Cleaning Hazardous Chemicals Out of Schools
A Manual For Agencies by Dave Waddell

Introduction

Visit any school in the United States, and the odds are good that you'll find rooms that contain bottles, boxes, bags and buckets holding hazardous chemicals. In many schools, most of the chemical containers on shelves and in cupboards have not have been opened for decades, if ever. Few school staff, teachers or administrators have even a rudimentary understanding of hazardous waste regulations, or safe chemical storage, handling and disposal practices.

Most schools are inadequately prepared to properly dispose of hazardous waste they routinely generate. They are even less prepared to decide which chemicals sitting in shelves and cupboards are no longer needed. There is a pressing need for state and local agencies to step in and work with schools to help them through the process of getting no-longer-needed hazardous chemicals out of their schools in an environmentally sound manner. The Federal government should step in with financial support to support these efforts. Much work has been done so far, though with inconsistent results.

This manual focuses on hazardous chemical issues in public and private secondary schools. Unlike other manuals written by state agencies or the Environmental Protection Agency, which are directed at school administrators, teachers and staff; this manual was written to train people working for those environmental agencies. In here, you'll learn the steps to take to effectively work with schools to get them to deal with their hazardous chemicals in a safe, sensible and environmentally appropriate manner. The ultimate goal of this manual is to get dangerous and unneeded chemicals out of schools. The schools have done a poor job of doing this and they need your help.

My focus will be on your agency's approach to this problem however, not on the school. The guidance contained in this document is based on discussions with school chemical cleanout coordinators in 11 states and over a dozen cities, and on personal experiences from working with over 500 teachers in over 250 schools across the United States. The issues and techniques recommended here utilize the fundamental concepts of Social Marketing and Behavior Change Theory.

Why Focus on Schools?

To avoid seeing a photo like this in your local paper following a preventable fire in a local school after an old shelf collapsed that was holding too many containers of hazardous chemicals.

Schools across the country contain old, highly-hazardous chemicals that could kill someone if they fell off a shelf or were otherwise opened. These chemicals are not being used and their containers are slowly degrading over time. If stolen by a student, their hazards could lead to death and destruction of property if even slightly mismanaged.

You could also consider that it's a feel-good, media-positive project for your program that you can focus on for one period of time and not have to worry about it resurfacing in your area again. Because hazardous chemicals in schools slip under the regulatory radar, schools do not receive feedback and guidance on how to improve this situation. This has led to a culture of chemical neglect and mismanagement.

All businesses, including schools, are required to properly manage their hazardous chemical products and wastes. Many businesses are visited by government inspectors or required to self-report about their hazardous waste disposal practices. Hazardous waste transporters and disposal companies are heavily regulated and routinely inspected by state and federal investigators to ensure they don't pollute the environment. These companies, in turn, provide guidance about regulatory requirements to their clients. In this way, the hazardous waste disposal industry provides most of the environmental education that most business owners and managers will ever get.

Schools rarely, if ever, are visited by hazardous waste disposal companies or inspected by state or local environmental inspectors. Most schools generate relatively small amounts of hazardous waste from their processes, much of it is diluted solutions that are flushed down the drain, often illegally. In 2007, the U.S Environmental Protection Agency (EPA) estimated that over 33,000 secondary schools (75 percent) contain unneeded and mismanaged hazardous chemicals. For these practices to be changed for the better they need help. And they need it now, before a natural disaster, an incompetent teacher or a teenager with a bad attitude and a copy of The Anarchist's Handbook opens the wrong container and sets off a chain of chemical reactions that release a shockwave or poison gas cloud that causes avoidable harm.

Vignette # 1 – Chlorine Gas in Schools?

VIGNETTE NUMBER 1 GOES HERE:

Moral of Vignette # 1 GOES HERE:

There are 75 high schools within 40 miles of Seattle in King County, Washington. Initial inspections of their science stockrooms found that 44 of 75 (59 percent) had highly reactive chemicals in their schools that required stabilization by chemical explosives experts. Picric acid, ethyl ether, tetrahydrofuran, elemental potassium and other potentially explosive compounds are commonly found in schools across the U.S. *when someone is actively looking for them*. You'll routinely find almost every federally regulated chemical hazard class on shelves or in cupboards within a school: poisonous mercury and cyanide compounds; carcinogens containing chromium, cadmium and arsenic; water reactive elements like elemental sodium; acidic poisons such as hydrofluoric acid, powerful oxidizers like ammonium nitrate and toxic inhalation hazards like elemental chlorine and bromine.

Based on conversations with inspectors from eight states that have initiated school chemical cleanout projects, EPA's estimate that 75 percent of schools contain unneeded chemicals may be low. These inspectors have found that schools usually needed less than half the chemicals stored in the science stockrooms. And, of those chemicals they are using, they typically have an overabundance of many of them on site given their current rate of usage.

Getting Started: Setting Objectives

Early in the process of scoping a chemical cleanout campaign, you should be asking yourself, "What exactly am I trying to accomplish with this project?" Unlike some projects that require a tight work plan before you start, school cleanout projects tend to be more fluid, so you will need to maintain some flexibility in your work plan to adapt to new developments and respond to opportunities that come up.

Here are five core objectives that should be a component of every school chemical cleanout project:

1. Get organized, define your initial scope and methods for measuring success
2. Find partners to assist with access to schools and funding for disposal
3. Get the highest-risk chemicals out of participating schools
4. Create lasting improvements in environmental health and safety at those schools
5. Keep everyone safe throughout the project

If you can confidently demonstrate that you've accomplished those objectives, you'll find you've made a positive lasting difference in the schools you worked with and their communities.

You may find you have other specific objectives you wish to accomplish. Here are some that have been chosen for projects related to school chemicals by agencies in the past:

- Collect and dispose of all elemental mercury and mercury compounds
- Eliminate all lead glazes from art programs
- Assist with funding for disposal of all unneeded hazardous chemicals
- Eliminate all picric acid and arsenic compounds
- Replace all mercury thermometers with digital or alcohol thermometers
- Require all schools to put in place a chemical hygiene plan including spill procedures and full chemical inventories
- Allow schools free disposal of all chemical containers they bring to their county household hazardous waste drop-off site
- Provide free disposal of all pesticides, herbicides and disinfectants through their state's agricultural chemical collection events
- Reduce the cost of liability insurance to any school that participates in a school chemical cleanout campaign

These latter projects have had varying success. Often more than one of these approaches has been cobbled together into a unified program. This list indicates some of the options that you can choose when designing your project and may start you thinking about potential partners that would be interested in working with you.

Getting Grounded in The Issues

With limited budgets, it's very tempting to look at one of the published school chemical cleanup guides, arrange a meeting with school district officials, give them a copy of the guide, and say this is something we think you ought to follow. Considering how busy teachers and school administrators are dealing with issues like bullying, playground safety, and failing of school levies to remodel their buildings, it's very unlikely that they will ever read and act on that type of information.

However, before you begin planning your program, you need to know what you're getting into. There are two steps to achieving this; reading the literature and seeing it first hand. There are a bunch of on-line manuals, reports and articles on school chemical hygiene that have been written by school districts and environmental protection agencies. A web search for "school chemical cleanout" or "rehab lab chemicals" will lead you to many of them. Look them over to see what guidance is being given to schools.

At the same time, be aware that the most effective school chemical cleanup programs in the United States have been based on person-to-person interaction in the schools while looking at the chemicals. This does not require a large staff of people, if you are willing to design a multi-year program and find partners to help carry some of the burden.

The State of Minnesota has done it pretty much with one person doing most of the fieldwork. King County's Rehab the Lab program operated with four inspectors working out in the field. In Washington State outside of King County, seven or eight inspectors visited schools and improved their chemical storage and handling practices and got them to get rid of their chemicals. The State of Iowa also had a very strong hand-on component and has been very successful with very few inspectors working in the field. Much of the work done in Vermont was handled by a staff of two.

An inspectors approach to looking at chemicals and their problems is very different than the approach that a teacher or a person working at a household hazardous waste (HHW) collection program would take. A teacher looks at chemicals and sees how they can be used to teach. An HHW staff person looks at chemicals and wonders which ones the teacher wants to get rid of. If you're working in a collection program, your inclination will be to ask what they want to get rid of, and then ensure that that process gets done properly, safely, and legally.

An inspectors approach is different in that we are looking at chemicals and asking 'What's this used for?" We're also asking 'How much of this do you use?' and 'Are there any alternatives to this compound?' By asking these questions we're able to get the teacher to start thinking about the chemicals in a different way.

By encouraging them to reduce their stockpile to at most a few years supply at a time, we're getting them to think about their chemical purchasing and usage. By changing this perspective, the chances are good they'll be more open to modifying their behaviors towards something more sustainable.

Even if you are not going to be able to have a full-fledged inspection program visiting every school and looking at all of their chemicals, it's very important that you get out in the field yourself, look at the chemicals, talk to teachers, see what condition the bottles are in, and see how they're stored, so you can learn enough about this issue to be able to sound like you're grounded in it when you're discussing it, either indirectly via publications or directly in presentations to teachers or school officials.

Get enough background in this issue to sound like you know what you're talking about by visiting a variety of schools, both in term of size, age of the school, and grade level. Make sure you visit at least a couple of middle schools and high schools. Try to visit a private high school and a public high school, an old school and a brand new school. This will provide you with enough perspective to help you understand how to craft your message so it will be useful to the broadest number of people possible.

When you visit the school make sure that you walk through all of the chemical generating programs or chemical storage areas in the school. This means you will need to visit the photography and art programs, and crafts programs they might have, the biology, chemistry, and other science programs and their stockrooms, grounds maintenance and custodial programs, and the janitorial supply areas.

Additionally you should ask if the district has any facilities maintenance locations that you can visit, since this will quite often be where old chemicals are taken and collected, and where many of the maintenance supplies will be stored. You'll probably find that the maintenance people at the district level are responsible for some of the aspects of hazardous waste management for the school district and for the schools and can clue you in on what procedures are in place and perhaps what techniques that they think will work most effectively in the long-term to help with their chemical management.

When you finally do get out to a school and get on-site, there are a bunch of questions that you should make sure that you ask. Let's start with the chemistry and biology programs:

- What do you use that for?
- How much of this compound do you use?
- Do you teach organic chemistry?
- Do you teach the ester lab?
- Do you know if your biology specimens are preserved in formaldehyde?
- Who purchases the chemicals for your school?
- Have you ever done a chemical cleanout? When?
- Do you need these mercury thermometers? If you do, how many do you need and what do you use them for?

By getting the answers to these questions, you can learn a lot about the school and also indicate that you've done your homework and know what kinds of issued may crop up in a chemistry program or biology program. Depending on the answers you get, you may be able to convince them to get rid of 10 of the 11 bottles of a lead compound they have.

If they don't teach organic chemistry then most of the chemicals in the flammable storage cabinet are probably not going to be used by them and should be disposed. If they do teach organic chemistry but don't teach the ester lab, then chemicals like butyric acid, amyl alcohol, and ethyl acetate are probably not needed.

If they know that all of the biology specimens they have are preserved in a formaldehyde alternative, like Carosafe or FlinnSafe solution, then you wont need to worry about disposing of formaldehyde liquids. If they don't know, then there's a good chance that there may be formaldehyde present in some of those containers.

If they know the person responsible for purchasing chemicals for their school, then you can get that contact name and have a resource that you can work with to improve their chemical purchasing practices. If they are purchasing them individually, teacher by teacher, then it's a good opportunity to talk to the district about the importance of having a coordinated chemical purchasing program, as a way to cut cost and reduce duplication of purchasing of chemicals.

If they've done a chemical cleanout in the past, you can get an idea of who was responsible for it, and make them a primary partner in your upcoming work of trying to get additional chemicals out of the schools. It's important to understand that just because a school says they've had a chemical cleanout in the past, it does not mean that they've cleaned out the chemicals that you may have as a priority to get off of their site.

Lastly, if they say they need mercury thermometers, but they're only using them for calibration, then one or two mercury thermometers may be the most they will need and they can switch to less hazardous alcohol or electronic thermometers for most of their work.

The important part of all this initial site visit activity is to establish credibility and assess the severity of the hazards at the schools. This allows you to ensure that when you're talking to the schools, or the teachers, or writing up a brochure, that what you're saying makes sense in the context of their operations. The guidance that works for businesses in some of these practices does not necessarily work for schools.

There's a reason the phrases "trial and error" and "live and learn" are timeless. We learn from our experiences and the lessons most deeply learned often arise from mistakes we've made that we must avoid repeating. Only by walking through a school with a knowledgeable site guide from the school and, if you're lucky, with a skilled and experienced hazardous materials inspector can you really understand the chemical problems that need to be fixed and the institutional barriers that need to be overcome.

I strongly recommend visiting several schools, public and private, junior and senior high school, old and new, rural and urban to broaden your perspective and to help you develop strategies that are adaptable to these variations. Bring your digital camera to show that you aren't making up some of the wacky, bewildering and terrifying situations you find. Those photographs will make a compelling case to move your project forward. For guidelines on taking useful photos during an inspection, see the **Photo Documentation** section below.

Fundamental Concepts for Improving Your Effectiveness

The general goals of any project are to make something happen within your available time and budget, and to stay out of trouble while doing it. Within this vague framework lie many possible objectives and approaches. In this case, your broad objective is to change the ways schools manage their chemicals and reduce the risk those chemicals pose to human health and the environment. The approach you take to do this will be based on the time and budget you have available.

The temptation to which most programs succumb is to provide the schools with excellent information and trust them to follow your guidance and fix the problems. It's tempting because it is a slam dunk on your initial broad objectives; staying within budget and finishing quickly. All you have to do is find a good school chemical management manual – Florida's is terrific – use it as a template to write your own, print lots of copies and mail it to every school in your area of responsibility. The just sit back, declare victory and wait for the positive feedback.

This method, unfortunately, just doesn't work because its basic assumption that information will change behaviors is flawed. Behavioral scientists and sociologists have studied people and their collective behavior for years. From these studies, they've learned many basic truths about what makes us tick. Here are some of their key findings about the techniques that are really successful at getting people to change their behaviors and adopt them over the long term.

Behavior is influenced by individual and environmental factors. Individual factors include a person's beliefs, motivation, knowledge and skills; environmental factors include their family, cultural norms, geography, and public policy. An approach that ignores these factors is unlikely to succeed.

Training people in the techniques you wish them to adopt only changes their skills and knowledge. It cannot, by itself, overcome barriers to adopting the long-term change you desire. In other words, increasing their knowledge and skills is necessary but not sufficient to change their behavior. So training can be an effective component, especially in creating a perceived need for your program, but it can't create the changes you need them to adopt without additional reinforcement.

Here are a few concepts to consider when designing your program:

- The project needs to use methods that will motivate people, since the motivation to learn enhances their retention of incoming information.
- People only process small amounts of information at one time and combine those bits into clumps of information to aid their memory and help them process it, so your information must be provided in discrete "chunks" using vivid, memorable language.
- Without practice, people forget what they learned within 48 hours of learning it.
- Behavior that is positively reinforced is more likely to happen again in the future. Behavior that followed by a negative result is less likely to happen again in the future.

If you want people to remember your messages, make them visual, using vivid, personal terms. We are prone to remember and embrace concepts that are presented in a way that allows us to "enter the world" of the information provider. I've included numerous chemical vignettes through this manual to provide you with vivid personal examples of situations you may encounter and then show the conclusions that can be drawn from them. Look for opportunities to tell a story when making your points.

People need to have direct, hands-on learning accompany the intellectual information you provide to them. It is much less effective to say "Store all chemical containers properly" than it is to stand beside a teacher and point to a bottle and say "Move that bottle of nitric acid out of the flammables cabinet before it starts a fire. If it comes in contact with that bottle of toluene you'll have flaming acid vapors shooting out of there the next time you open this cabinet."

When they read that chemicals must be properly stored, they may have assumed they were storing chemicals properly,. A cursory look at the shelves in the middle of a busy day in a teacher's life may be the extent of self-evaluation they'll give to this topic, unless someone is there to focus their attention.

By giving them focused information about a specific chemical in their storage cabinet and creating a vivid picture of exactly what can happen, you create a scene in which they can place themselves and hopefully more deeply grasp that this situation poses a significant risk to their health. By having them physically move their bottles to safer locations, you allow them to perceive through all their senses what it takes to segregate incompatible chemicals and make their laboratory a safer place.

The Case for On-site Assistance

If indirect approaches won't solve schools' problems with their hazardous chemicals, what will? The most effective direct method is on-site technical assistance coupled with financial incentives to offset some or all of the disposal costs. This method works, but can be expensive and time-intensive. It is dependent upon committing resources, funds and skilled inspectors to make your school chemical cleanout project successful. Later in the manual I'll describe techniques that can help reduce the demands for resources from your agency to make this work.

Experienced inspectors are trained to identify problems in their field through visual observations and structured interviews during a walk through a site. They've perfected the process of getting a site guide to explain the work that's being done and the reasons, or lack of them, for certain situations to exist.

In schools, a skilled hazardous materials inspector can find problem chemicals, help teachers and other school staff understand problems with their chemical management practices and offer specific solutions to those problems. Most importantly, the information is being provided and hopefully immediately adopted into practice within the context of a site visit to their school and is very specific to their chemicals.

People respond to direct, helpful messages and will respect the fact that you are actively participating with them in the process of improving their environmental health and safety. If you can incorporate body learning into the process, all the better. You can do by having the site guide actively improve chemical storage practices during the visit, test the eye wash station for you or take notes for you while you read off an inventory of the higher risk chemicals. Once they've learned to do an activity like segregating incompatible chemicals on shelves, they're more likely to continue doing it.

Not just inspectors should visit school chemical storage areas, project planners and other financial stakeholders should also go on-site and participate in the school inspection. Why should they join a skilled inspector in the field?

- So they really know what your program is tackling
- So they can document the risks to teachers and children in the schools in their city, county and state from the chemicals on site
- So they can sell their agency on providing financial or in-kind support of your project.

Barriers to Success – Funding

The primary barrier to school chemical cleanouts is finding the money to pay for disposal. It's not the only barrier, there are many more described below, but it's the big one. Schools have very tight budgets that rarely include a line item for disposal. Unfortunately, that problem is just as true for most agencies, especially environmental agencies. How can you overcome the budget barrier and get your project funded and on the road?

Fortunately there are multiple successful models that have been used across the U.S. that you can evaluate and modify to suit your circumstances. Here are a few successful clean-up programs and the methods they've tried.

Iowa Rehab the Lab

In Iowa, the Rehab the Lab school chemical cleanout is coordinated by EMC Insurance Companies, the primary insurers for all schools in the state. Metro Waste Authority (MWA) initially coordinated the program, but with very limited funding to support the cleanouts, partnered with EMC to manage the program.

Schools signing up for participation in the Iowa Rehab the Lab program receive these services:

- Chemical management training and a chemical resource packet
- On-site assessment by trained inspectors including follow-up support and regulatory compliance assistance
- Access to significantly discounted disposal rates

EMC, with the assistance of MWA, provides this program as a value added-service whose costs are included in the school insurance program. To qualify, K-12 schools must have their general liability insurance through the statewide insurance program..

The disposal of all chemicals and all associated disposal costs remain the responsibility of the school. Those costs can be significantly reduced by participation in Rehab the Lab since participants receive substantial discounts from the disposal contractors working with Rehab the Lab. A quotation for the disposal of chemicals will be provided by a disposal contractor after EMC or MWA professionals perform an on-site assessment and produce an inventory of old and hazardous chemicals that need disposal.

Vermont School Science Lab and Mercury Cleanout

The Vermont Department of Environmental Conservation fully funded their school science laboratory chemical cleanout project. The project had several objectives:

- Dispose of science lab chemicals that were outdated, extremely hazardous or present in excessive quantities.
- Reduce the amount of hazardous chemicals coming into the schools and improve the management of those on site.
- Encourage school science labs to remove all mercury compounds and mercury-containing equipment and to discontinue future mercury use.

Vermont DEC staff provided direct assistance to 83 secondary schools through on site inspections, assistance with inventorying of mercury and other lab chemicals, waste disposal at no cost to the school, and establishing safe chemical storage systems.

Lab clean-out costs averaged $1,100 per school, which they considered low, since they used state agency staff for on-site inspection work, municipal solid waste staff for packaging and transporting waste off site, and consolidation of the 21,000 pounds of waste at a municipally-owned and operated hazardous waste facility.

Connecticut School Mercury Cleanout Projects

The Connecticut Department of Environmental Protection (DEP) coordinated a school cleanout pilot in 2000, removing 75 pounds of mercury and mercury compounds from six schools. Connecticut chose to focus on eliminating mercury from schools as a way to reduce student exposure to mercury and methyl mercury vapors and to reduce mercury spills in schools and the enormous costs of clean-ups.

This project was financed by a supplemental environmental project (SEP). In lieu of part of a monetary penalty from a successful enforcement action against a polluter, a company may choose to finance an SEP. After the successful initial pilot, the DEP has continued to direct SEP funds toward mercury programs.

Tennessee School Chemical Cleanout Campaign

The Tennessee Department of Environment and Conservation ran a two-year program, funded largely by the United States EPA. Two TDEC programs, the Green Schools Program and the Household Hazardous Waste Mobile Collection Service have collaborated with the State Department of Education to provide a program that includes teacher training, on-site chemical management assistance, chemical segregation, and disposal cost on a sliding scale to the selected schools based on their county economic index. This program has removed approximately 30,000 pounds of hazardous lab chemicals, including 602 pounds of mercury.

Schools are required to apply for participation, assign a primary contact person, complete an inventory of all excess lab chemicals, implement a chemical management plan, and agree to pay a portion of the cost (10 – 50%)

As you can see from these examples, flexibility in design and the use of partnerships are common components of successful programs. Depending on your situation and what you hope to accomplish, the partners you need will vary.

Finding Needed Partners

Successful school chemical cleanout projects require partnering with others. You'll need to link with other agencies, waste disposal contractors and local and state educational support programs. There are several questions you'll find yourself asking at some point:

- Who coordinates hazardous waste disposal for the school system you're working with?
- Who insures schools in your state or county and are they willing to offer reduced insurance premiums to schools that participate in your program?
- What other public health, safety or environmental agencies inspect schools?
- Who can safely manage potentially explosive compounds you'll come across?
- What other agencies will commit funds or in-kind support to your school clean-out project?
- Who can you work with to reduce the costs of disposing of radioactive compounds?
- Which companies will accept old compressed gas cylinders for reuse?
- Are there any willing volunteers or interns with strong chemistry backgrounds available to you for screening the chemicals in the stockrooms?
- Are there trained hazardous waste investigators available to train you?
- Are there people who can alert you to grant opportunities to help offset costs?
- Are there currently active teacher training programs that could help you advertise your program and convince schools to participate in it?

Potential Partners	What they bring to your Project
State environmental protection department	Funding resources, hazardous chemical expertise, trained inspectors, regulatory expertise
County hazardous waste management agencies	Possible waste disposal services and reduced disposal costs , familiarity with schools in their county, experience in inexpensive screening of unknown wastes
Public health departments	Experience inspecting schools, knowledge of school contacts, regulatory authority to deal with unsafe situations
School insurance providers	Leverage, ability to reduce premiums for schools that participate in your project, experienced insurance inspectors
School district risk managers and safety officers	Parallel interests in creating a safer school environment, knowledge of who has responsibility for hazardous waste disposal at the district, ability to get you in the door of the school and the chemical storage rooms

State educational agencies	Statement of support for your program, possible funding (though somewhat unlikely)
Fire marshal departments	Shared concerns for safe chemical storage, possible expertise in safe management of explosive chemicals, inspectors who conduct routine in sections of schools
Police bomb squads	Expertise in disposal of explosive materials
University environmental health and safety programs	Experience in proper handling, storage and disposal of laboratory chemicals, knowledge of chemical hazards, contracts for disposal of laboratory chemicals and removal of explosive chemicals
State worker protection department (State OSHA programs)	Regulatory authority to mandate school chemical hygiene plans under the OSHA Laboratory Safety Standard
U.S. Environmental Protection Agency	Educational materials from the School Chemical Cleanout Campaign (SC3), possible grant funding to establish your program
North American Hazardous Materials Management Association (NAHMMA)	Access to public agency project managers who have successfully completed school cleanout projects, advocacy for your project, photos from schools that vividly illustrate the problems you'll face, trainers for your staff and teachers
State science teachers association	Knowledge of how chemicals are used in the schools, advocates for safer school environments, names of teachers in the schools who may be willing to participate in your project
State radiation safety program	Possibility of low cost or free disposal of radioactive materials
State agriculture department	Possible access to low-cost disposal of unneeded pesticides

Getting in the Door

One of the big challenges of delivering direct on-site assistance to schools is getting your foot in the door. Unlike other businesses, it's challenging to figure out who the best person to contact is at the school or district office. But, before you start phoning, e-mailing or visiting schools to introduce yourself, be sure you have your "sales pitch" in order.

Many schools will be very leery of having you visit their site and look for what they're doing wrong. They're very risk adverse operations and will be nervous about bad publicity and unfunded mandates. You'll need to anticipate this nervousness when you develop your messages to administrators who'll allow you to visit the school and the teachers and other staff who can actually explain what's being used and what's not, why it's being used and how it's handled and disposed.

Ultimately, you have three ways to get into the school and start your inspection:

- Use your right-of-entry authority to just walk on in and do it.

- Convince them to let you on site by walking up to the front desk and saying "I'm so-and-so from such-and-such agency here to do a compliance inspection" and hope they don't ask if they have to let you in.
- Convince them it is in their best interest to work with you so, together, you can improve the environmental health and safety of the schools.

Very few agencies have the right of entry and, even if your agency does, your chances of showing up unannounced at a good time to inspect the school and work with the teachers is slim. If you have the necessary authority, I would use this approach as a last option when the other, less authoritative methods haven't worked.

Most inspectors are talented at bluffing their way to success by not explaining anything about their authority unless they're asked. If you can't get a response from schools or districts to your request for a site visit, try just showing up at the door and saying you're there to do a routine hazardous materials inspection and need to talk with the person responsible for chemical management at the school. It may still be inconvenient, but it can be an efficient way to at least get a look at the stockroom and decide if there's a need for a scheduled revisit when the teacher is available to answer your questions.

For public schools, I recommend making your initial contact with the school district by phone. A list of school districts can be found from an internet search for "school district [*name of your jurisdiction/ county*] phone." Once you have a phone number for the district, give them a call, describe who you are and ask to speak with a person who is responsible for chemical storage and disposal. This will lead you to someone with a different job titles at each district. Key contacts could be the maintenance manager, assistant superintendent, risk manager or safety manager. Occasionally, if you're lucky, the district will have an environmental compliance manager.

Lists of private schools in your county or state can also be found through an internet search for "private schools [*your jurisdiction*]." For private schools, you'll probably be connected to either the principal or assistant principal. Avoid assumptions about the differences between public and private schools. Private schools face the same issues with their chemicals as public schools. Their profitability varies significantly, so they may have similar problems finding funds for waste disposal as their public counterparts.

Explain the purpose of your visit to the key contact and ask if they can accompany you on an inspection of one of their schools. They'll be able to get you on-site, unlock doors and help you understand how things are done in that district. Ask if they can schedule your joint visit for a time when the chemistry teacher will be free to answer your questions. Stress that this is an opportunity for them to get the latest information on environmental requirements and not an enforcement inspection. Be clear about your purpose. If you're trying to learn more about the issues and see what needs to be done, say so. If you have plans for incentives to offer participating schools, mention them too.

Remember to ask if they have any questions or have any particular areas or issues of concern they'd like you to address. It's always best to know you're addressing their concerns rather than trying to guess what they are. Often school districts know where there may be problems and are confused about what steps they should take to address them. By asking up front, before you're on site, you can get some time to do your research and have the answer ready prior to the inspection. This is one way to establish credibility in the site guide's eyes.

Prepare To Go On Site

Once you've gotten a school to allow you and your inspectors on site, you need to prepare for the initial inspection. Every initial school inspection should include these steps:

- Pulling together your toolkit
- Clarifying roles and responsibilities
- Identifying rooms where chemicals are stored and used
- Organizing the schedule so you maximize your time with the teachers
- Inspecting chemical storage issues
    - High-hazard chemical assessment.
    - Identifying no-longer-needed chemicals.
    - Segregating incompatible chemicals
- Documenting your observations
- Providing your initial recommendations
- Nudging the school towards action

Chemical Cleanout Inspector's Toolkit

Prior to going on site, pull together the materials you'll need to make your visit safe and productive. A school cleanout inspector's toolkit includes personal protective equipment, chemical identification resources, educational brochures, and a few unique tools that seem to always be useful. Here are the components of a useful inspector's toolkit:

Long sleeved shirt and pants that can take abuse	Chemical-resistant, non-fogging lab goggles
Closed toed shoes that are chemically resistant	Safety glasses
Box of disposable nitrile (not latex) gloves	Lab coat (optional)
12 one-gallon & one quart slide-lock plastic bags	10 plastic caps that fit one-gallon acid bottles
Swiss Army knife w/ scissors & screwdriver	Digital camera
Pocket flashlight	Magnifying glass
Black marking pens (fine point & wide point)	Peel-off stickers to mark bottles
Photo ID (agency & personal) for check-in	Duct tape and Parafilm plastic wrap

Labels: Hazardous Waste & Non-RCRA Waste	pH paper (can be borrowed from science labs)
Cell phone	Informational brochures and other handouts
Clipboard, pad of paper, pens and pencils	Air flow meter to test exhaust flow rate (optional)
Hazardous chemical lists (Appendix A and B)	Inspector's checklist (Appendix C)

The clothing you wear on site should be able to take abuse and provide a first-line defense against chemical exposures. Many chemical storage areas are cluttered, dirty and have crystals on surfaces left behind when chemicals were spilled. Regularly check your clothing to be sure it has not become contaminated. Though steel-toed shoes are not required, leather shoes are recommended over tennis shoes due to their superior chemical resistance. Sandals are not allowed in laboratory stockrooms or other chemical storage locations. Safety glasses are sufficient for dry chemical storage inspections, but inadequate when viewing corrosive liquids.

Plan on using a lot of nitrile gloves when you're on site and consider bringing extra boxes with you to share with the teachers you meet. It's a relatively inexpensive way to create good will early in the inspection process and to have them model safe chemical handling practices. The King County Rehab the Lab Program provided a couple dozen gloves to many of the science teachers they worked with. This provided an opportunity to talk about avoiding latex gloves due to concerns about skin allergies and chemical breakthrough susceptibility.

Locking plastic bags are useful in many ways:

- Enclosing bottles containing iodine crystals so they don't release corrosive vapors through degraded caps.
- Enclosing leaking containers of dry chemicals.
- Lining beakers used for evaporating water from waste metal solutions in states that allow evaporation as a treatment by generator option.
- Holding your brightly colored sticky dots for marking containers to keep them from getting stuck on every piece of gear you own.

Plastic caps on acid bottles are routinely corroded. You can order spare caps from many chemical-supply companies and bring them with you in a sliding-lock bag. If you see a corroded cap in an acid cabinet, replace it with a new one. Bring along ordering information to share with the teachers so they can have their own stash.

A pocket knife is often useful for cutting tape that is sealing a cardboard shipping box. Shipping boxes are not acceptable storage containers, since it is impossible to tell the condition of the container and chemical contents it holds. A Swiss Army-type knife with a flathead screwdriver and scissors attachment will often be useful for opening containers, cutting stickers to fit, etc.

A magnifying glass (a cheap plastic one will do) can help when trying to read very fine print label information. Similarly, a small pocket flashlight will help you see the labels on bottles tucked away in the back of hard-to-access cupboards and cabinets.

Duct tape and Parafilm are handy when closing beakers, leaking eye dropper bottles or other containers without caps that are holding liquids.

Stickers can be used in a couple ways. Larger stickers (at least one-inch long) can be a handy way for schools to tell how frequently their chemicals are being used. Here's how:

- Write the current year on every label
- Place a dated sticker on the side of every container so it touches both the container's cap and the side of the bottle.
- Post these instructions on a sheet in the storeroom and explain it to the teachers:

When you open a chemical container, remove & discard the sticker on it.

Every summer consider disposing of degraded or unopened containers over 5 years old.

When you buy a new compound, put a sticker on it labeled with that year's date.

- This provides a simple yet very visually obvious indicator of how long it has been since the last time a container has been opened.

Be sure to bring a cell phone with emergency numbers set up on speed dial. These numbers should include a contractor or agency to manage potentially explosive chemicals, your manager for quick guidance on unexpected issues that arrive and the number to call in case of an imminent health threat.

You'll need a clipboard with a pad of paper to go along with your inspector's checklist and high-risk chemical list. It's always helpful to have prepared brochures on topics that are likely to come up. These are some of the topics that prepared handouts can explain:

- Fluorescent tube recycling
- Electronics recycling
- Hazardous waste disposal options and haulers in your state
- Secondary containment of stored chemicals
- Techniques for on-site treatment of chemicals (neutralization, evaporation)
- Local sewer guidelines
- Safe chemical storage practices for lab stockrooms
- Best management practices for laboratories, photo processing and auto repair
- Descriptions of available financial incentives

Clarifying Roles and Responsibilities

Before you contact a school district or private school to discuss their old, unneeded chemicals, be sure you have your agency's roles and responsibilities clearly defined. School representatives typically start by assuming one of three things when you call:

- Your visit is going to interfere with their well-ordered operations
- You will be issuing citations and fining them for regulatory violations
- You will tale all the hazardous chemicals you find with you immediately, will pay all the disposal costs and won't need more than a few minutes of the teachers time

Enter your discussions with the district representative or principal with those assumptions in mind. Be prepared to explain how you'd like to work with the school, while realizing they'll expect you to adapt to their very rigid and busy schedule. It is essential to identify yourself and the reason for the call in order to dispel initial misperceptions.

By carefully explaining what you hope to accomplish, how you plan to do it and the limitations on your ability to fix problems that are found, you'll have made significant steps toward establishing a trusting and honest rapport with them.

Once you've gotten the OK to inspect a school, you'll need to schedule the visit. Contact the school's front desk by phone, explain who you are, your agency's name, the purpose of your visit and ask to speak with the person responsible for hazardous chemical disposal. Ask if they think an assistant principal would be the right person.

Once you've gotten to a key contact at the school, explain to them that you'll not be interrupting classes, but will be spending time in the chemical storage areas. Be sure that they understand you MUST have someone who knows about the chemicals in those storage rooms to accompany you for at least a part of the time you're there. Ask if it would be possible to schedule the inspection during the chemistry teacher's planning period.

During this call to the key contact at the school, identify what programs they have at the school that could have hazardous chemicals. Ask if they teach these subjects in addition to science and art:

- Auto Shop
- Ceramics
- Photography

The answers to these questions will help you prepare for other chemical waste management questions that may come up during the visit.

Be Safe on Site

Personal protective equipment is necessary during inspections, and is particularly important when you are nosing around storage shelves and cabinets holding lab chemicals. Chemical stockrooms can be filthy, so be sure to wear clothes you don't mind getting grungy.
Eye protection is mandatory in labs and chemical goggles should be worn when you open and inspect both acid storage and flammable liquid storage cabinets. Closed-toed shoes will keep your feet protected from spills, leaks or broken glassware. Though they're not required, a lab coat and chemical splash apron are excellent protection for your clothes if you'll be spending considerable time in the chemical stockrooms.

Chemical-resistant gloves are mandatory if there's a chance you will touch a chemical containers during your inspection. I recommend you handle some of the containers too. Your credibility goes up when you show a degree of comfort and competence handling chemical containers. By lifting a bottle and looking at its contents, you'll better understand the chemical and can train the teachers in minimal personal protection around chemicals. Most teachers don't wear gloves when handling the chemicals on their shelves or in their storage cabinets, unless students are watching. By wearing gloves and, especially, by requiring teachers to wear them, you get them to think a bit more about their chemicals and their personal safety. This is a primary goal of your inspection, increasing chemical hazard awareness. If they realize these chemicals can harm them, they're more likely to get rid of the ones they don't really need. See the section titled **Address Other Safety Issues** for more information on this topic.

Similarly, putting on a white lab coat allows you to model proper behavior in the lab stockroom. It provides an added layer of protection for you, has several pockets for holding pens, stickers, and your lab goggles, and gives you an air of "chemical competence" that indicates your knowledge of safe laboratory practices.

I recommend disposable non-latex gloves because they provide some chemical resistance and give you needed dexterity when handling small bottles and taking notes. Though they're not as chemically resistant as a Silver Shield glove, Nitrile gloves offer moderate broad-spectrum chemical resistance and are relatively inexpensive. Throw them away as soon as you see any sign of a chemical on them. Go with **at least** five-millimeter thickness and perhaps 10-millimeter to provide a good combination of durability and dexterity.

Few inspectors or teachers know the hazards associated with the hundreds of different chemicals that are found in most schools. For your visit to be safe and productive, it's important that you be able to spot higher hazard chemicals and describe the risks they pose to the school. Appendix A contains a list of the Highest Priority Chemicals for Removal from Secondary Schools. The Chemicals of Concern in Appendix B should be excluded from middle schools and junior high schools unless they are purchased and used in a very diluted form. No chemicals with Risk Ratings above level 1 should be used in elementary schools.

For a full list of chemicals found in schools, visit websites that provide a downloadable Excel spreadsheet, Word Table or .XML file that could be used in a laptop or personal digital assistant for preparing and maintaining chemical inventories. Here are a few websites that have useful chemical spreadsheets.

El Paso County, Texas: http://www.elpasocountyhealth.org/environment/school.asp

State of Massachusetts: http://www.mass.gov/dep/service/schlchem.pdf (embedded)

State of Florida: http://www.dep.state.fl.us/waste/categories/hazardous/pages/schoolchemicals.htm

State of Tennessee: http://www.state.tn.us/environment/sc3/inventory.shtml

Appendix D provides you with a good tool for quickly determining which chemicals are not federally regulated as hazardous waste. If your state has more stringent guidelines, see if you can develop a simple, one-page chart to help the teachers understand how to manage their waste chemicals.

Initiating The Inspection: Observations and Recommendations

When you finally do get to a school, begin your inspection from the moment you leave your vehicle. Have your digital camera ready with spare batteries. Take a photograph of a sign with the name of the school to establish where the following pictures were taken. Enter the door, sign in at the Main Office and ask to speak with your site contact.

I recommend beginning with the chemistry and biology programs, since they are where the majority of the high hazard chemicals will be located. Be sure to take a photo of the room number prior to taking photos of stored chemicals or other items of interest. This will help your note-taking immensely.

Remember to stop now and then to jot down notes on your observations and to remind you about the recommendations you made to your contacts and any requests they made of you that need to be addressed back at your office.

Gather information from the teachers as you go. As mentioned earlier, there are set questions that you'll want to ask in every science lab inspection. You can simultaneously conduct both your high hazard chemical survey and your school chemical cleanout inspection in the science lab.

First, screen the flammable storage cabinets, acid and base cabinets and shelves for high-hazard chemicals. If any are found, explain the hazards and your concerns, and isolate those containers to prevent an accident from happening. Then, go back through the cabinets and shelves and ask questions about what you see and recommend the steps they may want to take to get rid of hazardous compounds and improve hazardous situations.

Eliminating the Highest Risk Chemicals

How do you identify the high-risk chemicals that you want to get out of these schools? The easiest way to start is to pick a few characteristics of hazards that pose the greatest risk to students and teachers in the school. I recommend that you begin with chemicals that are highly toxic if inhaled or touched and those that are highly reactive.

I find a sense of humor and a flair for dramatic story telling goes a long way when you're trying to engage teachers in a discussion of high-hazard chemicals. A good website to refer teachers to is titled "Chemical Vignettes" on the website of Local Hazardous Waste Management Program in King County at www.govlink.org/hazwaste/publications/chemicalvignettes.html . Before you start visiting science labs, take a look through this website to get some examples of problems that can be found working with higher hazard chemicals. It will give you an appreciation for some of the crazy situations people can get themselves into when they're around chemicals.

When discussing high hazard chemicals with teachers, start by finding one compound on their shelves that has very high hazards and very low educational utility. That combination makes it easy for a teacher to understand the concept of a chemical's risk exceeding its usefulness. Most of the Highest Priority Chemicals found in Appendix A are good choices for this type of discussion. Take a look at the Chemical Vignettes below for information on specific chemicals of concern and illustrative stories about them.

When you find a container holding a Risk Level 4 chemical in during your initial screen, ask the teacher, "Do you use this compound?" Chances are very good that they'll say "Nope." If they say they need it, ask them what they use it for and how much they use each year. Ask if they know of a less hazardous substitute that could be used.

Once you get a teacher going along with you and agreeing that a chemical is not useful, they tend to be more open to going through the shelves and finding others that they can get rid of. If you can find several of the higher risk chemicals on the shelves, this will reinforce the fact that they have chemicals they really don't need.

The challenging conversation is when you get into the "Risk Factor 3" chemicals listed in Appendix B. These compounds are used in high school classes that are teaching college level chemistry to students, including more advanced laboratory exercises. These advanced labs may require small amounts or more diluted concentrations of higher risk chemicals. These chemicals have been assigned Risk Factor 3, indicating they're not to be used in junior high schools, middle schools or elementary schools; but may be acceptable to be used in small amounts and low concentrations in high schools.

We've already discussed one Risk Factor 4 compound, chlorine gas, which is poisonous and corrosive via inhalation or skin contact. The following vignettes describe the most useful Risk Factor 3 compounds, Lead Nitrate and Nitric Acid, and a few of the more commonly found Risk Factor 4 chemicals, their hazards and the arguments that may be made for keeping them.

Vignette #2: **Toxic & Oxidizing Lead Nitrate – Risk Factor 3**

A middle school in Washington State had over 500 containers of lab chemicals, including 13 pounds of lead nitrate, in their science stockroom. Lead nitrate is a poisonous oxidizer that is often used in dilute solutions and reacted with other chemicals to create colorful precipitates.

I asked the teacher if he used the lead nitrate. "Oh yeah, don't get rid of that stuff, I need it." "How *much* do you use?," I asked. "Well, let's see, I use one gram each quarter in the double displacement lab, and another gram a year in the flame test." "OK," I said, "then that's about five grams a year, right?" "Yeah, that sounds right." "Well then, with 454 grams in a pound, that means it'll take you 90 years to use up one pound. And with 13 pounds in stock, you've got about a 1,200 year supply on hand. How long are you planning on teaching?" He laughed and agreed that he could probably get rid of some. By the end of the discussion, he kept the newest container and set aside the other 12 pounds for disposal as hazardous waste. And, most importantly, he was then willing to dispose of another 150 pounds of hazardous chemicals that were on his shelves without feeling threatened that I was there to get rid of his needed chemicals.

What lessons can we pull from this typical story of too many bottles in storage?

- They may need the chemical, but it doesn't mean they need all they have.
- A skilled inspector, asking probing questions in a non-threatening way, can help a science teacher look at their chemicals in a new way.
- When people gain perspective on the risks their chemicals pose to themselves and the students at their school, they are more willing to dispose of unneeded hazardous compounds.

The lessons that use this chemical are typically only taught in high-school-level chemistry classes.

Vignette #3: Corrosive Hydrofluoric Acid – Risk Factor 4

VIGNETTE NUMBER 3 GOES HERE

From this report you can see why hydrofluoric acid is considered a higher risk than other acids; it's extremely toxic and readily passes into the bloodstream through exposed skin, a potent combination of risk factors. The fluorine ion in hydrofluoric acid preferentially binds with calcium. Spilled hydrofluoric acid acts as an anesthetic as it passes through the skin into the bloodstream where it quickly begins to dissolve bones and cause systemic poisoning. This is why hydrofluoric acid is considered the highest risk acid in schools. Other acids may be corrosive but they do not contain this additional secondary effect that increases their risk.

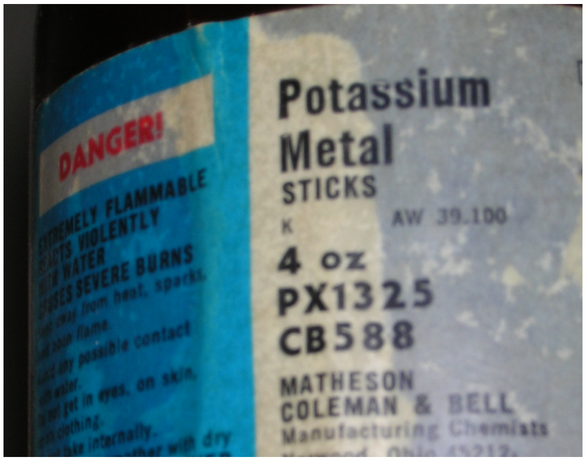
Though most science teachers are willing to eliminate their collection of old hydrofluoric acid containers, that's often not the case with art teachers. Why would an art teacher argue to keep their hydrofluoric acid? Because it dissolves glass. This compound has been used by artists for years in stained glass and other glass-etching techniques.

Though they work with a lower concentration hydrofluoric acid-based etching paste, the risks remain. Hydrofluoric acid in contact with glass will release fumes that are harmful, as was described by Arthur Louis Duthie in 1908 in his manual *Decorative Glass Processes*. "The fumes escape from full strength acid so profusely as to be quite visible like a yellow smoke, and are not only obnoxious, but dangerous. Even at moderate working strength they will cause bleeding of the throat and nostrils in persons in whom these organs happen to be weak, while they commonly cause severe smarting of the eyes, which is only relieved by a flow of tears."

Vignette # 4: Pyrophoric White Phosphorus – Risk Factor 4

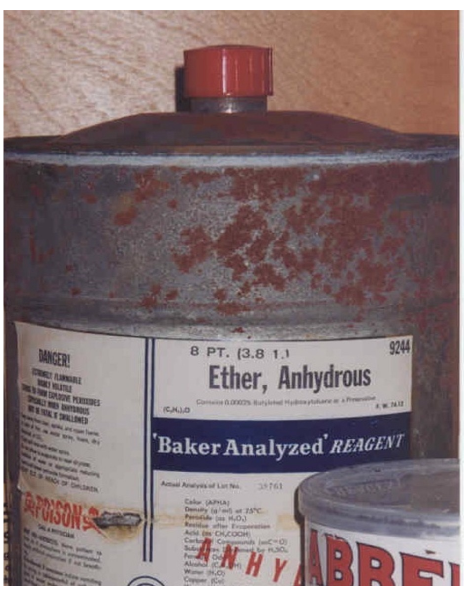
VIGNETTE NUMBER 4 GOES HERE

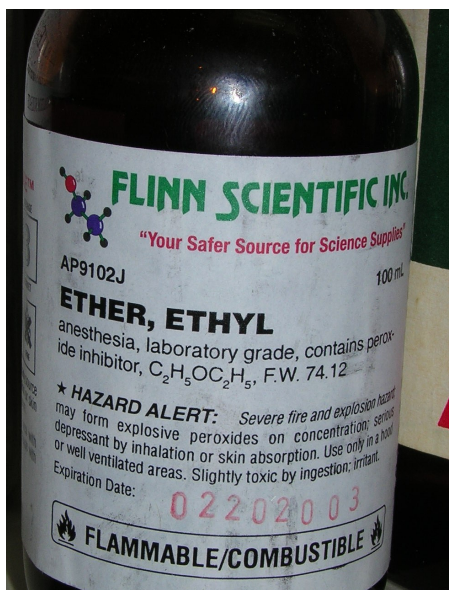
Vignette #5: Water Reactive & Peroxidizable Elemental Potassium – Risk Factor 4



VIGNETTE NUMBER 5 GOES HERE

Vignette #6: Flammable and Peroxidizable Ethyl Ether – Risk Factor 4





VIGNETTE NUMBER 6 GOES HERE

All peroxide forming chemicals such as ethyl ether and dioxane will form explosive peroxide crystals over time once they've been exposed to air. These materials are also highly flammable, but it's the combination of flammability and potential explosivity that bumps them up to the highest level, and makes them a priority for you to get off the sites. The final component of these highest risk chemicals is that their risk exceeds their educational utility. In other words, they're not particularly useful in schools in part because they are so hazardous, that combination makes them prime candidates for you to immediately try to get off the school site. There should be very little argument from the teachers that they must have this material. If they do argue this I would strongly suggest that they cannot back up that argument and there should be less hazardous substitutes that they should be able to use.

Vignette #7: Toxic Mercury Compounds and Mercury Devices – Risk Factor 4

VIGNETTE NUMBER 7 GOES HERE

Most agencies focus on getting mercury out of schools; it's a priority chemical throughout the United States for disposal.

Elemental mercury will typically only be found in the chemistry department. Elemental mercury is typically used to demonstrate density. Density can be demonstrated through many compounds, although mercury is the most glamorous.

Think beyond elemental mercury when you're discussing mercury with teachers. You need to talk about mercury devices, mercury compounds, and mercury liquid. Among the mercury devices you'll find at school will be mercury thermometers, which will be located in the chemistry, biology, and other science departments and the nurses station if they have one. Mercury thermometers are only really needed at higher temperatures, since high level more expensive alcohol and spirit thermometers work well at intermediate temperatures and lower temperatures. Even at high temperatures mercury thermometers can be replaced with digital electronic thermometers which are now highly accurate.

Mercury compounds will be found in the chemistry and biology department. Look for the words mercuric, mercurous, or mercuro- as a prefix. All of these compounds can be replaced by substitutes. The mercury salts, mercuric chloride, etc. are most easily replaced since very few schools are using them anymore.

Vignette #8: Corrosive and Oxidizing Nitric Acid – Risk Factor 3

VIGNETTE NUMBER 5 GOES HERE

Though useful in teaching Chemistry at the high-school level, nitric acid is such a powerful corrosive and oxidizing compound that it must be stored safely and separately from other compounds. Its ability to degrade the cap that seals its container poses an additional storage risk. Of all the chemicals that are used in a laboratory, few are more conducive to just-in-time purchasing than nitric acid.

Schools should avoid having more than one container of nitric acid on site, and should buy containers that are small enough to be used completely in less than five years.

Conducting a High Risk Chemical Screening Inspection

For you to be able to get the highest risk chemicals out of schools in your area, you're going to have to look at almost every bottle of chemicals that is out there and, if not you, then someone you can trust who's experienced with higher-risk chemicals in laboratory settings to locate them for you. You can't trust teachers to find these compounds and arrange for their deactivation and disposal.

This sounds like a very labor-intensive process, and indeed it is. However, it has been shown over and over that someone must go on-site and look through all of the bottles to find these things, because the schools are unable to find them themselves.

The first step in your inspection is to look for potentially deadly situations and explosive compounds. This entails going through each cupboard, storage cabinet and set of shelves twice; looking the containers over once as a quick screen for imminent threats, then doing a more in-depth review to identify unneeded and degraded containers of chemicals and determine if improper storage and disposal practices are happening.

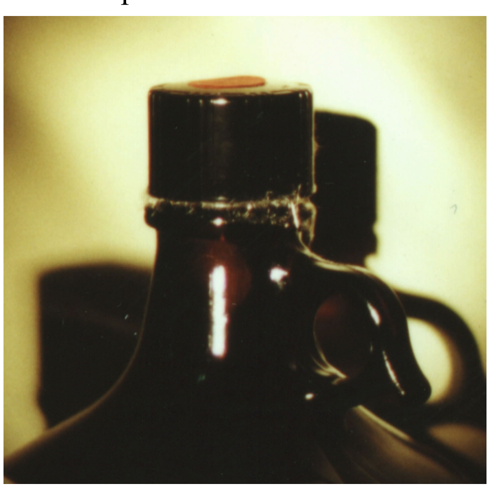
To conduct your site assessment and help the school identify chemicals that should be disposed, you'll need a tool that will help you understand the chemicals that are being used in schools and those that are no-longer-needed but still sitting on the shelves. Currently, the best available tool is the Flinn Scientific Company catalog, which includes a chemical usefulness code with every chemical they sell. Flinn catalogs are a challenge to order unless you're a school. Most schools will have new catalogs and be willing to give you their copy of last year's catalog.

The following sections show the recommended order your inspection should follow, from the more storage areas holding the more hazardous chemicals to those that typically hold safer chemicals. It is very important to realize that extremely dangerous chemicals could be found anywhere in the science stockrooms and unsafe chemical storage practices are commonly found throughout schools.

Science Flammable-Storage Cabinets – Observations and Recommendations

The first place to check in any chemical storage area is the flammable storage cabinet. This is where some of the most hazardous chemicals may be found. First off, a word of warning. The first thing to look for when inspecting the flammable storage cabinet are crystals on bottle caps.

Here are pictures of two bottles with crystals on them. Which should make you more nervous?



A rule of thumb is that crystals on a brown glass, one-gallon bottle are very suspicious; crystals on a clear glass, one-gallon acid or base bottle are not unusual at all. If you see crystals on a solvent container in a flammable storage cabinet, you MUST assume they are explosive unless you can be convinced they are not. In this case, the photo on the left is of explosive peroxide crystals on a bottle of tetrahydrofuran. The bottle on the right is hydrochloric acid and the crystals below the cap are of ammonium chloride, a non-toxic, non-reactive compound that can safely be rinsed off the bottle.

The photo above shows what appears to be an ideal situation. They have adequate storage for all their flammable liquids and you can see every container's label without having to move the bottles. There are still several questionable situations that deserve comment. Let's look at them more closely.

Left Cabinet

- Why are the heaviest containers are sitting on the middle shelf.
    - Get them moved to the bottom shelf so they're not straining the shelf's support clips
- Why is that can sitting on top of the others?

  - No stacking of chemical containers on top of others is allowed in stockrooms!
- What's in the shipping boxes on the shelves?
  - All shipping containers must be opened immediately to inspect the contents and ensure the containers are intact.

Right Cabinet

Detail of 2nd Shelf

- Potential problems in this cabinet that should prompt discussions:
  - The heaviest chemical containers are on the top shelf.
  - There is an unopened box on the middle shelf.
  - There is an open beaker and three small bottles without labels on the middle shelf.

Here's another typical flammable storage problem.

The cabinet on the right looks to be in good condition, with no evidence of rusted hinges or shelves. There are a lot of boxed materials visible, even from this angle, that should be pulled out of their boxes, inspected for soundness and put back in the cabinet.

Let’s look closer at some areas in the photo.

Note the flammable liquids being stored on the top two shelves on the right. These too should be in the cabinet. The second shelf holds more than 10 containers of flammable rubbing alcohol, a common International Fire Code violation. Just because it can be purchased in grocery stores and pharmacies doesn’t mean it is exempt from being stored with other flammable liquids.

Now lets look at the contents of some typical cramped and crowded flammable storage cabinets.

The container label is on the right is so corroded that touching it will destroy it. It looks like there may be information on the back that would help us identify it. How would you check it out?

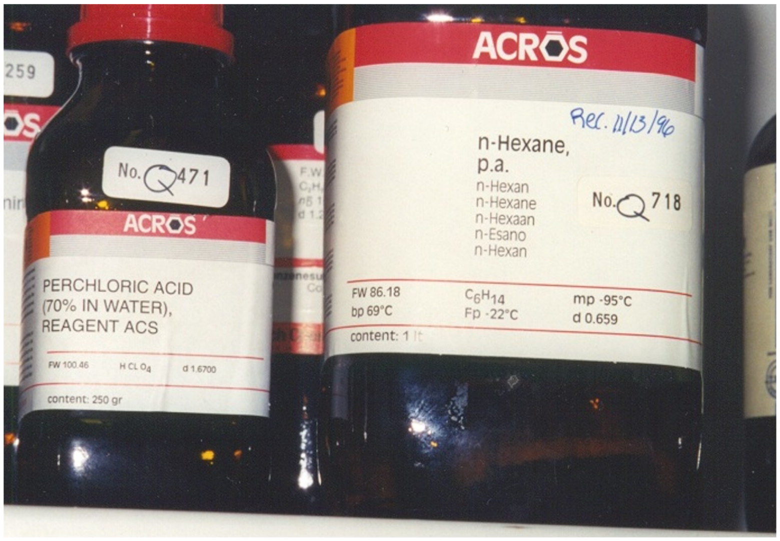
- Grab the bottle by the cap and twist it around so you can see the rest of the label?
  - Not recommended. If it turns out to contain a peroxide-contaminated solvent, the explosive crystals would be located in the threads of the cap and could detonate.
- Grab the glass between the label and the cap or below the label and try twisting gently.
  - This is the best bet. Do it gently because the bottle may be stuck to the shelf.

The sec-Butyl Alcohol label has fallen off the bottle behind it, or has it?

- Just because the label is adjacent to the bottle doesn't mean it belongs on it.
  - Hold the label up to the bottle to ensure it matches the border of the missing label
  - If it does match, reattach it to the bottle with Parafilm or transparent tape.

The hydrochloric acid should be moved to the acid storage cabinet. Eventually, all the chemicals should be removed at some point and the corroded shelf should be replaced.

Here's another photo of a shelf in a flammable-storage cabinet that raises questions and illustrates the challenges that can be faced when trying to safely inspect all the bottles in a storage area.



The obvious problem is that perchloric acid, a powerful oxidizer and very corrosive acid, is stored next to highly flammable hexane, a neurotoxin. The perchloric acid should be immediately moved to the acid-storage cabinet.

The less obvious problem is trying to see what else is stored in this cabinet behind the bottles in the front row. To avoid accidents from happening, remove the first five or six bottles you inspect and set them on a nearby counter temporarily. That should give you space to move through the bottles from side to side, shifting the ones you’ve looked at out of the way before you touch the next one.

Here's a crowded flammable storage cabinet. Let's make our observations from back a ways.

- The blue and white-labeled bottles on the shelves all date from the 1960s, chances are good they can all be disposed with no noticeable change in the curriculum.
- The white powders don't belong in a cabinet designed to hold liquids.
- The flammable solid on the top shelf is probably water-reactive and should be moved to dry storage, since the alcohols in this cabinet can contain up to 30 percent water.
- The tray in the bottom left corner has some odd containers.

Here's a photo of what we found in the bottom of a similar cabinet.

If you were doing a high-risk chemical screening when you saw those two containers, you'd have hite hit the mother lode. The jar on the left contains discolored potassium metal that, based on the label, appears to be at least 50 years old. When potassium turns purplish-red like this, it is coated in explosive organic peroxide crystals. The chemical bomb squad will need to handle this container and either stabilize or detonate it prior to disposal as hazardous waste.

The can of ethyl ether on the right is probably safe to be disposed as an ignitable hazardous waste, since it has an intact lid that must be punctured to be opened. If air has not come in contact with the ether, then peroxides should not have formed. Unfortunately, the can has begun rusting, so you would have to check to make sure that no small holes have formed and allowed air to contaminate the solvent.

Flammable storage cabinets are not the only place where flammable liquids may be stored in the stockroom. In this school they couldn't afford a cabinet, so they used an old refrigerator instead.

This situation is much worse if the refrigerator is plugged in. Old containers like these are likely to leak flammable vapors that could be ignited by a spark from a refrigerator's compressor.

Let's say you've looked in the flammable cabinet and have not found any potentially explosive chemicals. What else should you look for and comment on?

If you only see alcohols (methanol, ethanol and isopropanol)

- Ask if there a flammable storage cabinet in another room.
  - This may just be storage for the Biology Program.
- Ask if they use any other solvents in the school besides alcohol.
  - If not, this will likely be a quick and easy inspection.

If you see glacial acetic acid in the flammable-storage cabinet

- Well done! Ask how they knew to store this combustible acid in here?

  - This will let you know if they've had technical assistance visits earlier or if it is just a very sharp teacher.

If you see amyl alcohol, amyl acetate or butanol

- Ask if they teach organic chemistry and, if so, if they teach the ester lab?
- If they don't, then they'll have little use for flammable solvents. If they teach organic chemistry but don't teach the ester lab, then butyric acid, butanol, amyl alcohol, amyl acetate and ethyl acetate will probably not be needed.

Science Corrosive-Storage Cabinets – Observations and Recommendations

Once you've looked through the flammable storage cabinet, it's time to move on to the corrosive storage cabinet(s). There are three primary issues with corrosive storage: corrosion of the cabinet and its shelves, incompatible chemicals together, and leaking containers that pose a risk of physical harm to you if moved.

Let's look at some common situations and review the steps to take when working near corrosives. Before you open a corrosive storage cabinet, find the eye wash station.

If they eye wash station looks like either of the pictures above, you need to talk to the school representative about proper chemical safety equipment. Then you need to consider if you're willing to work around corrosive chemicals when there's inadequate emergency response equipment if you should happen to have a chemical exposure.

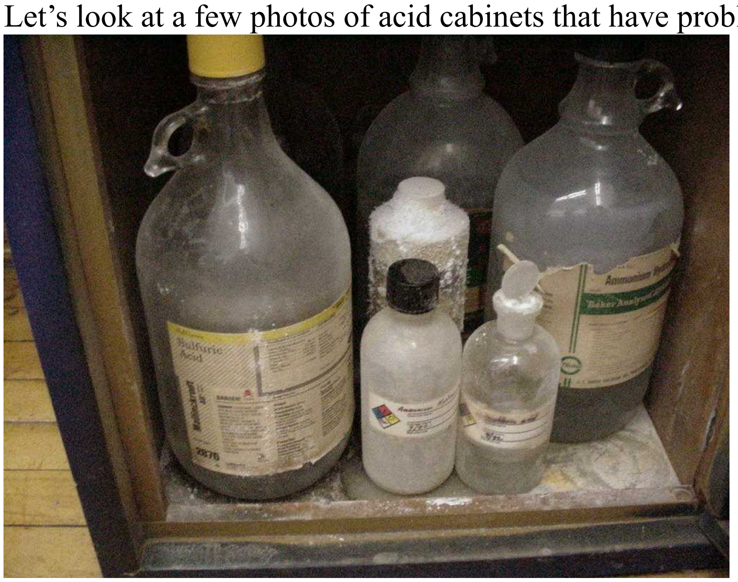
If the eye wash station is nearby and appears to be functioning properly, don your safety goggles and gloves and approach the cabinet. Examine the exterior of the cabinet before opening it.

If the lock is corroded, then expect to find leaking acids inside. If there's a white powder covering the door, it's likely that there is a leaking container of hydrochloric acid inside and a leaking container of ammonium hydroxide in the room. White powder, like that shown on the blue surface of the cabinet is almost always ammonium chloride.

Acid Storage Issues

Carefully open an acid cabinet, especially if it appears there may be leaking containers inside. Have something stable nearby that you can use to prop the doors open. Open one of the doors while holding your breath, prop it open, step back a pace or two, then breathe in and get an initial impression. This reduces the chance of you inhaling a slug of acid vapor when the cabinet is open.

Let's look at a few photos of acid cabinets that have problems.



In this photo, it's clear that the plastic bottle in the center is leaking. The rounded white crystals are diagnostic of ammonium chloride. The green-labeled bottle on the right is ammonium hydroxide, so the odds are good that its cap is degraded so the ammonia vapors can escape. It's equally likely that the container covered in crystals is hydrochloric acid.

Ammonium hydroxide is a concentrated base, like all hydroxides, and is highly incompatible with acids. This bottle should immediately be moved to a separate storage area for corrosive liquid bases and all other hydroxides should be removed from this cabinet.

Whenever you see a metal acid storage cabinet, it's likely you'll find significant corrosion inside. Let's look inside a couple cabinets like the one below.

This cabinet is only five years old and was painted with a chemical-resistant coating. What happened? Hydrochloric acid is particularly corrosive to steel and iron. Once the door was opened, paint flaked off the hinge. This provided a location for the hydrochloric acid from the leaking container in the photo to begin corroding it. The best acid cabinets are made of epoxy-coated marine-grade plywood with plastic hinges. Be sure the wooden cabinets don't have metal support brackets though, or all the positive aspects of the wood will be offset by rusting shelf support clips.

The most frequent problems you'll find in the acid storage cabinet will be connected with nitric acid.

As a powerful oxidizer, nitric acid reacts with organic materials and breaks them down over time. This is true of plastics, like the caps in the photos above, which tend to break down in seven to ten years. This makes is very likely that the nitric acid could spill when handled and creates a serious indoor air quality problem in stockrooms with poor ventilation.

Nitric acid reacts with so many compounds that it is generally recommended that it be stored separately. One problem with this recommendation is that there is seldom enough storage space in a school for another cabinet to hold just one chemical compound.

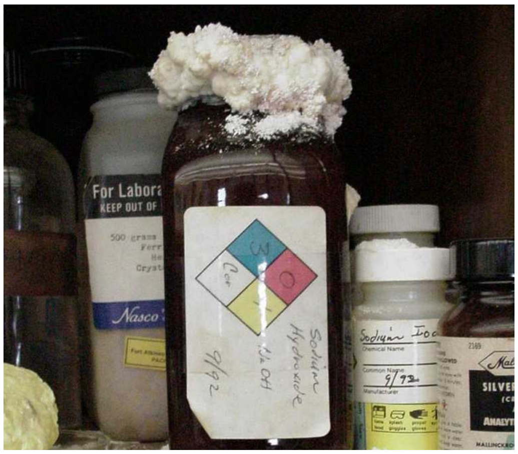
One school came up with an inexpensive solution to this problem, as shown in this photo.

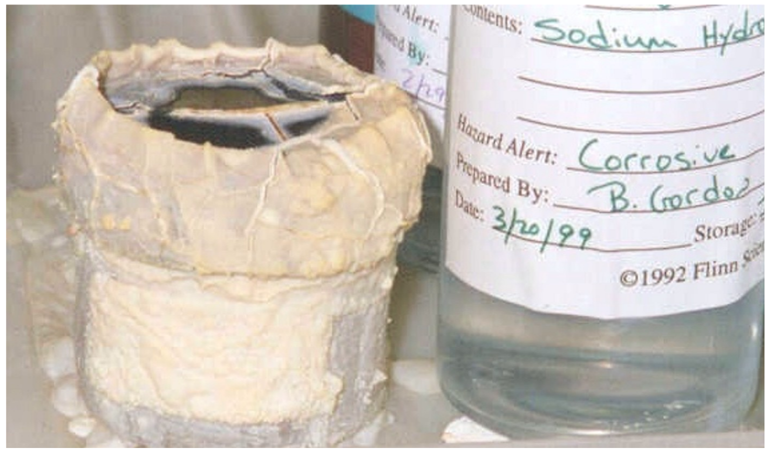
Another frequent problem with acid-cabinet storage practices is storing organic and inorganic acids in the same cabinet. Organic acids are incompatible with oxidizing acids like nitric acid and sulfuric acid. Dry organic acids often are shipped in containers with metal caps, like those shown in the photo below. The caps will degrade quickly in an acid storage cabinet. Therefore, most organic acids should be stored on a shelf in the lab. Combustible organic acids like glacial acetic acid should be stored in the flammable-storage cabinet.

Base Storage Issues

Liquid bases like ammonium hydroxide and sodium hydroxide solution should be stored in a separate location away from other chemicals. The hydroxides are much less corrosive to metals than the acids, so storage in a metal cabinet is acceptable. The cupboard under a chemical fume hood is often a good location if provided with a secondary containment tray and a padlock for the door to keep it secure.

Bases tend to be hard on their caps. As can be seen in the photos below, sodium hydroxide tends to degrade its cap then climb out of and coat its container in crystals.





These crystals are extremely corrosive, especially to the eyes. Chemical safety goggles must always be worn when working near any of the hydroxides. Always wash your hands immediately after taking off your gloves.

Science Dry Chemical Storage– Observations and Recommendations

Most chemicals in the chemistry stockroom will be stored on shelves or in cupboards. Let’s look at a typical stockroom with its dry chemicals on shelves of in cupboards

Looking at these two photos may be a bit intimidating for the fledgling inspector. Keep in mind, these are only two cupboards. A large high school could have three large chemical stockrooms just for the science programs. Here are a couple photos from large high school stockrooms.

So, where do you start with something this big to tackle?
It's best to begin with bottles that will get the teacher's attention. Your goal, after all, is freeing up some space in here by getting rid of the nasty chemicals. So start by looking for some high-hazard chemicals and by checking to see if incompatible chemicals are stored together.

A good place to start is by looking for bright orange caps on one-pint brown glass bottles. Here are a couple examples:

These orange caps are made of a chemically-resistant plastic and, like South American poison dart frogs, are brightly colored to warn you that their contents are hazardous. The photo on left shows two containers of corrosive organic halides (benzoyl chloride and benzyl chloride). They are equally corrosive and appear to be about the same age. Notice the differences in the condition of the caps. The orange caps work well, though they will degrade eventually as you can see in the photo on the right of elemental bromine.

Any orange-capped container on an open shelf is worth asking about. Many chemicals that come in these containers possess multiple hazards and are volatile liquids. Most are not being used in current secondary school curricula.

By using these as a starting point for discussion of the chemicals on the shelves. You can jump-start the process of identifying chemicals for disposal in the near future. This will speed the process of moving through the remaining chemicals, since the teacher can now work on carefully separating chemicals that are no-longer-needed from those that are useful, and marking those that are to go for ease of collection and packaging for shipment later.

Biology

- Do you know if your biology specimens are preserved in formaldehyde?
- Do you need these mercury thermometers? If you do, how many do you need and what do you use them for?

If they know that all of the biology specimens they have are preserved in a formaldehyde alternative, like Carosafe or FlinnSafe solution, then you wont need to worry about disposing of formaldehyde liquids. If they don't know, then there's a good chance that there may be formaldehyde present in some of those containers.

Lastly, if they say they need mercury thermometers, but they're only using them for calibration, then one or two mercury thermometers may be the most they will need and they can switch to less hazardous alcohol or electronic thermometers for most of their work.

The important part of all this initial site visit activity is to establish credibility and assess the severity of the hazards at the schools. This allows you to ensure that when you're talking to the schools, or the teachers, or writing up a brochure, that what you're saying makes sense in the context of their operations. The guidance that works for businesses in some of these practices does not necessarily work for schools.

Tips for Interviewing Teachers

The following outlines the general procedures and considerations in a typical interview.

Use pauses as a motivator. "Eternity of Silence" is a term used by attorneys and inspectors. Silence is uncomfortable. People are psychologically motivated to fill in the gaps. Often this will bring out a better response than direct questioning.

Avoid negative or accusatory statements.

Avoid appearing overbearing or using words of authority.

Start with non-threatening topics.

Conclude your interview by summarizing and verifying information you noted. Ask and provide opportunities for additional information and/or clarification. Express appreciation and re-establish the rapport.

Key words to consider when expressing your professionalism: Sympathy, understanding, patience and fairness.

Hazardous Waste Disposal Inspection Guidelines

Explain the inspection process and what you will be doing. Try to provide an idea of how long it will take and explain that there will be certain records that you will need to review. Indicate that photographs may be taken.

√ Wash your hands as soon as practical and always before eating or smoking.

√ Carry pocket change with you to pay for soft drinks, coffee or phone calls. Do not accept anything free from the facility.

√ During the facility tour, look for containers of products or waste, this may indicate a hazardous waste stream.

√ Inspect all buildings, sheds or trailers.

√ While you are inspecting the facility, check trash cans and dumpsters for containers of hazardous waste, non-empty hazardous material or paint containers, non-empty aerosol cans, contaminated rags or wipes, oil filters, etc.

√ Check floor drains and ask where they drain. Also, ask if the facility is on city sewer or a septic tank.

√ Make notes of the answers and document discrepancies with photos.

2Always listen to employees as they answer your questions. Let them finish their answer. Write down what you have been told. If necessary, repeat back what you understand to be their answer. Never be afraid to admit you don't understand their reply, or to ask them to repeat their answer. Look at the person giving you an answer.

Make a point of asking permission to open doors, lockers, shipping containers, etc. so that it is clear that the facility has granted permission to proceed. Otherwise, ask the facility employee to open doors, lockers, containers, etc. If you find containers that do not have any identifying information on them don't hesitate to ask the facility employee what is in the container. This process may have to be repeated numerous times during an inspection but is necessary.

Briefly describe photos taken and briefly describe areas of the facility that were inspected. It is a good idea to keep track of observations by area. For example, document all of your observations in the paint shop under a section with a header of "Paint Shop." Describe how they clean their paint guns, where they store their waste paint and the paint employee you spoke with. Then continue on to the paint booth with another header to separate the areas.

To keep track of observations at larger facilities, it is a good idea to separate areas and buildings. It is recommended that you put stars or asterisks in the margin of your notebook to note areas of violation or concern. This will enable you to quickly return to a section of your notes when you prepare for your facility exit interview or inspection report. Make note of any documentation that you may want to see at the end of the tour. Mark that page to facilitate finding it when you are going over your notes before the exit interview.

Include in your notes any information relative to the site. Remember that your field notes are public records so be objective and do not record opinions or negative remarks about employees of the facility.

Exit Interview

After you have finished with your inspection:

1. Take a few minutes to complete all of your checklists and notes.
2. Discuss the results of your site visit including compliance assistance and P2 suggestions. Include missing documentation that the facility may need to obtain and send to you. Go over these items with the facility representative and encourage the representative to take notes and make a list.
3. If needed, decide on a time frame for any corrective actions required. It is recommended that the inspector ask the facility to correct the areas of deficiencies and provide written documentation that they have been corrected. A letter and photographs are usually acceptable. Disposal documents may also be required, and an inspector may request proof of disposal.
4. Before leaving, review your observations and request any necessary clarifications. During your closing discussion, present and discuss findings.
5. During the exit interview, review possible P2 options.
6. Inspectors should immediately report any signs of dumping to the ground or threats to human health and safety to their supervisor.
7. Work with your Office beforehand to discuss and identify types of problems discovered during inspections that would trigger contacting them for follow-up.

Compliance Assistance

Use this time to suggest ways to properly manage wastes, including P2. Report any signs of potential hazardous waste contamination to the appropriate DEP district office immediately. The following are suggested activities that you can do to provide assistance to the business. Develop an SQG Program Information Folder that contains, at a minimum, the following information (sample handouts can be found on the SQG Program Web Site):

Use the opportunity while conducting on-site verification to assist the business in correcting problems identified during the verification process. Specifically, discuss (at the end of your on-site verification) a review of compliance related or P2 issues identified during the verification process. It is a good time to hand out the SQG folder and P2 contact information and to assist the business in addressing identified problems.

Inspectors and Pollution Prevention (P2)

Environmental protection agencies generally believe that there are limits to how much environmental improvement can be achieved under their media-specific pollution control programs, which emphasize management after pollutants have been generated. So the question to be answered is:

- How can a environmental protection agency provide improved protection to the general public at no additional cost?

Further improvements can be achieved by reducing or eliminating waste generation through the implementation of source reduction and environmentally sound recycling practices, commonly referred to as pollution prevention—P2.

What Is P2 and How Can It Help Inspectors?

Generally speaking, P2 is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous and non-hazardous materials, energy, water or other resources, as well as those that protect natural resources through conservation or more efficient use. P2 avoids cross-media transfers of wastes and/or pollutants and is multimedia in scope. It addresses all types of wastes and environmental releases to air, water, and land. P2 is a useful tool in encouraging and motivating the regulated community to understand and consider the full spectrum of its environmental costs and integrate these costs into its decision-making process. During inspections, SQG inspectors have the opportunity to encourage organizations, facilities and individuals to fully utilize source reduction techniques in order to reduce risk to public health, safety, welfare and the environment.

P2 also provides benefits to industries. These benefits can include reduced regulatory burden and operational costs. For example, the regulatory burden upon a company can be reduced by assisting the company in reducing its waste generation status from SQG to CESQG status. To an SQG inspector this could be a very useful tool and benefit. The main basis for companies to implement P2 is the economical benefits that can be achieved by reducing the amount of waste generated and material purchased through source reduction. The resulting economic benefit that comes from implementing P2 also provides a mechanism that encourages companies to strive for continual improvement.

For more information on pollution prevention call the Florida Pollution Prevention Program at:(850) 245-8707 or visit the web site at http://www.dep.state.fl.us/waste/categories/p2/.

Common P2 Opportunities

√	Water Reuse	Energy Efficiency	Material Reclamation
√	Process Modification	Material Substitution	Inventory Controls
√		Preventative Maintenance	

What to Do When You Get Back to the Office

After you get back from your inspection, organize and finalize your paperwork. Follow-up on any items that may need to be referred to another department within your county, or another agency. (For example, you may need to follow-up on abandoned wells found during your inspection, illicit connections to stormwater, discharge to septic system, or storm water.) It is recommended that you complete these tasks and enter your data within 24 to 48 hours of conducting the inspection.

START HERE

Every initial school inspection should include these steps:

- Staying safe on site
- Inspecting chemical storage issues.
  - High-hazard chemical assessment.
  - Identifying needed chemicals.
  - Segregating incompatibles
- Documenting your observations
- Providing your initial recommendations
- Nudging the school towards action.

Address Other Safety Issues

Teachers and school administrators are focused on the education and safety of their students, but are often unaware of unsafe situations and inadequate chemical safety procedures. During your visit to their school, you can provide some general recommendations and resources to help them improve their long-term environmental health and safety. Even though these issues may lie outside the scope of your program's responsibilities, by getting them to incorporate good chemical hygiene practices into their daily operations, you increase their awareness of chemical hazards.

To avoid liability for providing official guidance on topics outside your areas of responsibility, direct schools to other agency websites for details. Two excellent resources for teachers and administrators are the School Chemical Cleanout Manual by the Florida Department of Environmental Protection at http://www.dep.state.fl.us/waste/quick_topics/publications/shw/hazardous/SC/SCC_Manual.pdf and

Plastic bags are helpful for holding bottles that are missing caps or are otherwise in poor condition. They can also be used to demonstrate treatment-by-generator techniques for evaporating water from aqueous wastes, if that is allowed in your state. I wrap every bottle of iodine I see in a zipper-locking bag. Iodine is highly corrosive and will inevitably eat through the cap on its bottle and get into the air in the lab via sublimation of its crystals to iodine fumes. By enclosing the container in a plastic bag, the iodine vapors are contained, which improves indoor air quality. It also serves as an early warning of a degraded cap. When the bag starts turning purple, it's time for them to replace that container's cap.

Nitric acid is also a highly corrosive compound that degrades the plastic cap on its bottle in about seven years. By carrying replacement caps with you, problems with acid storage can be fixed when you see them rather than at some hoped-for date in the future. This is another case where you model the behavior you want the school to adopt. Have the teacher screw off the old cap and put on the new one. While they're doing it (and developing a more indelible body memory) you can tell them why it's important to clean and save a few acid bottle caps in case this should ever happen again.

Photo Documentation

Many school chemical cleanout programs have been proposed but never got off the ground. While most say their program fizzled because of a lack of funding, a more likely culprit is an inadequately compelling case to implement a cleanout program. Photographs of scary chemicals and unsafe chemical handling practices in schools are very powerful tools you should use to make that case.

By documenting observations of unsafe situations, you will create a demonstrated need for support of your program. Once stakeholders see the images of corroded cabinets, leaking containers of hazardous chemicals, and highly reactive chemicals stored near children, your project stands a better chance of moving forward.

You need to be careful about taking photos. Be sure to ask for permission and to promise, to the best of your ability, to keep the name of the school confidential when showing the images. With these assurances, most schools will be willing to allow you to document your observations digitally. More information about effective photo documentation is provided in the chapter titled, not surprisingly,

Far too few photographs are taken at schools by technical assistance inspectors. Photographs are the best form of documentation. Common problems are too few photographs, poor quality photos and lack of identification of the subjects in the photographs. Make references in your notes where photographs were taken. The thorough and detailed steps you take now will improve the accuracy of your guidance to schools and provide you with specific data for reporting your project's accomplishments.

Defuse Chemical "Bombs"

TAKEITFROMHERE

Separate Unneeded from Useful Chemicals

TAKEITFROMHERE

Segregate Incompatibles

TAKEITFROMHERE

Reduce Their Future Disposal Costs

TAKEITFROMHERE

Schools and Green Chemistry

TAKEITFROMHERE

Appendix A:
Highest Priority Chemicals For Removal From All Secondary Schools

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Acetaldehyde	4	O-3 Flam Cabinet	Suspect carcinogen. Flammable. Peroxide (explosive) former.		
Acetyl Chloride	4	O-4 Explosive	Corrosive. Water reactive. May form explosive mix with air.		
Acrolein	4	O-3 Flam Cabinet	P-listed. Flammable. Inhalation toxin. Severe irritant.		
Acrylamide	4	O-3 Toxic	Toxic by absorption, suspected carcinogen		
Acrylic Acid	4	O-1 Flam Cabinet	Corrosive. Poison by inhalation & skin absorption. Flammable		
Acrylonitrile	4	O-7 Flam Cabinet	Flammable. Poison by inhalation, skin absorption. Carcinogen.		
Adrenaline	4	O-2 Org salts	P-List. Toxic. Theft risk. Drug Precursor.		
Ammonium Bifluoride	4	I-2 Inorg salts	Corrosive. Poison. Can form hazardous hydrofluoric acid		
Ammonium Perchlorate	4	I-6 Oxidizer	Explosive; highly reactive		
Ammonium Polysulfide	4	I-5 Sulfide Cyanide	Reacts with acids to form poison gas		
Anhydrous Ammonia	4	Gas Cylinder	Poisonous gas. Corrosive. Choking vapors..		
Aniline	4	O-2 Org salts	Carcinogen, toxic, absorbs through skin		
Aniline Hydrochloride	4	O-2 Org Salts	Poison		
Arsenic - Metal	4	I-1 Metals	Poison. Carcinogen.		
Arsenic - Powder	4	I-1 Metals	Poison. Carcinogen.		
Arsenic Trioxide	4	I-4 Bases Carbonates	Deadly poison & carcinogen. P-listed		
Barium Chromate	4	I-8 Oxidizer	Toxic, oxidizer, carcinogen		
Benzene	4	O-3 Flam Cabinet	Flammable. Carcinogen. Toxic.		
Benzidine	4	O-2 Org Salts	Carcinogen. Poison via skin. Use is banned in many countries.		

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Benzonitrile	4	O-7 Flam Cabinet	Toxic. Reacts w/ acids to make cyanide gas. Combustible.		
Benzoyl Chloride	4	O-3 Flam Cabinet	Corrosive. Combustible. Poison. Water Reactive.		
Benzoyl Peroxide	4	O-6 Org Peroxide	Explosive. Flammable solid. Oxidizer. Mutagen.		
Beryllium	4	I-1 Metals	Poison, highly toxic, carcinogen. Beryllium dust is P-listed waste		
Beryllium Hydroxide	4	I-4 Bases Carbonates	Poison via inhalation & ingestion, carcinogen.		
Beryllium Oxide	4	I-4 Bases Carbonates	Poison via inhalation & ingestion, carcinogen.		
Beryllium Sulfate	4	I-2 Inorg salts	Poison via inhalation & ingestion, carcinogen.		
Bouin's Fixative	4	O-4 Explosive	Explosive if dry. Carcinogen. Allergen Picric acid & formaldehyde		
Bromine	4	I-9 Acid Cabinet	Corrosive. Oxidizer. Volatile. Poison vapors.		
Bromoform	4	O-4 Flam Cabinet	Toxic. Lachrymator. Bioaccumulates		
Butyraldehyde	4	O-3 Flam Cabinet	Flammable. Toxic via skin. Destroys mucous membranes.		
Cadmium - Powder	4	I-1 Metals	Carcinogen. Poison.		
Cadmium Chloride	4	I-2 Inorg salts	Toxic heavy metal, carcinogen		
Cadmium Nitrate	4	I-3 Oxidizer	Poison, carcinogen. Oxidizer.		
Cadmium Oxide	4	I-4 Bases Carbonates	Carcinogen. Poison.		
Cadmium Sulfate	4	I-2 Inorg salts	Carcinogen. Poison.		
Calcium Phosphide	4	I-5 Sulfide Cyanide	Emits poisonous, flammable phosphine gas when wet.		
Carbon Disulfide	4	I-5 Flam Cabinet	Flammable. Poison. P-Listed. Reacts with acids.		
Carbon Tetrachloride	4	O-4 Flam Cabinet	Toxic. Carcinogen. Bioaccumulates		
Catechol	4	O-8 Poison	Poison, powerful allergen, very corrosive.		

Chloral Hydrate	4	O-2 Org Salts	Hypnotic drug. Controlled substance		
Chloretone	4	O-4 Flam Cabinet	Poison. Narcotic. Controlled substance.		
Chlorine Gas	4	Gas Cylinder	Poison gas. Corrosive.		
Chloroethanol	4	O-4 Flam Cabinet	Poison by inhalation, ingestion or skin. Corrosive. Flammable.		
Chloroform	4	O-4 Flam Cabinet	Carcinogen, toxic, anesthetic. Can form deadly phosgene gas.		
Chlorophenol	4	O-4 Flam Cabinet	Poison by inhalation, ingestion & skin. Irritant. Bioaccumulates		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Container**	**Estimated Amount**
Chloroprene	4	O-4 Flam Cabinet	Peroxide former. Flammable. Neurotoxin via inhalation-ingestion.		
Chromic Acid	4	I-8 Acid Cabinet	Strong oxidizer. Poison. Carcinogen. Corrosive.		
Cobalt - Powder	4	I-1 Metals	Flammable solid. Suspect carcinogen. Toxic.		
Colchicine	4	O-2 Org Salts	Deadly poison. Affects cell division. Severe eye irritant.		
Copper Cyanide	4	I-7 Poison	Severe poison. P-List. Makes cyanide gas when slightly acidified		
Corrosive Sublimate	4	I-2 Inorg salts	Poison by ingestion and skin absorption (when wet). Corrosive.		
Cresol	4	O-8 Flam Cabinet	Corrosive to skin & eyes. Poison via ingestion, skin absorption.		
Cumene	4	O-4 Flam Cabinet	Flammable. Neurotoxin. Peroxide former. Explosion risk.		
Cyanogen Bromide	4	O-4 Toxic	Poison. Corrosive. Reacts with acids to form poison gas.		
Cyclohexanone	4	O-4 Flam Cabinet	Flammable. Extreme Poison via skin contact.		
Cyclohexene	4	O-3 Flam Cabinet	Flammable, peroxide former, explosion risk.		
Dichloroethane	4	O-4 Flam Cabinet	Flammable. Toxic via inhalation, ingestion, skin. Bioaccumulates.		
Diethylamine	4	O-2 Flam Cabinet	Extremely flammable. Corrosive. Toxic via skin and ingestion.		
Dimethyl Aniline	4	O-2 Flam Cabinet	Combustible. Neurotoxin by ingestion, inhalation, skin.		

Dinitrophenol	4	O-4 Explosive	Poison by inhalation, skin absorption. Explosion risk. Mutagen.		
Dinitrophenyl Hydrazine	4	O-4 Explosive	Keep wet. Explosive if dry. Toxic via skin, inhalation, ingestion.		
Dioxane	4	O-4 Flam Cabinet	Flammable. Peroxide former. Explosion risk.		
Estrone	4	O-2 Org Salts	Steroid. Carcinogen. Theft Risk.		
Ethyl Chloride	4	O-4 Flam Cabinet	Extremely flammable gas. Produces corrosive, toxic fumes if wet.		
Ethyl Ether	4	O-4 Flam Cabinet	Flammable. Peroxide former. Explosion risk.		
Ethyl Nitrate	4	O-4 Explosive	Explosive.		
Ethylene Oxide	4	Gas Cylinder	Flammable gas. Toxic. Carcinogen. Mutagen. Severe irritant.		
Ethylenediamine	4	O-2 Flam Cabinet	Flammable. Toxic by inhalation. Corrosive base.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Container**	**Estimated Amount**
Ethyleneimine	4	O-2 Flam Cabinet	Flammable. P –listed extremely toxic.		
Formaldehyde, 37%	4	O-3 Toxic	Toxic. Carcinogen. Severe sensitizer and allergen		
Formamide	4	O-4 Toxic	Teratogen. Deep tissue corrosive. Suspect carcinogen		
Gilson's Fixative	4	I-9 Acid Cabinet	Mercuric Chloride + Nitric Acid + Acetic Acid + Ethanol		
Gunpowder	4	I-10	Explosive, theft risk		
Hayem Diluting Fluid	4	I-2 Inorg salts	Contains mercuric chloride. Severe poison.		
Hydrazine	4	O-2 Flam Cabinet	Explosive. Poison by all routes Flammable. Carcinogen. Corrosive		
Hydrazine Sulfate	4	O-2 Org Salts	Poison. Absorbs through skin. Carcinogen.		
Hydrofluoric Acid	4	I-9 Acid Cabinet	Corrosive. Poison via skin, with delayed symptoms.		
Hydrogen Sulfide	4	Gas Cylinder	Poison gas. Inhalation hazard. Stench.		
Isopropyl Ether	4	O-4 Flam Cabinet	Flammable, Highest-risk peroxide former. Explosive.		

Lead Chromate	4	I-8 Oxidizer	Highly poisonous. Possible carcinogen.		
Lithium Aluminum Hydride	4	I-5 Sulfide Cyanide	Flammable solid. Water reactive.		
Mercaptoethanol	4	O-2 Flam Cabinet	Flammable. Corrosive. Intense stench		
Mercurochrome	4	O-2 Org Salts	Toxic. Mercury compound		
Mercury - Liquid	4	I-1 Metals	Poison. Volatile. Corrosive.		
Mercury Chloride	4	I-2 Inorg salts	Poison		
Mercury Chloride	4	I-2 Inorg salts	Poison		
Mercury Iodide	4	I-2 Inorg salts	Poison.		
Mercury Nitrate	4	I-3 Oxidizer	Poison. Oxidizer		
Mercury Nitrate	4	I-3 Oxidizer	Poison. Oxidizer		
Mercury Oxide	4	I-4 Bases Carbonates	Poison		
Mercury Sulfate	4	I-2 Inorg salts	Poison.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Container**	**Estimated Amount**
Mercury Sulfate	4	I-2 Inorg salts	Poison.		
Mercury Sulfide	4	I-5 Sulfide Cyanide	Poison. Reacts with acids to form poison gas		
Methyl Iodide	4	O-4 Toxic	May be a narcotic; Carcinogen. Choking vapors.		
Methyl Tert-Butyl Ether	4	O-4 Flam Cabinet	Extremely flammable. Peroxide former		
Methylamine	4	O-2 Flam Cabinet	Flammable. Corrosive. Intense stench. Inhalation toxin.		
Millon's Reagent	4	I-9 Acid Cabinet	Mercury nitrate + nitric acid. Deadly poison. Highly corrosive.		
Naphthylamine	4	O-2 Flam Cabinet	Combustible, Toxic. Carcinogen. Absorbs through skin or lungs		
Nessler's Reagent	4	I-4 Base Cabinet	Mercury iodide + sodium hydroxide. Deadly poison. Corrosive.		

Nicotine	4	O-2 Org Salts	P-Listed Extremely Hazardous. Poison.		
Nitrilotriacetic Acid	4	O-1 Organic Acids	Confirmed carcinogen. Toxic via ingestion.		
Nitrobenzene	4	O-3 Flam Cabinet	Toxic. Combustible. Oxidizer. Absorbs through skin.		
Nitrogen Triiodide	4	O-4 Explosive	Explosive. Highly unstable!		
Nitroglycerin	4	O-4 Explosive	Explosive.		
Osmium Tetraoxide	4	I-4 Bases Carbonates	P-Listed Extremely Hazardous. Poison.		
Paraformaldehyde	4	O-3 Toxic	Releases poisonous formaldehyde gas when heated		
Paraldehyde	4	O-3 Flam Cabinet	Flammable. Controlled substance. Poison. Theft risk.		
Paris Green	4	O-8 Poison	Poison. Arsenic compound. Carcinogen.		
Pentachlorophenol	4	O-8 Flam Cabinet	Extremely toxic. Bioaccumulative pollutant.		
Perchloric Acid	4	I-9 Acid Cabinet	Powerful oxidizer. Highly corrosive. Reactive w/ metals.		
Phenylarsine Oxide	4	I-4 Bases Carbonates	Arsenic compound. Poison. Corrosive to skin and eyes.		
Phenylthiocarbamide	4	O-2 Org Salts	Deadly poison.		
Phosphorus - White	4	I-10 Pyro (Bagged)	Spontaneously ignites in air. Poison.		
Phosphorus - Yellow	4	I-10 Pyro (Bagged)	Spontaneously ignites in air. Poison.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Container**	**Estimated Amount**
Phosphorus Pentasulfide	4	I-5 Sulfide Cyanide	Water Reactive. Toxic. Incompatible with air & moisture		
Phosphorus Pentoxide	4	I-4 Bases Carbonates	Oxidizer. Corrosive. Toxic.		
Physostigmine	4	O-2 Org Salts	P-listed. Severe poison. ingestion may lead to death.		
Picric Acid	4	O-4 Explosive	Explosive if dry. Explosive crystals form in contact with metals.		
Potassium	4	I-1 Metals	Water reactive, may form explosive peroxide (orange crystals)		

Potassium Cyanide	4	I-7 Poison	Severe poison. P-List. Makes cyanide gas when slightly acidified		
Potassium Peroxide	4	I-6 Oxidizer (bagged)	Water reactive. Possible explosion. Strong oxidizer. Corrosive.		
Pyridine	4	O-2 Flam Cabinet	Flammable. Toxic via ingestion, inhalation, skin. Teratogen.		
Selenium	4	I-1 Metals	Poison via inhalation, ingestion, skin.		
Silver Cyanide	4	I-7 Poison	Severe poison. P-List. Makes cyanide gas when slightly acidified		
Sodium Arsenate	4	I-7 Poison	Deadly poison. Carcinogen.		
Sodium Arsenite	4	I-7 Poison	Deadly poison. Carcinogen.		
Sodium Azide	4	I-7 Poison	P-List Extremely hazardous. Poison. Explosive reaction w/ metals.		
Sodium Borohydride	4	I-5 Sulfide Cyanide	Corrosive, toxic, Highly flammable solid. Water reactive		
Sodium Cyanide	4	I-7 Poison	Severe poison. P-List. Makes cyanide gas when slightly acidified		
Sodium Hydrosulfite	4	I-5 Sulfide Cyanide	Water reactive. Toxic by ingestion & inhalation. Allergen.		
Sodium Nitroferricyanide	4	I-7 Poison	Poison via inhalation, ingestion. React w/ acids =cyanide gas.		
Sodium Perchlorate	4	I-6 Oxidizer	Oxidizer. Heat & shock sensitive. Potential explosive. Irritant.		
Strychnine	4	O-2 Org Salts	Poison, may be fatal if swallowed or inhaled.		
Sulfur Dioxide	4	Gas Cylinder	Poison gas at high levels. Corrosive irritant to eyes & skin.		
Testosterone	4	O-2 Org Salts	Controlled substance. Steroid. Theft risk.		
Testosterone Proprionate	4	O-2 Org Salts	Controlled substance. Steroid. Theft risk.		
Tetrahydrofuran	4	O-4 Flam Cabinet	Extremely flammable. Peroxide former. Explosion risk.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Container**	**Estimated Amount**
Thallium	4	I-1 Metals	Poison by inhalation, ingestion & skin. Teratogen.		
Thimerosal	4	O-2 Org Salts	Poison, possible reproductive toxin. Organic mercury compound.		

Thioacetamide	4	O-2 Flam Cabinet	Toxic. Carcinogen. Combustible.		
Thionyl Chloride	4	I-2 Acid Cabinet	Corrosive. Poison via inhalation. Forms acid gas if wetted.		
Thiourea	4	O-2 Org Salts	Carcinogen. Harmful if swallowed or inhaled; allergen.		
Thorium Nitrate	4	I-3 Radioactiv	Radioactive. Toxic, possible carcinogen. Oxidizer		
Titanium Tetrachloride	4	I-2 Inorg salts	Toxic inhalation hazard. Highly corrosive. Water reactive		
Trichloroethylene	4	O-4 Flam Cabinet	Toxic via skin, inhalation. Bioaccumulates. Carcinogen.		
Triethyl Phosphate	4	Pesticide Locker	Pesticide. Cholinesterase inhibitor.		
Triethylamine	4	O-2 Flam Cabinet	Flammable liquid. Corrosive. Toxic via skin.		
Trinitrobenzene	4	O-4 Explosive	Explosive.		
Trinitrotoluene	4	O-4 Explosive	Explosive.		
Uranium	4	I-1 Radioactiv	Radioactive. Poison by inhalation and ingestion.		
Uranyl Nitrate	4	I-3 Radioactiv	Radioactive. Toxic by inhalation, ingestion. Carcinogen. Oxidizer.		
Vanadium Pentoxide	4	I-4 Bases Carbonates	Poison by inhalation and ingestion. May be fatal.		

Appendix B – Chemicals of Concern

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Acetic Acid - Concentrated	3	O-1 Flam Cabinet	Corrosive. Combustible.		
Acetic Anhydride	3	O-1 Flam Cabinet	Corrosive. Flammable. Poison. Reacts violently with water.		
Acetonitrile	3	O-7 Flam Cabinet	Flammable. Toxic by skin absorption, inhalation & ingestion.		
Adipoyl Chloride	3	O-1 Organic Acids	Corrosive. Absorbs through skin, Choking vapors		
Adipoyl Chloride - Hexane Solution	3	O-3 Flam Cabinet	Flammable. Corrosive.		
Aitch-tu-ess Cartridges	3	I-5 Sulfide Cyanide	Sulfur, sand, asphalt & dye. Makes poison hydrogen sulfide gas		
Alkaline Iodide Azide	3	I-4 Base Cabinet	Corrosive. Poison.		
Aluminum Powder	3	I-1 Metals	Highly flammable as dust, especially when damp. Irritant.		
Aluminum Trichloride	3	I-2 Inorg salts	Corrosive. Water reactive.		
Ammonium Chromate	3	I-8 Oxidizer	Oxidizer, toxic, carcinogen		
Ammonium Dichromate	3	I-8 Oxidizer	Powerful oxidizer, toxic, carcinogen		
Ammonium Fluoride	3	I-2 Inorg salts	Caustic. Toxic.		
Ammonium Hydroxide - Concentrated	3	I-4 Base Cabinet	Corrosive. Poison. Choking vapors.		
Ammonium Nitrate	3	I-3 Oxidizer (Bagged)	Oxidizer. Explosive reactions with organic compounds and heat.		
Ammonium Nitrite	3	I-3 Oxidizer	Powerful oxidizer. Explosion hazard when heated or shocked		
Ammonium Oxalate	3	I-2 Inorg salts	Toxic via ingestion & inhalation. Corrosive.		
Ammonium Oxalate	3	I-2 Inorg salts	Toxic via ingestion & inhalation. Corrosive.		
Ammonium Persulfate	3	I-6 Oxidizer	Oxidizer. Toxic. Strong irritant.		
Ammonium Sulfide	3	I-5 Sulfide Cyanide	Reacts with acids to form poison gas		
Antimony Trichloride	3	O-2 Org Salts	Corrosive, toxic, emits hydrogen chloride gas if moistened		
Ascarite	3	I-4 Bases Carbonates	Sodium hydroxide on silica. Poison, corrosive. May be asbestos.		

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Barium Acetate	3	I-2 Inorg salts	Toxic by ingestion.		
Barium Carbonate	3	I-4 Bases Carbonates	Poison via ingestion, inhalation.		
Barium Chloride	3	I-2 Inorg salts	Poison via ingestion, inhalation.		
Barium Hydroxide	3	I-4 Bases Carbonates	Toxic by ingestion.		
Barium Nitrate	3	I-3 Oxidizer	Toxic. Oxidizer		
Barium Peroxide	3	I-6 Oxidizer	Toxic by ingestion and inhalation. Oxidizer. Corrosive.		
Barium Sulfate	3	I-2 Inorg salts	Toxic by ingestion.		
Benzaldehyde	3	O-3 Flam Cabinet	Combustible. Convulsive with narcotic effects if inhaled.		
Benzophenone	3	O-4 Toxic	Toxic via inhalation.		
Benzyl Alcohol	3	O-2 Flam Cabinet	Combustible. Toxic via skin absorption, severe irritant.		
Bismuth - Powder	3	I-1 Metals	Flammable solid. Irritant.		
Bismuth Trichloride	3	I-2 Inorg salts	Corrosive to skin. Toxic via inhalation.		
Bromine Water	3	I-9 Acid Cabinet	Corrosive. Toxic & irritating fumes.		
Bromobenzene	3	O-4 Flam Cabinet	Flammable liquid. Toxic via inhalation & skin. Bioaccumulates		
Bromobutane	3	O-4 Flam Cabinet	Flammable liquid. Toxic via inhalation & skin. Bioaccumulates		
Butoxyethanol	3	O-2 Flam Cabinet	Toxic by skin absorption. Combustible.		
Butyric Acid	3	O-1 Flam Cabinet	Corrosive; intense stench. Combustible. Theft risk.		
Cadmium - Solid	3	I-1 Metals	Carcinogen. Poison.		
Calcium Carbide	3	I-5 Sulfide Cyanide	Water reactive, producing acetylene. Store away from alcohols.		
Calcium Hypochlorite	3	I-6 Oxidizer	Toxic. Oxidizer. Corrosive. Reacts with ammonium hydroxide		
Calcium Sulfide	3	I-5 Sulfide Cyanide	Reacts with acids to form poison gas		

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Camphor	3	O-4 Toxic	Combustible. Toxic.		
Canadian Balsam in Xylene	3	O-3 Flam Cabinet	Balsam dissolved in xylene. Flammable		
Carbol Fuchsin	3	O-8 Flam Cabinet	Phenol + Ethanol. Toxic & flammable.		
Carnoy's Fixative	3	O-4 Flam Cabinet	Flammable. Corrosive. Carcinogen.		
Chlorine Water	3	I-9 Acid Cabinet	Corrosive. Toxic & irritating fumes.		
Chlorobenzene	3	O-4 Flam Cabinet	Flammable, toxic by inhalation & skin. Suspect carcinogen.		
Chlorosulfonic Acid	3	I-9 Acid Cabinet	Toxic inhalation hazard. Highly corrosive. Bioaccumulates.		
Chromium - Powder	3	I-1 Metals	Powdered form may be human carcinogen		
Chromium Trioxide	3	I-4 Bases Carbonates	Oxidizer. Poison. Carcinogen.		
Cobalt - Metal	3	I-1 Metals	Flammable solid. Toxic. Potential carcinogen.		
Cobalt Nitrate	3	I-3 Oxidizer	Oxidizer. Suspect carcinogen. Toxic.		
Collodion	3	O-4 Flam Cabinet	Extremely flammable. Explosive when dry. Nitrocellulose + Ether.		
Copper Nitrate	3	I-3 Oxidizer	Oxidizer. Toxic.		
Copper Sulfide	3	I-5 Sulfide Cyanide	Reacts with acids to form poison gas		
Creosote	3	O-8 Flam Cabinet	Carcinogen. Combustible.		
Cyclohexanol	3	O-2 Flam Cabinet	Combustible. Slight risk to form peroxides if concentrated. Toxic.		
Dibutyl Phthalate	3	O-4 Toxic	Teratogen. Severe skin and eye irritant.		
Dichlorobenzene	3	O-4 Toxic	Toxic by ingestion, inhalation & skin. Suspect carcinogen.		
Dichlorophenoxy Acetic Acid	3	Pesticide Locker	Toxic via ingestion, skin contact.		
Dimethyl Sulfoxide	3	O-7 Flam Cabinet	Combustible. Toxic via skin absorption.		
Ethidium Bromide	3	O-2 Org Salts	Potent Mutagen		

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Ethyl Carbamate	3	O-2 Flam Cabinet	Toxic. Combustible. Possible carcinogen.		
Ethyl Iodide	3	O-2 Flam Cabinet	Combustible. Contact w/ water produces corrosive, toxic vapors.		
FAA Solution	3	O-3 Flam Cabinet	Formaldehyde + acetic acid + ethanol. Flammable. Toxic		
Formalin Buffered	3	O-3 Toxic	Toxic. Carcinogen. Severe sensitizer and allergen.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Containers**	**Estimated Amount**
Furfural	3	O-3 Flam Cabinet	Combustible. Toxic via inhalation & ingestion. Corrodes eyes.		
Glutaraldehyde	3	O-3 Toxic	Toxic via inhalation & skin absorption. Strong irritant.		
Hexamethylenediamine	3	O-2 Flam Cabinet	Corrosive. Absorbs through skin, Choking, corrosive vapors.		
Hexane	3	O-3 Flam Cabinet	Flammable. Neurotoxin.		
Hexanediamine in Sodium Hydroxide	3	O-2 Flam Cabinet	Corrosive. Absorbs through skin, Choking, corrosive vapors.		
Hydriodic Acid	3	I-9 Acid Cabinet	Highly corrosive. Toxic by inhalation		
Hydrobromic Acid	3	I-9 Acid Cabinet	Highly corrosive. Toxic fumes		
Hydrogen - Gas	3	Gas Cylinder	Flammable		
Hydrogen Peroxide (>20%)	3	I-6 Acid Cabinet	Oxidizer. Corrosive to skin. Do not use at over 30% strength.		
Hydroquinone	3	O-2 Org Salts	Toxic by ingestion & inhalation. Corrosive to eyes & skin.		
Hydroxylamine Hydrochloride	3	O-2 Org Salts	Corrosive, especially to mucous membranes.		
Iron Sulfide	3	I-5 Sulfide Cyanide	Reacts with acids to form poison gas		
Isopentyl Alcohol	3	O-2 Flam Cabinet	Flammable. Slight risk to form peroxides when concentrated		
Lauroyl Peroxide	3	O-6 Org Peroxide	Severe irritant. Powerful oxidizer.		
Lead - Powder	3	I-1 Metals	Poison.		
Lead Acetate	3	I-2 Inorg salts	Poison.		

Lead Bromide	3	I-2 Inorg salts	Poison.		
Lead Carbonate	3	I-4 Bases Carbonates			
Lead Chloride	3	I-2 Inorg salts	Poison		
Lead Iodide	3	I-2 Inorg salts	Poison.		
Lead Iodide	3	I-2 Inorg salts	Poison.		
Lead Monoxide	3	I-4 Bases Carbonates	Poison		
Lead Nitrate	3	I-3 Oxidizer	Poison. Strong oxidizer		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Containers**	**Estimated Amount**
Lead Oxide	3	I-4 Bases Carbonates	Poison.		
Lead Oxide	3	I-4 Bases Carbonates	Poison.		
Lead Oxide	3	I-4 Bases Carbonates	Poison.		
Lead Sulfate	3	I-2 Inorg salts	Poison.		
Lead Sulfide	3	I-5 Sulfide Cyanide	Poison. Reacts with acids to form poison gas		
Lithium Fluoride	3	I-2 Inorg salts	Poison by ingestion. Emits toxic fumes when heated.		
Magnesium Perchlorate	3	I-6 Oxidizer	Powerful oxidizer. Explosive reaction with alcohols.		
Mercury Thermometers	3	I-1 Metals	Poison. Volatile. Corrosive.		
Methyl Ethyl Ketone	3	O-4 Flam Cabinet	Highly flammable. Dangerous fire risk. Toxic		
Methyl Isobutyl Ketone	3	O-4 Flam Cabinet	Flammable. Peroxidizable. Toxic.		
Methyl Isopropyl Ketone	3	O-4 Flam Cabinet	Flammable. Toxic by ingestion. Skin irritant.		
Methyl Methacrylate	3	O-3 Flam Cabinet	Flammable. Toxic via inhalation. Can polymerize violently.		
Methylene Chloride	3	O-4 Flam Cabinet	Toxic. Suspected carcinogen. Bioaccumulates.		

Molisch Reagent	3	O-2 Flam Cabinet	Napthol + ethanol. Toxic & flammable.		
Naphthalene Acetic Acid	3	O-1 Flam Cabinet	Corrosive to skin and eyes. Slightly toxic via ingestion.		
Nickel - Powder	3	I-1 Metals	Carcinogen. Toxic.		
Nitric Acid - Concentrated	3	I-9 Acid Cabinet	Poison. Highly corrosive. Powerful oxidizer.		
Nitrophenol	3	O-8 Poison	Toxic via ingestion, inhalation.		
Nitrophenol	3	O-8 Poison	Poison via inhalation, ingestion, skin contact.		
Octyl Phenol	3	O-1 Organic Acids	Corrosive. Toxic via skin absorption		
Oxalic Acid	3	O-8 Poison	Toxic. Corrosive to soft tissues		
Pentane	3	O-3 Flam Cabinet	Flammable. Narcotic at high concentrations.		
Perchloroethylene	3	O-4 Flam Cabinet	Toxic. Suspected carcinogen. Bioaccumulates.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Containers**	**Estimated Amount**
Phenol	3	O-8 Poison	Poison. Corrosive. Readily absorbed through skin.		
Phenylhydrazine Hydrochloride	3	O-2 Org Salts	Corrosive. Poison via inhalation, ingestion, skin.		
Phosphomolybdic Acid	3	I-9 Acid Cabinet	Corrosive. Irritant via inhalation. Toxic via ingestion.		
Phosphoric Acid - Concentrated	3	I-9 Acid Cabinet	Corrosive, causes severe burns. Toxic.		
Phosphorus - Red	3	I-10	Poison. Flammable solid.		
Phthalic Anhydride	3	O-1 Organic Acids	Corrosive. Toxic.		
Potassium	3	I-1 Metals	Water reactive, may form explosive peroxide (orange crystals)		
Potassium Chlorate	3	I-6 Oxidizer	Powerful oxidizer. Theft risk. May explode if heated.		
Potassium Chromate	3	I-8 Oxidizer	Powerful oxidizer. Toxic. Carcinogen		
Potassium Dichromate	3	I-8 Oxidizer	Powerful oxidizer. Toxic. Carcinogen		
Potassium Hydroxide - Concentrated	3	I-4 Base Cabinet	Corrosive. Poison. Blisters skin on contact.		

Potassium Hydroxide - Solid	3	I-4 Bases Carbonates	Corrosive. Blisters skin on contact.		
Potassium Perchlorate	3	I-6 Oxidizer	Powerful oxidizer. Reactivity hazard. Severe irritant.		
Potassium Sulfide	3	I-5 Sulfide Cyanide	Flammable. Corrosive. Toxic. Reacts with acids = poison gas		
Propane	3	Gas Cylinder	Flammable gas.		
Propionic Acid	3	O-1 Flam Cabinet	Corrosive. Flammable.		
Pyrogallol	3	O-8 Poison	Toxic. Readily absorbed through skin. Moderately flammable		
Resorcinol	3	O-8 Poison	Toxic. Easily absorbed through skin. May be fatal if swallowed.		
Sebacoyl Chloride	3	O-1 Organic Acids	Corrosive, causes severe burns. Choking vapors. Water reactive.		
Sebacoyl Chloride - Hexane Solution	3	O-3 Flam Cabinet	Flammable. Corrosive.		
sec-Butanol	3	O-2 Flam Cabinet	Flammable. Slight risk to form peroxides when concentrated		
Silver Nitrate	3	I-3 Oxidizer	Oxidizer. Poison. Corrosive.		
Sodium	3	I-1 Metals	Water reactive. Corrosive.		

Name of Chemical on Labels	Risk	Storage Category	Hazards	Number of Containers	Estimated Amount
Sodium	3	I-1 Metals	Water reactive. Corrosive.		
Sodium Bifluoride	3	I-2 Inorg salts	Poison, may be fatal by ingestion or inhalation. Severe irritant.		
Sodium Chlorate	3	I-6 Oxidizer	Powerful oxidizer, toxic. Theft risk. May explode if heated.		
Sodium Chromate	3	I-8 Oxidizer	Powerful oxidizer. Corrosive. Toxic. Carcinogen		
Sodium Dichromate	3	I-8 Oxidizer	Powerful oxidizer. Severely corrosive. Toxic. Carcinogen.		
Sodium Ferricyanide	3	I-7 Poison	Can release cyanide gas if heated to decomposition or acidified.		
Sodium Ferrocyanide	3	I-7 Poison	Can release cyanide gas if heated to decomposition or acidified.		
Sodium Fluoride	3	I-2 Inorg salts	Poison, may be fatal by ingestion or inhalation. Severe irritant.		
Sodium Hydroxide - Concentrated	3	I-4 Base Cabinet	Poison. Corrosive. Causes severe burns.		

Sodium Hydroxide - Solid	3	I-4 Bases Carbonates	Corrosive. Causes severe burns and permanent eye damage.		
Sodium Oxalate	3	I-2 Inorg salts	Poison via inhalation. Corrosive to skin.		
Sodium Peroxide	3	I-6 Oxidizer	Corrosive. Oxidizer.		
Sodium Sulfide	3	I-5 Sulfide Cyanide	Toxic. Corrosive. Reacts with acids = poison gas		
Strontium	3	I-1 Metals	Flammable. Store under naphtha. Water reactive.		
Styrene	3	O-3 Flam Cabinet	Flammable. Suspect carcinogen.		
Sulfurated Potash	3	I-5 Sulfide Cyanide	Flammable solid. Severe irritant. Contains potassium trisulfide		
Sulfuric Acid - Concentrated	3	I-9 Acid Cabinet	Corrosive. Oxidizer. Poison.		
Thermit	3	I-4 Bases Carbonates	Flammable solid.		
Thermit Igniting Sticks	3	I-1 Metals	Flammable solid.		
Titanium Trichloride	3	I-2 Inorg salts	Corrosive. Produces corrosive, toxic fumes if wetted or heated.		
Toluene	3	O-3 Flam Cabinet	Highly flammable. Toxic, inhalation and skin absorption hazard.		
Trichloroacetic Acid	3	O-1 Flam Cabinet	Corrosive. Toxic. Bioaccumulates. Degrades to form chloroform.		
Trichloroethane	3	O-4 Flam Cabinet	Toxic via skin, inhalation. Bioaccumulates. Carcinogen.		
Name of Chemical on Labels	**Risk**	**Storage Category**	**Hazards**	**Number of Containers**	**Estimated Amount**
Uranyl Acetate	3	I-2 Radioactive	Radioactive. Poison by inhalation, ingestion. Suspect carcinogen.		
Wood's Metal	3	I-1 Metals	Poison by inhalation, ingestion. Carcinogen. Has cadmium & lead		
Xylene	3	O-3 Flam Cabinet	Flammable and toxic liquid and vapors, skin absorption hazard.		
Zinc Sulfide	3	I-5 Sulfide Cyanide	Reacts w/ water & acids to form poisonous hydrogen sulfide gas.		

Appendix C – Inspector's Checklist

School Name:_________________________ Date of Inspection:________________

Site Contact Name:___________________________ Position:______________________

Site Contact Phone Number: ________________ Email address____________________

<u>School Info</u>: Public School? Private? School on Sewer? Septic?

Grades: Elementary Middle / Jr. High High School Other? Give grades__________

Generator status: CESQG SQG/MQG LQG They don't know

Lead Inspector:___________________________ ***List others on visit in notes below***

<u>Site Prep</u>: Inspector's Toolkit? Camera & Photo Log? High Risk List?

<u>NOTES / PHOTO LOG:</u> ____

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NOTES:

<u>Chemistry</u> Stock Room # ________ Classroom # __________

Teacher's Name:______________________

1) **Health and Safety**
   - Eye wash accessible, adequate, tested recently? Y N
   - Safety shower present, accessible, tested recently? Y N
   - Fume hood functional, tested, uncluttered? Y N
   - Exhaust ventilation functioning in stockroom? Y N
   - Tripping, slipping, overhead hazards? Y N
2) **Review chemical storage practices**
   - Inventory and assess high-risk chemical assessment done? Y N
   - Any potentially unstable highly reactive compounds? Y N
     - ⇒ If so, did you list compound, amount, etc. in notes Y N
     - ⇒ Did you list date and time explosives contractor notified? Y N
   - Incompatibles segregated initially? Y N Fixed during visit? Y N
   - Containers sealed and sound? Y N
   - Secondary containment for chemicals near drains or in fume hood? Y N
   - Mark the unneeded and degraded hazardous chemicals for disposal? Y N
   - Notes on condition of storage cabinets (spill residues, corrosion)? Y N
3) **Review routine chemical disposal practices**
   - Take notes on types and amounts of hazardous waste generated? Y N
   - How is hazardous waste being disposed?
     - ⇒ Discharge down drain? Y N Acceptable? Y N
     - ⇒ Evaporation of solvents to air? Y N Acceptable? Y N
     - ⇒ Disposed as solid waste disposal? Y N Acceptable? Y N
     - ⇒ Disposal as hazardous waste? Y N Vendor name:______________________
     - ⇒ Wastes being treated on-site? Y N
       - ⇒ Acid/base neutralization? Y N
       - ⇒ Evaporate aqueous solutions? Y N
4) **Spill Response**
   - Procedures in place? Y N
   - Training provided? Y N
   - Spill supplies on hand? Y N
5) **Documentation**
   - MSDSs for chemicals? Y N
   - Haz waste manifests? Y N
   - Chemical hygiene plan? Y N

Biology/Physics/Earth Science

Stock Room #s ____________, ______________, ______________

Teacher's Name(s):____

1) **Health and Safety**
   - Eye wash accessible, adequate, tested recently? Y N
   - Safety shower present, accessible, tested recently? Y N
   - Fume hood functional, tested, uncluttered? Y N
   - Exhaust ventilation functioning in stockroom? Y N
   - Tripping, slipping, overhead hazards? Y N
2) **Review chemical storage practices**
   - Inventory and assess high-risk chemical assessment done? Y N
   - Any highly reactive compounds? (Ether common in Biology) Y N
     - ⇒ If so, did you list compound, amount, etc. in notes Y N
     - ⇒ Did you list date and time explosives contractor notified? Y N
   - Incompatibles segregated initially? Y N Fixed during visit? Y N
   - Containers sealed and sound? Y N
   - Secondary containment for chemicals near drains or in fume hood? Y N
   - Mark the unneeded and degraded hazardous chemicals for disposal? Y N
     - ⇒ Focus on formalin-preserved specimens in Biology
     - ⇒ Focus on radioactive materials in Physics
   - Notes on condition of storage cabinets (spill residues, corrosion)? Y N
3) **Review routine chemical disposal practices**
   - Take notes on types and amounts of hazardous waste generated? Y N
   - How is hazardous waste being disposed?
     - ⇒ Discharge down drain? Y N Acceptable? Y N
     - ⇒ Evaporation of solvents to air? Y N Acceptable? Y N
     - ⇒ Disposed as solid waste? Y N Acceptable? Y N
     - ⇒ Disposal as hazardous waste? Y N Vendor name:________________________
     - ⇒ Wastes being treated on-site? Y N
       - ∇ Acid/base neutralization? Y N
       - ∇ Evaporate aqueous solutions? Y N
4) **Spill Response**
   - Procedures in place? Y N
   - Training provided? Y N
   - Spill supplies on hand? Y N
5) **Documentation**
   - MSDSs for chemicals? Y N

Inspection of Non-Lab School Programs

Auto/Carpentry/Metal Shops: Room #s___________, _____________, ___________

Teacher's Names:_______________, ______________________, ___________________

1) **Hazardous Materials Storage Practices**
   - Incompatibles segregated? Y N
   - Unneeded chemicals present? Y N
   - Any high-risk chemicals present? Y N
   - Containers sealed and in good condition? Y N
   - Secondary containment for chemicals near drains? Y N
2) **Review routine chemical disposal practices**
   - What wastes are generated?
     - ⇒ Antifreeze? Y N Acceptable? Y N
     - ⇒ Waste oil? Y N Acceptable? Y N
     - ⇒ Parts washer solvent? Y N Acceptable? Y N
     - ⇒ Brake cleaners? Y N Acceptable? Y N
     - ⇒ Paint? Y N Acceptable? Y N
     - ⇒ Auto batteries? Y N Acceptable? Y N
   - How much is being disposed?
     - ⇒ Total lbs per month _________________________
   - How is it being disposed?
     - ⇒ Discharge down drain? Y N Acceptable? Y N
     - ⇒ Evaporation of solvents to air? Y N Acceptable? Y N
     - ⇒ Disposed as solid waste? Y N Acceptable? Y N
     - ⇒ Disposal as hazardous waste? Y N Vendor name:______________________
3) **Spill Response**
     - ⇒ Procedures for solvents, acid, antifreeze? Y N
     - ⇒ Training provided? Y N
     - ⇒ Spill abatement supplies on hand? Y N
   - Documentation
     - ⇒ MSDSs for hazardous materials? Y N
     - ⇒ Hazardous waste disposal manifests? Y N
   - Health and Safety
     - ⇒ Eye wash present, accessible, near batteries? Y N
     - ⇒ Guards on equipment? Y N
     - ⇒ Personal protective equipment? Y N

Photography/Ceramics/Art: Room #s___________, _____________, ___________

Teacher's Names:________________, _______________________, ____________________

1) **Hazardous Materials Storage Practices**
   a) Incompatibles segregated? **Y N**
   b) Unneeded chemicals present? **Y N**
   c) Any high-risk chemicals present? **Y N**
      - Look for the words "contains lead" in glazes & "hydrofluoric acid" in glass etch
   d) Containers sealed and in good condition? **Y N**
   e) Secondary containment for chemicals near drains? **Y N**
2) **Review routine chemical disposal practices**
   a) What wastes are generated?
      - Photo fixer? **Y N** Acceptable? **Y N**
      - Photo processor cleaner? **Y N** Acid-based? **Y N**
      - Waste paints? **Y N** Acceptable? **Y N**
      - Clean-up solvent? **Y N** Acceptable? **Y N**
      - Paint? **Y N** Acceptable? **Y N**
      - Etching acids? **Y N** Acceptable? **Y N**
   b) How much is being disposed?
      - Total lbs per month ___________________________
   c) How is it being disposed?
      - Photo Fixer down drain? **Y N** Acceptable? **Y N** (needs treatment)
      - Evaporation of solvents to air? **Y N** Acceptable? **Y N**
      - Disposed as solid waste? **Y N** Acceptable? **Y N**
      - Disposal as hazardous waste? **Y N** Vendor name:________________________
3) **Spill Response**
   - Procedures for solvents, acid, antifreeze? **Y N**
   - Training provided? **Y N**
   - Spill abatement supplies on hand? **Y N**
4) **Documentation**
   - MSDSs for hazardous materials? **Y N**
   - Hazardous waste disposal manifests? **Y N**
5) **Health and Safety**
   - Eye wash present, accessible, near acid etch? **Y N**
   - Personal protective equipment? **Y N**

Custodial/Maintenance/Grounds: Room #s______________, ______________

Custodial/Maintenance Supervisor Name: ___________________________________

1) **Hazardous Materials Storage Practices**
   - Unneeded chemicals present? Y N
   - Incompatible chemicals segregated? Y N
     - ⇒ Bleach and ammonia
     - ⇒ Acidic and basic drain cleaners
     - ⇒ Flammables (gasoline) and nitrate fertilizers
   - Containers sealed and in good condition? Y N
   - Secondary containment for chemicals by drains? Y N
   - Storage area for pesticides kept locked? Y N
2) **Hazardous Waste Management**
   - Avoiding acid-based toilet bowl cleaner? Y N
   - Computer monitors being recycled? Y N
   - Fluorescent light tubes recycled? Y N
   - Pesticide containers triple rinsed? Y N
3) **Spill Response**
   - Procedures in place for corrosives? Y N
   - Training provided? Y N
   - Spill abatement supplies on hand? Y N
4) **Documentation**
   - MSDSs for hazardous materials? Y N
   - Hazardous waste disposal manifests? Y N
5) **Health and Safety**
   - Personal protective equipment provided? Y N
     - ⇒ Chemical resistant gloves if working with butoxy ethanol (butyl cellosolve)

Appendix D – RCRA Non-Hazardous Cations and Anions

Provide this list to teachers as a quick-reference chart to help them know the chemicals that are not regulated as hazardous waste by the Environmental Protection Agency. Compounds that combine ions from the first column with those from the second column MAY be acceptable for disposal as solid waste unless state and local regulations are more stringent than federal requirements.

Combinations of Cations & Anions that are EPA Non-Hazardous

Prefixes (Cations) and Suffixes (Anions) MUST be combined for this to apply!

Aluminum (Al)		Acetate (C2H3O2)	
Ammonium (NH4)		Bicarbonate (H2CO3)	
Calcium (Ca)		Borate (BO3)	
Iron (ferric, ferrous) (Fe)		Carbonate (C2O3	
Lithium (Li)	+	Chloride (Cl)	= EPA non-hazardous
Magnesium (Mg)		Iodide (I)	
Manganese (Mn)		Phosphate (PO4)	
Potassium (K)		Silicate (SiO2)	
Sodium (Na)		Sulfate (SO4)	
Strontium (Sr)		Tartrate (C4H4O6)	
Zinc (Zn)		Thiosulfate (S2O3)	

Note that you must combine the elements/ions for this to be accurate.

Potassium alone is a very hazardous, water-reactive compound. Potassium + Sulfate = Potassium Sulfate, which is non-hazardous under federal hazardous waste guidelines.

Appendix E – Chemical Storage in Small Spaces

This chart was taken from the King County Laboratory Waste Management Guide with permission. The Laboratory Waste Management Guide can be downloaded from this link: http://www.govlink.org/hazwaste/publications/LabGuidelinesRevAugust06.pdf

The storage codes listed in the table match those in Appendix A and Appendix B and are widely used by schools across the United States. This chart, unlike those found in most school guidelines, is adapted for small stockrooms with limited shelf space. Most storage systems assume the laboratory has extensive shelf and storage cabinet space, which is rarely the case in schools.

Inorganic Shelves	Organic Shelves
I-1 & I-10 – Sulfur, phosphorus, arsenic, metals, hydrides (store all away from water!)	O-1 – Dry and dilute organic acids, anhydrides, peracids
I-2 – Halides, sulfates, sulfites, thiosulfates, phosphates, halogens	O-5 & O-7 – Organic peroxides, azides
I-5 & I-7 – Sulfides, selenides, phosphides, carbides, nitrides, arsenates, cyanides	O-6 & O-8 – Epoxy compounds, isocyanates, sulfides, sulfoxides, nitriles
I-4 – Dry hydroxides, oxides, silicates, carbonates	**Cabinets for Liquid Storage**
I-3, I-6 & I-8 – Nitrates, nitrites, borates, chromates, manganates, permanganates, chlorates, chlorites, inorganic peroxides	Flammable Storage Cabinet – Hydrocarbons, ethers, ketones, amines, halogenated hydrocarbons, aldehydes, alcohols, glycols, phenol, cresol, combustible organic acids, combustible anhydrides
	Corrosive Acid Storage Cabinet – Inorganic acids. Nitric acid stored separately in this or another cabinet
	Corrosive Base Storage Cabinet or Cupboard – Concentrated inorganic hydroxides
***Notes**: Keep water reactive metals away from aqueous solutions and alcohols. Use secondary containers to separate yellow and white phosphorus, which are stored under water, from water-reactive metals.*	

Appendix F – Common School Waste Streams

FIND A HOME FOR THIS ↓

There are many programs and areas within a school where hazardous materials can be found. These include art classrooms, science stockrooms and laboratories, auto, metal and wood shop classes, photography darkrooms, printing rooms, and grounds maintenance and janitorial supply departments. Mercury thermometers or mercury blood pressure sphygmomanometers may be present in nurses' offices.

The manual begins by providing guidelines for creating a chemical management system and then provides specific guidance on handling, storage and disposal of chemicals found in the school during the initial inventory. It finishes by providing program-specific best management practices for school chemicals.

TAKEITFROMHERE

Art/Ceramics/Photography

TAKEITFROMHERE

Biology/Chemistry

TAKEITFROMHERE

Maintenance/Custodial/Grounds

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Shop Classes – Auto/Metal/Wood

Appendix G – Annotated Resources List for More Information

- Local Hazardous Waste Management Program in King County
- Flinn Scientific Company
- Tennessee

Appendix H – Quick Reference Chart of Chemicals for Schools to Avoid

The chart below provides school district personnel, teachers and inspectors with a quick reference to chemicals that are highly regulated and potentially problematic.

P-Listed Chemicals found in schools
Never keep >1 kilo on-site!

Arsenic Trioxide
Adrenaline / Epinephrine
All Pure Cyanides (1st name, space, "cyanide
Beryllium powder
Carbon Disulfide
Dinitrophenol
Endothall
Nicotine alkaloid
Nitric Oxide
Osmium Tetroxide
Sodium Azide
Strychnine
Vanadium Pentoxide
Warfarin

Potential Explosives found in schools

Acetaldehyde
Benzoyl Peroxide (dry)
Bouin's Fluid
Collodion
Cumene
Cyclohexene
Dinitrophenol
Dinitrophenyl Hydrazine
Dioxane
Ethyl Ether
Isopropyl Ether
Nitroglycerin
Picric Acid
Potassium Metal, degrade
Tetrahydrofuran
Trinitro- anything

TCLP Metals (toxicity characteristic leaching procedure test method)

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Silver
Selenium