxidizers (I-3, I-6, I-8) Nitrates, Nitrites, Borates, Chromates, Manganates, Permanganates, Chlorates, Chlorites, Peroxides,	Flammable Storage Cabinet (O-2, O-3, O-4, O-8 & concentrated organic bases) Alcohols, Glycols, Phenol, Hydrocarbons, Esters, Ethers, Concentrated Organic Acids
Dry Inorganic Corrosive Bases (I-4) Hydroxides, Oxides, Silicates, Carbonates, Carbon	Dry /Dilute Organic Acids Anhydrides (O-1) Citric Acid, Anhydrides, Peracids, etc.
Inorganic #5 and #7 Toxins Arsenates, Cyanides, Sulfides, Selenides,, Carbides,	Miscellaneous Household chemicals (vinegar, baking soda, vegetable oils), Dyes, Stains, Agars, Sugars, Gels
Corrosive Base Storage Cabinet (I-4 Liquids) >1.0 molar Hydroxides, Oxides, Silicates	Corrosive Acid Storage Cabinet (I-9 Liquids) >1.0 molar Inorganic Acids. Nitric separately stored in this or another cabinet

Acids Away from Bases

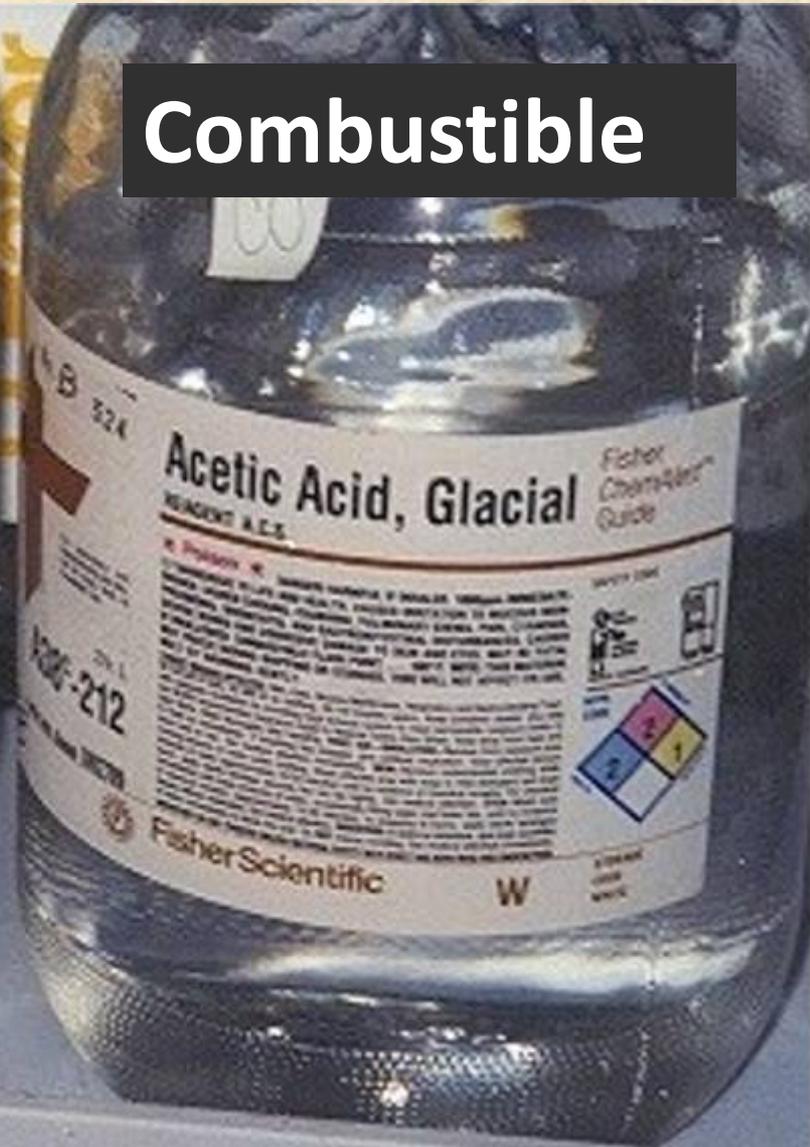


Oxidizers Away From Combustibles

Oxidizer



Combustible



Cap eaters

- Nitric acid
- Liquid hydroxides
- Compromised containers spill when tipped



A note on Iodine

- Among most common “spilled” chemicals
- Crystal to fumes directly
- Fumes degrade cap
- Look for brown labels
- Store in a Ziploc bag

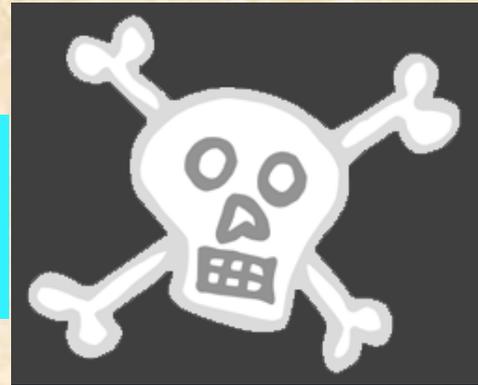
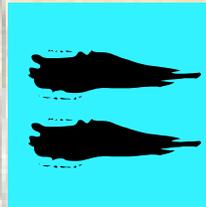


Troubles With Bleach?

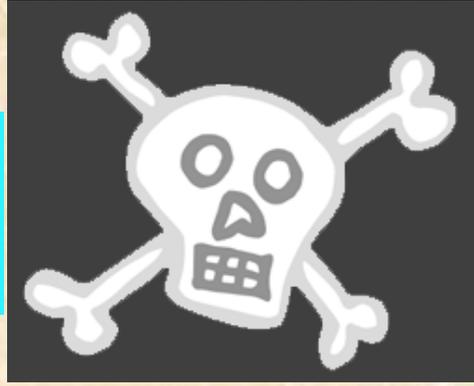
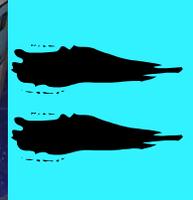
- Great disinfectant
- Not highly toxic
- Doesn't play well with some other chemicals



Bleach & Ammonia = Poison Gas

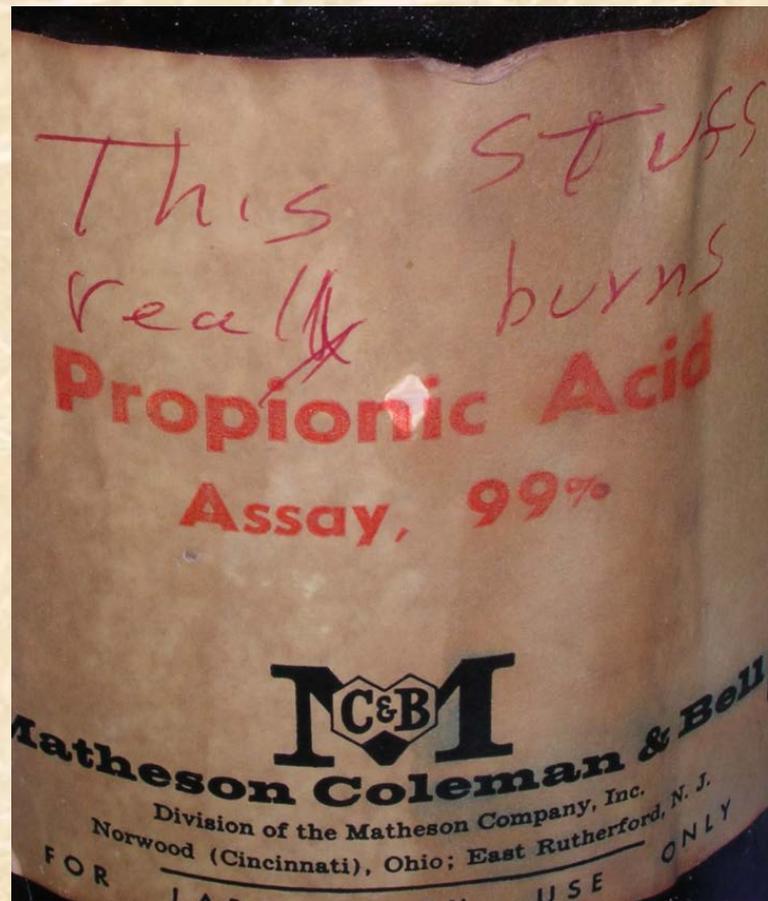
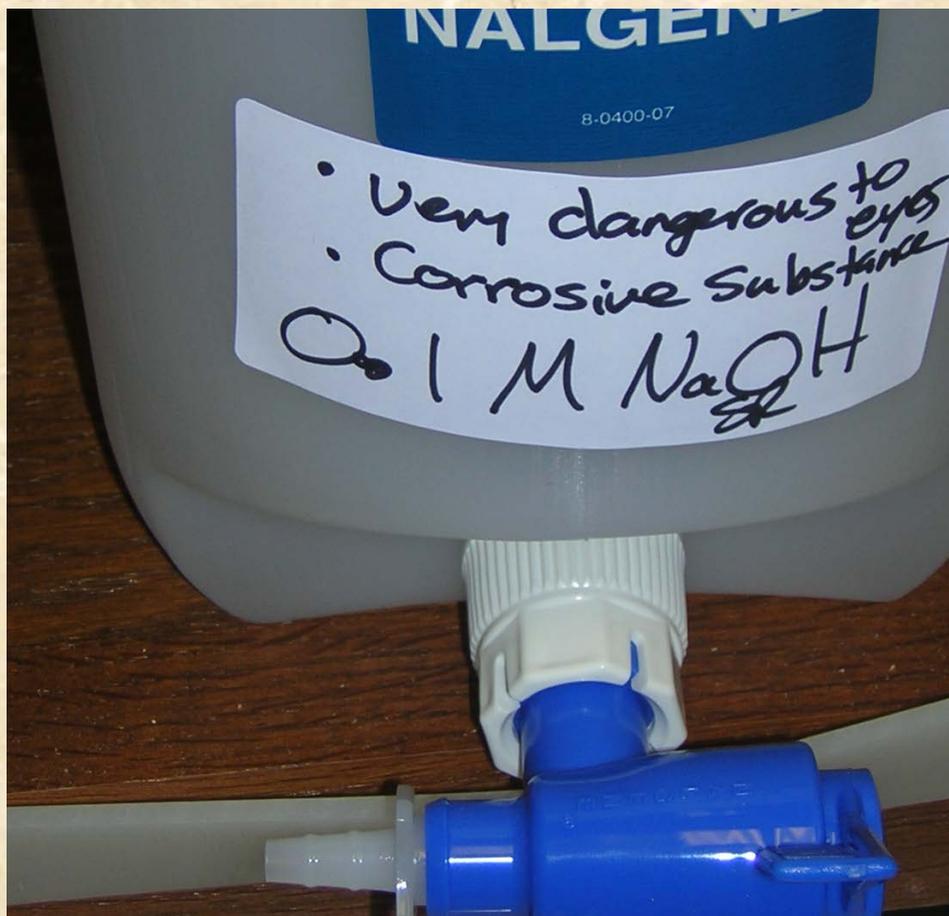


Bleach & Acid = Toxic Chlorine Gas



Proper Labels Include Two Items

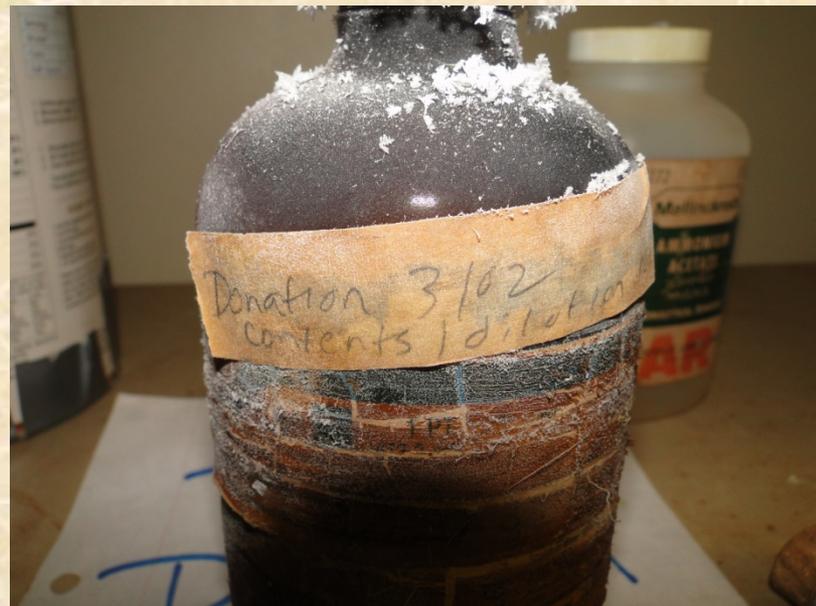
- Name that matches MSDS
- Primary hazard

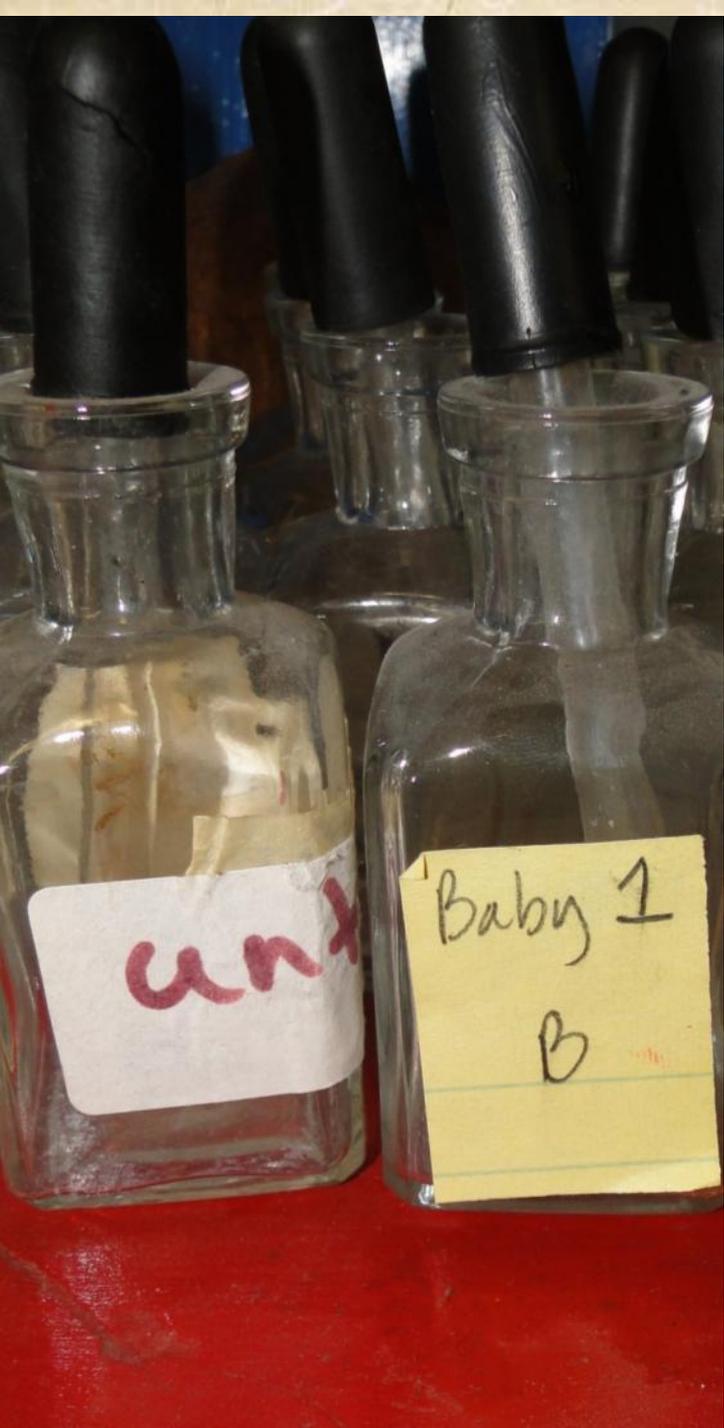


Not appropriate, helpful or accurate



You can't safely
handle or legally
dispose of
unknown
chemicals





Please, no more weapons of mass destruction in King County Schools

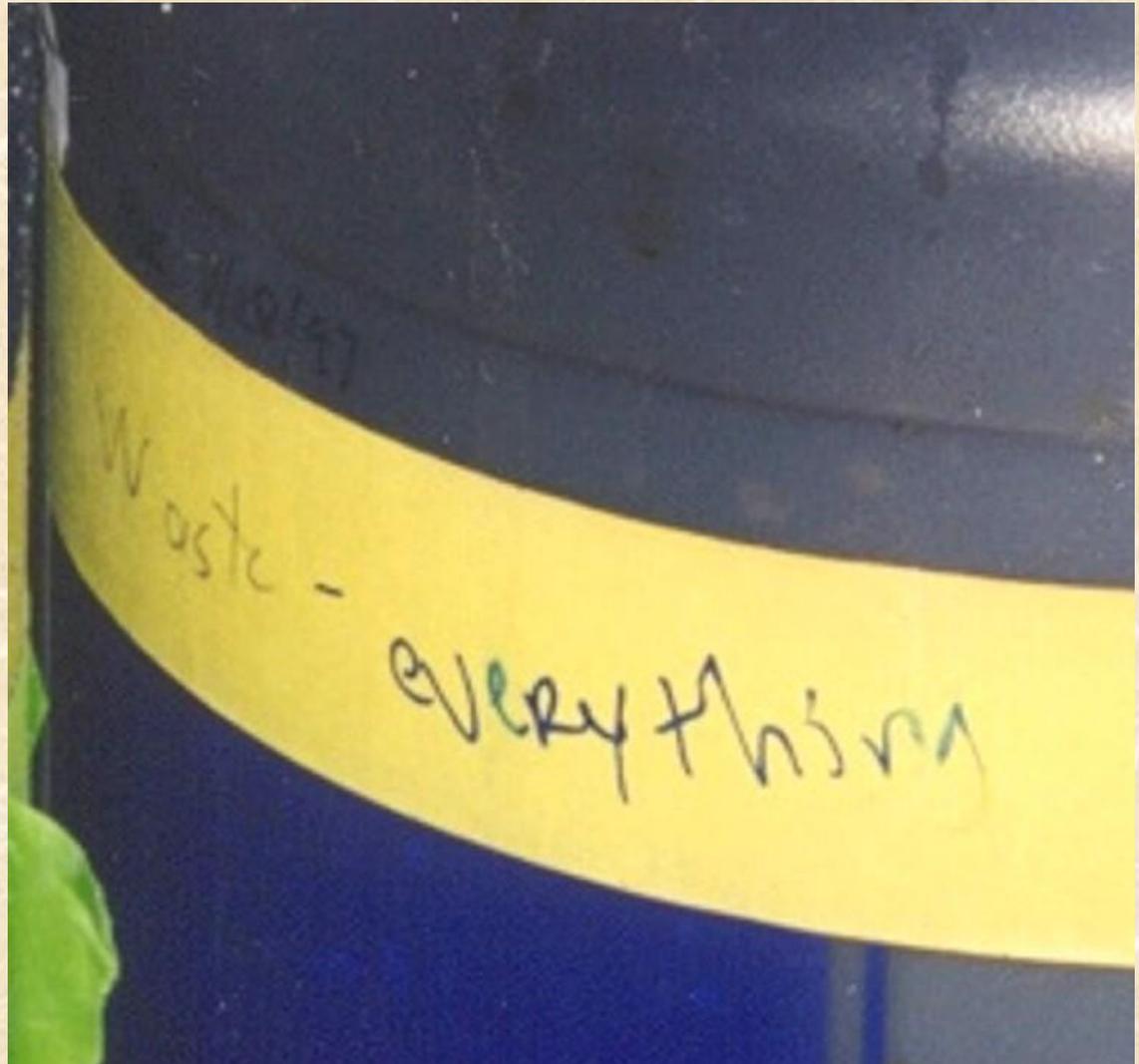


Hazardous waste disposal



What is waste?

- Don't want it
- Can't use it
- Unknown
- Orphaned
- Spilled



What's "hazardous" mean?

Defined by Federal and State Regulations

- Resource Conservation & Recover Act (CFR 40)
- Search "*state name* hazardous waste regulations"
- Characteristics
 - Hazardous qualities
- Designation
 - Listed chemicals or processes



What's **not** hazardous waste?

- Something someone else can use
- Something you can still use
- Empty container residues

- Things that are hazardous but not chemical-based (like knives & ninja cats)

Ninja cat strikes from above.



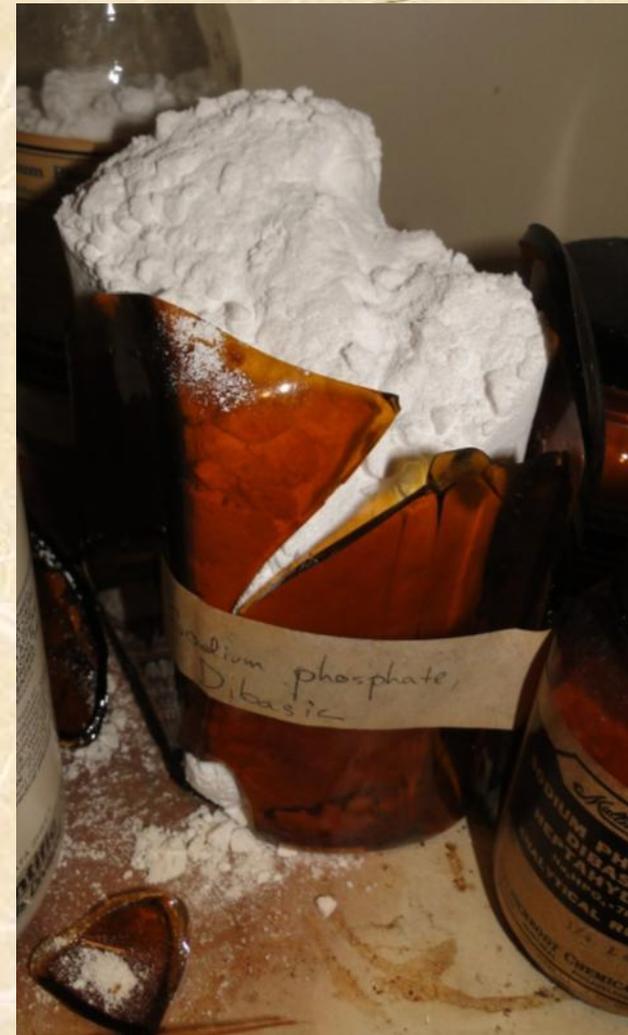
Empty container exemptions

For almost all chemical wastes

- Emptied using all normal means, **and**
- Contains less than 3% of container capacity

Basic regulatory requirements

- Know what it is
 - Can't dispose of unknowns
- Handle & store it safely
- Dispose or recycle it properly
- Document everything in writing



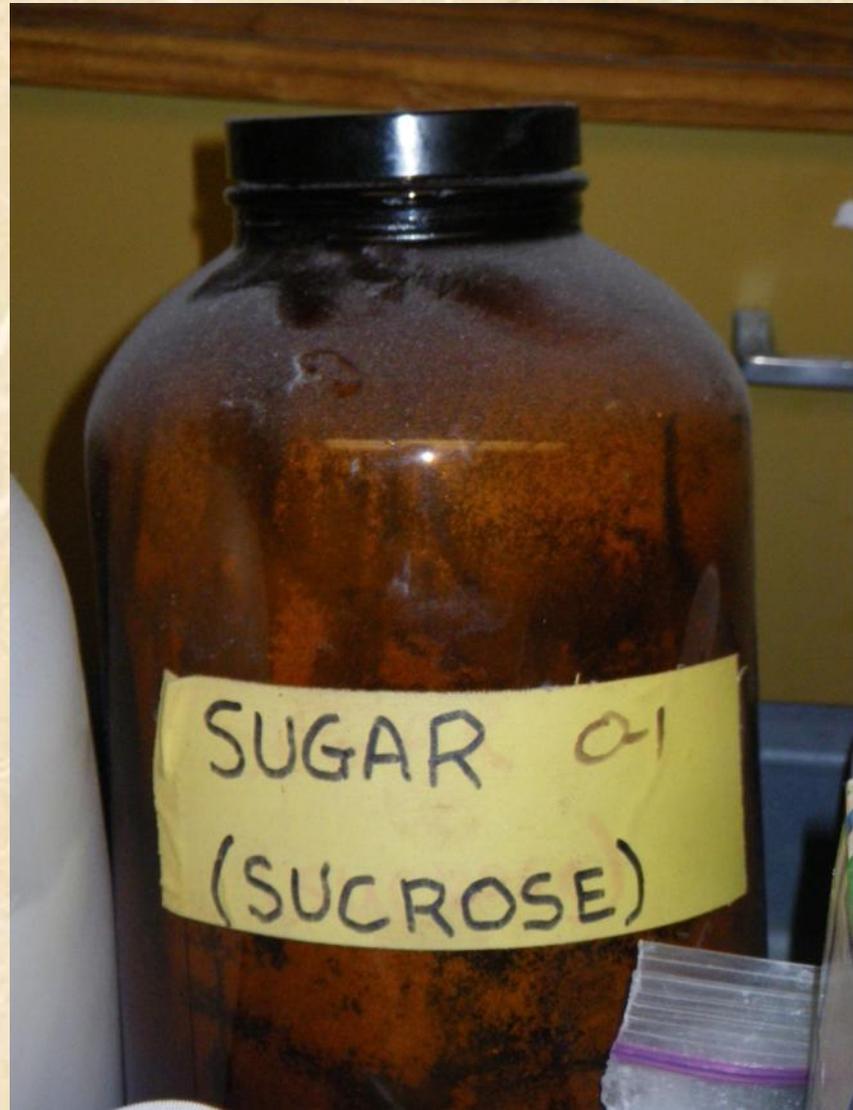
Non hazardous materials can go in dumpster or down the sewer drain

- Risk rating of 0 in database
- Saves you lots of money



Some non-hazardous wastes

- Sugar
- Starch
- Carosafe™
- Water
- Vinegar
- Plaster of Paris
- Epsom salts
- pH paper



Keep hazardous chemicals out of drains



Hazardous chemicals must be disposed as hazardous waste

SMALL BUSINESS HAZARDOUS WASTE DISPOSAL

A no fee disposal option for Small Quantity Hazardous Waste Generator (SQG) businesses in King County.



- **LATEX PAINT/
LATEX PAINT STAINS**
- **FLUORESCENT TUBES
OR BULBS**

Delivering waste to King County HHW site

- Free in **King County**
- Make a list
- [Fill out the form](#)
- Label clearly
- Get approval first
- Business waste line
 - 206-263-8899



May be able deliver waste to HHW site

- Free in King County
- Make a list
- [Fill out the form](#)
- Label clearly
- Get approval first
- Business waste line
 - 206-263-8899



Household Hazardous Waste

The Household Hazardous Waste facility is free to residential / household customers. Conditionally exempt small quantity generator businesses may use the facility for a fee, by appointment only.

Accepted Hazardous Waste Products

For the safety of you and your family, transport these products to our Household Hazardous Waste Drop-Off Station in sealed, non-leaking containers. Household hazardous waste can be dangerous if spilled or combined. Do not mix liquids or other chemicals.

The following items are accepted at the county's Household Hazardous Waste Drop-Off Station:

- Aerosol spray can
- Antifreeze*
- Batteries*
- Bleach
- Brake Fluid
- Chemistry Sets
- Compact Fluorescent Light bulbs (CFL's)*
- Cooking Oil
- Drain Cleaner
- Fire Extinguishers*
- Floor Wax
- Lamp Ballasts
- Mercury
- Mildew Removers
- Moth Balls
- Motor Oil*
- Oil Filters*
- Oven Cleaner
- Paint, Varnish or Stains (Oil-base Only)
- Photographic Chemicals
- Pool Chemicals
- Propane Tanks* (BBQ size or smaller)
- Rug and Upholstery Cleaner

Contact Us



Drop Off Station

3434 McDougall Ave.
Everett, WA 98201-5041

Ph: 425-388-6050

Hours

Wednesdays, Thursdays, Fridays, and Saturdays

7:30 a.m. - 4 p.m.

[\(View holiday closures\)](#)

Businesses: call for appointment and details about what's accepted.

You can box your waste in advance



Or wait and let a contractor do it



Then have them drum & remove them



Separate unlike wastes



Don't drive with them in the cab





ST JOHN'S AVE
Queensburg
New German

Much better under a pickup canopy



Treatment by generator options

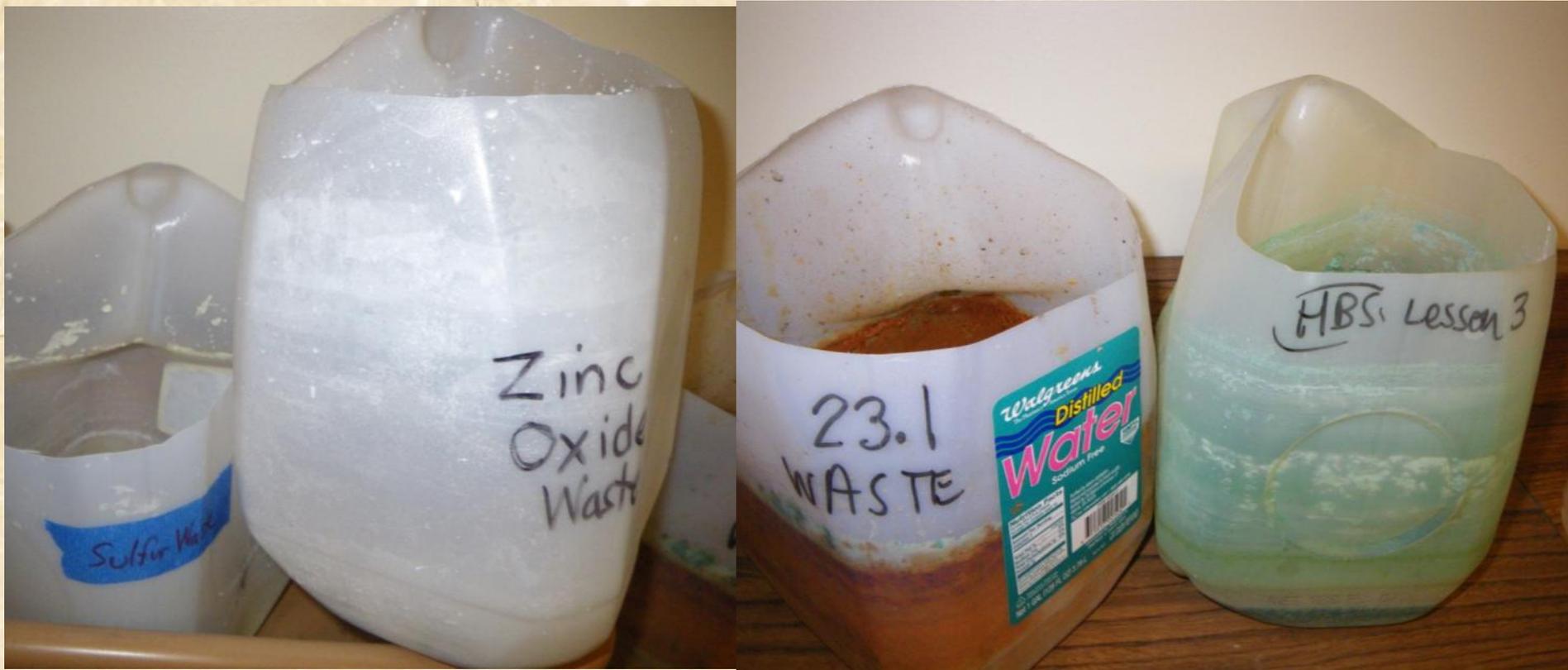
- Inorganic acids & bases
 - Neutralize to pH 6 to 9, then flush to sewer
- Aqueous metals can be evaporated
 - Remaining solids are disposed as hazardous waste

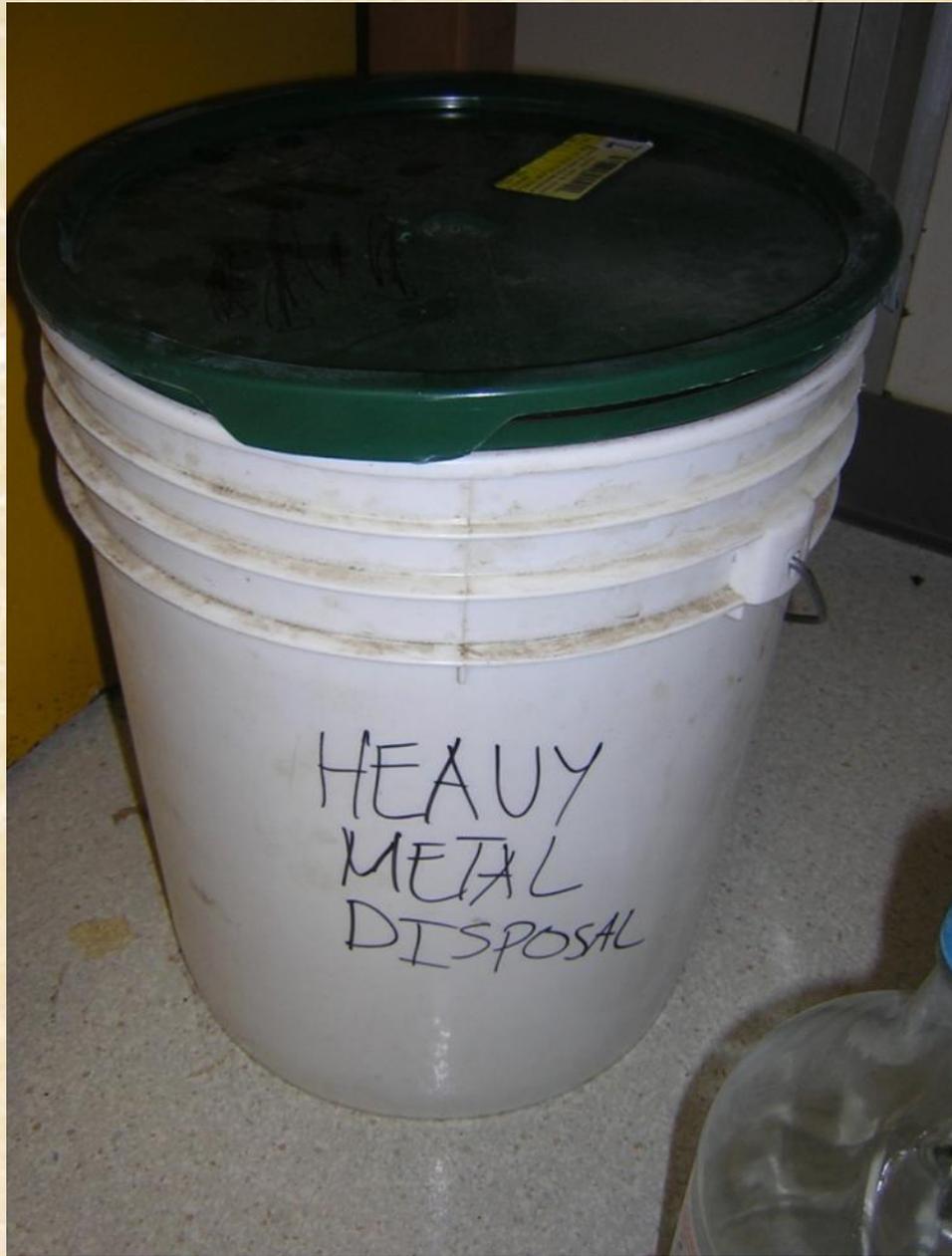


Evaporation of aqueous metals

Combine them all in one jug

- Pay by the drum – use bag liners





Once baggie's
full, zip closed
and put in here

When this is
full, it's time
for disposal

Keep a log if you treat your wastes

- Header describes process
- Waste, initials, date

Treatment by Generator Log - I

IMPORTANT! Be sure you neutralize the solution

Date	Com
1/1/1888	(Examples) NaOH (p
12/13/02	HCl 1M
2/7/03	HCl 3M

03.23.2004 13:23

If it's useful, it's not waste

- Only true if you don't have to modify it first



Incorporate treatment into lessons

- Neutralization of corrosive “wastes”
 - Chemistry of pH
 - Measuring changes of molarity with volume
- Evaporation of “waste” metal solutions
 - Ability of dried metal salts to form crystals
 - Variable rate of evaporation with temperature



A CAUTIONARY TALE

FARMER
DAVE'S
COWS

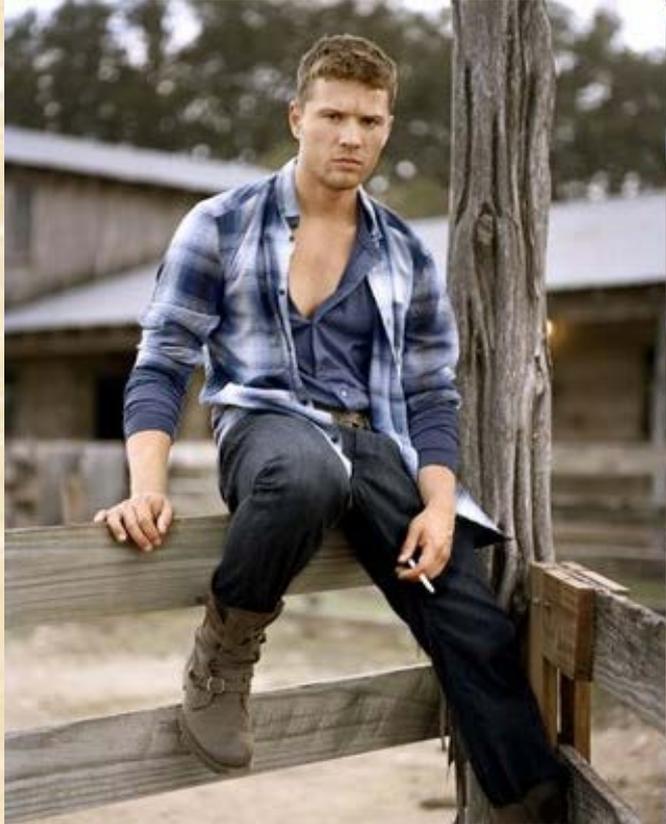
Meet Farmer Dave



Dave Owns 17 Cows



Farmer Dave Has Three Sons



Dave's Not Looking Healthy!



He Wills 17 Cows to His Sons

- $\frac{1}{2}$ to eldest
- $\frac{1}{3}$ to middle
- $\frac{1}{9}$ to youngest



It Doesn't Work – Tempers Rise!

- $17/2 = 8.5$
- $17/3 = 5.7$
- $17/9 = 1.9$



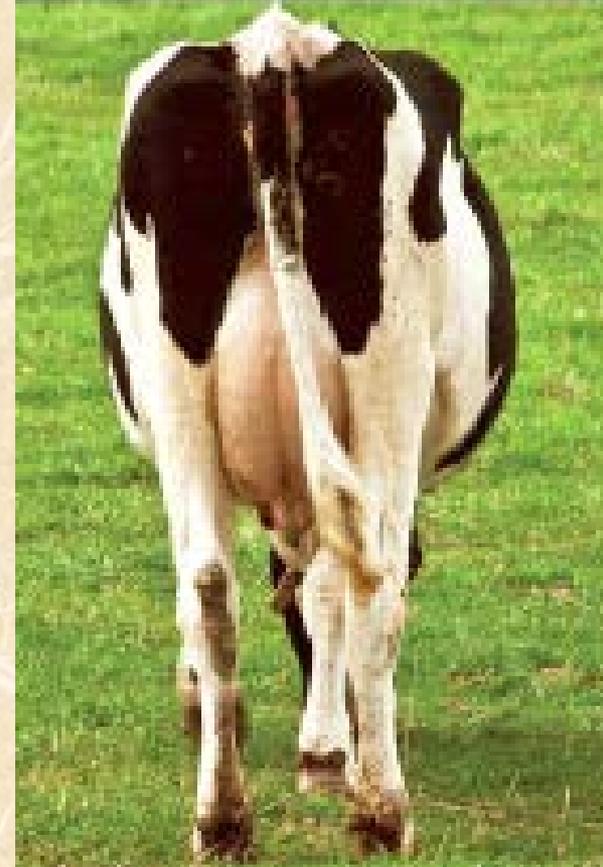
Neighbor Pam Hears the Ruckus

- “I can fix this”
- Goes to her farm
- “You can have my biggest cow”



They Do The Math

- $18/2 = 9$
- $18/3 = 6$
- $18/9 = 2$
- 17 cows
- Everybody's happy
- Pam takes her cow home



Familiarity Breeds Contempt

- Don't be chemically complacent





Any questions?