

# **Science Teacher's Health and Safety Workshop**

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March 2017



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# Science Health and Safety

- Serious responsibility for all science teachers
- Many classroom health and safety issues
- Many health and safety resources for teachers
- Biology, earth science, physics inherently less hazardous than chemistry at the K-12 level(?)

# Outline of Training

- Safety Rules and Regulations for K-12
- Teacher Responsibilities- NIOSH
- Chemical Hygiene and Plans
- Chemical Storage, Purchasing, Disposal

# Outline of training

- PPE, Eyewashes and Showers
- Hazard Communication and SDS's
- Fires and Emergency Action Plans
- Electrical Safety
- Plants, Animals, and Disinfection
- Other issues?

# Safety and Health Laws and Regulations

- Enforced by NYS Department of Labor, Public Employee Safety and Health (PESH) program in NY, OSHA for pub. employees
- All public school employees are under the jurisdiction of PESH, but NOT students
- Potential citations and fines
- Nearly all regulations identical to Fed. OSHA

# Health and Safety Laws and Regulations

- But the reason for having safe and healthful laboratories is not the law, but the teachers and the students!
- Terrible, preventable accidents are still occurring in schools- in 2006, 2 HS girls in Ohio were badly burned in a methanol explosion caused by the teacher; they received a \$19 million settlement





# Enforcement

- PESH has cited local school districts in NY for inadequacies in Chemical Hygiene Plans, Hazard Communication, and there have been DEC/EPA actions over hazardous waste
- Citation to a high school: employer did not provide science instructors with information and training on chemicals (acids and bases) in labs and chemical store room

# Examples of OSHA/PESH regulations in schools

- OSHA/PESH Regs. applicable to K-12 and comm. college science classes include:  
Electrical, First Aid, Eyewash and Shower, Flammables Storage, Chemical Hygiene Plans, Personal Protective Equipment, Hazard Communication, Fires and Emergency Plans, others

## New resources

- Education historically lagged industry in laboratory health and safety planning
- New resources and programs have helped education catch up
- The internet has been a big help
- NIOSH Safe Lab has the information needed to maintain a state of the art program

# Fundamentals of NIOSH Safe Lab

- Students need to learn good habits from day one to keep themselves and others safe in the laboratory
- Safety and Health must be an integral part of the planning, preparation, and implementation of any science program
- Responsibilities must be shared among administration, teachers, and students

# Teacher's Responsibilities- Safe Lab

- Inspect laboratory equipment and first aid equipment, keep records
- Notify administration in writing of any hazardous conditions, such as worn gas hoses, electrical issues, chemical storage
- Safety and emergency procedures- plan and practice procedures to be used in an emergency, train students

## Teacher's responsibilities, cont.

- Provide students with verbal and written safety procedures
- Know location of all cut-off switches for water, gas, electricity
- Know how to use all safety equipment (eyewash, fire blanket, mercury spill kit, etc.)
- Conduct drills, have emergency numbers

## Teacher's responsibilities- Chem maintenance

Perform regular inventories and inspections of chemicals

Insure proper storage and disposal of chemicals

Keep chemicals and hazardous equipment locked up when not in use

# Teacher's Responsibilities

- In conjunction with the administration, lesson plans for chemical usage and experiments must address potential health and safety hazards and appropriate controls
- Experiments must be carried out with health and safety hazards as the most important priority



# Teacher's responsibilities

- Understand hazards of materials used, the process, and equipment in each lab activity
- Inspect all equipment and materials before use
- Instruct students in proper procedures and discuss safety concerns
- Ensure appropriate conduct

# Student responsibilities

- The document outlines an extensive list of do's and don'ts for students

# SED and Lab Safety

- Have not been willing to develop guidelines-  
“liability”

Not too much guidance

Look to NIOSH, web, DEC, etc.

# Housekeeping and Safety

- Keeping rooms clean, neat, and uncluttered is the first element of a safe work environment
- Insuring good ventilation and lighting are also first priorities
- Clear access to exits, emergency equipment, and utility cut-offs is vital

# The chemical hygiene plan

- Written program with policies and procedures and responsibilities to protect employees, and indirectly students
- Must have SOP's for each activity involving the use of hazardous chemicals
- Hierarchy of controls to be used to reduce exposures to chemicals

# Hierarchy of Controls

- Engineering Controls: ventilation, fume hoods, plastic shields, etc.
- Administrative Controls: limits to time of exposure, substitution of hazardous chemicals, etc.
- PPE: personal protective equipment, such as respirators, safety glasses, gloves

Why eliminate the hazard when you can buy personal protective equipment?



# Chemical Hygiene Plan

- Must insure lab fume hoods and other protective equipment such as eyewashes and showers are installed and functioning properly
- Extensive information must be available to those who work with the chemicals, including hazards of the chemicals, the CHP, signs and symptoms of exposure, PEL's and TLV's, safe handling and disposal info, etc.



# Chemical Hygiene Plan elements

- Employees must be trained in proper procedures and hazards, and how to detect the release of hazardous chemicals, how to protect against the hazards, what are the health and safety hazards
- What are the circumstances that require prior approval from administration?

# Ongoing maintenance of CHP

- Must be updated annually
- Must appoint new CHO as position turns over
- Best if science committee (H & S) is involved

## Sources for the CHP

Handbook of Chemical Health and Safety,  
ACS Handbooks, 2001, Robert Alaimo

Prudent Practices in the Laboratory: Handling  
and Disposal of Chemicals, NRC, 1995.

# Labeling Containers- Part of Hazcomm

- Replace any damaged or faded labels
- Include date first received, first opened, use by or expiration date
- Secondary containers must be labeled as to chemical name, manufacturer or preparer, handling and hazard info, concentration, dates

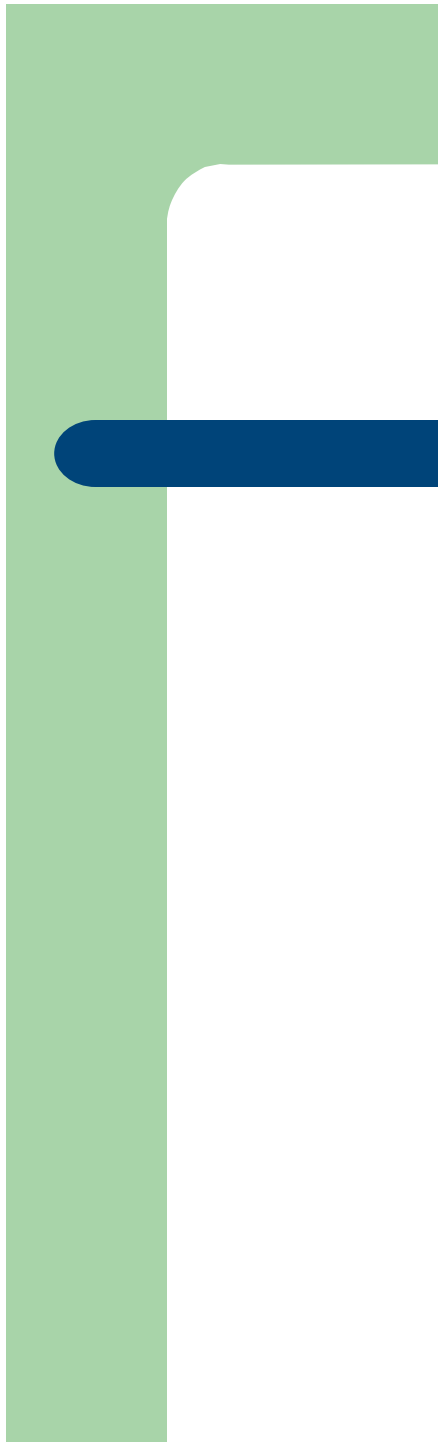
# Chemical Storage

- Are there any insurance requirements?
- OSHA/PESH regs are minimal, for larger quantities only
- All shelving must have a  $\frac{3}{4}$  inch front lip
- Chemicals must be locked up
- Ventilation must be adequate
- Very clear storage guidelines in document



# Chemical Storage

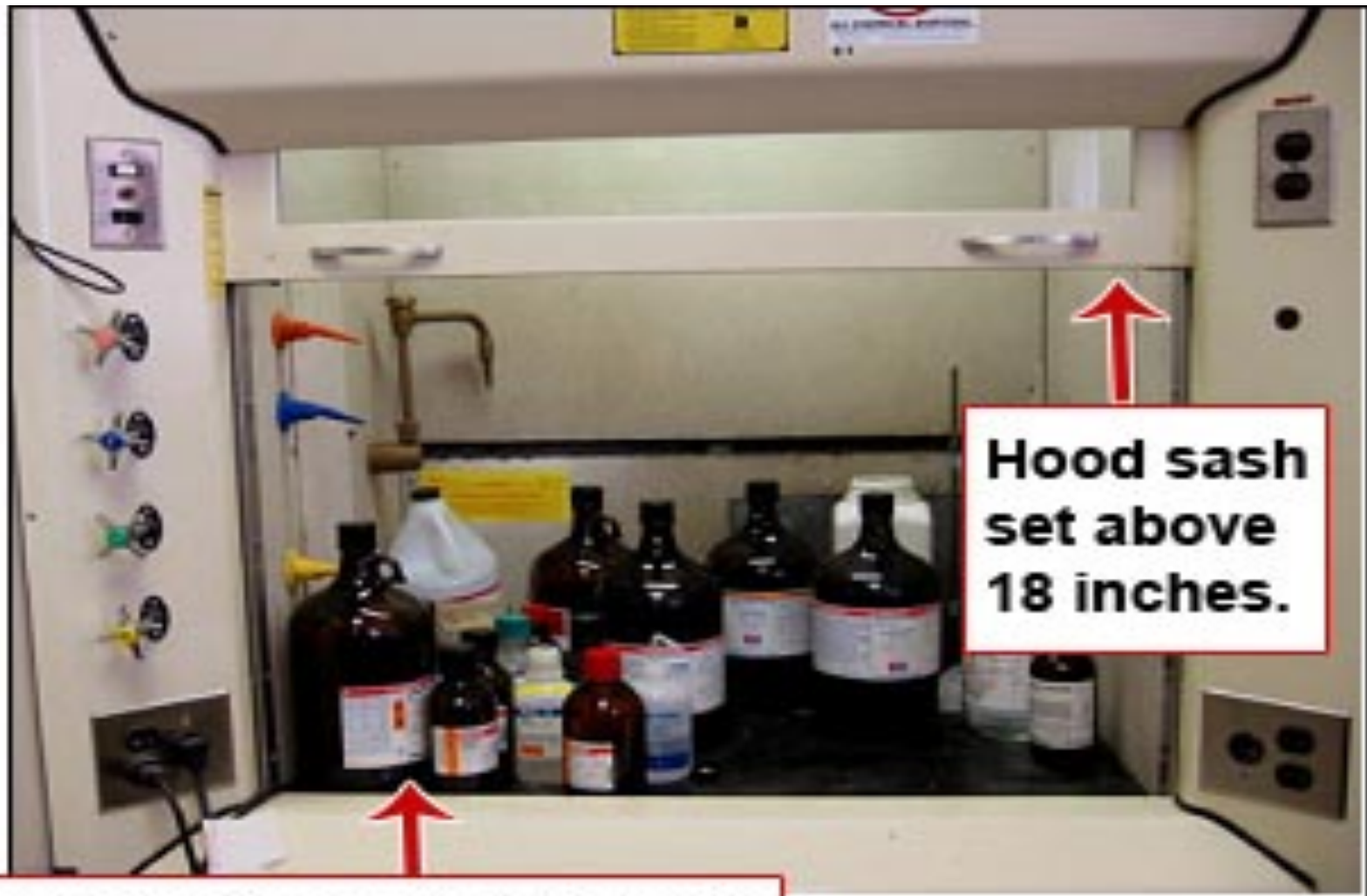
- Organize by compatibility, NOT alphabetically
- May be alphabetic within compatible group
- Acids stored separately, preferably in dedicated cabinet, with nitric acid segregated from all other chemicals
- Flammables only stored in approved flammable storage cabinets





# Chemical storage

- Isolate water reactive chemicals
- Do not store heavy containers, liquids, or large containers on higher shelves
- Do not store on the floor, lab benches, or in chemical hoods
- Shelving should not be above eye level
- Make sure containers are closed and wiped



**Hood sash  
set above  
18 inches.**

- Excess storage of chemicals.**
- Exhaust slots blocked.**
- Containers stored within six inches of face of hood.**

# Disposal

- Contractors dispose of waste
- Very expensive, so minimize quantities
- Must be properly labeled and documented
- Acids and bases can be neutralized
- Never mix nitric acid and organics
- Call the administration for disposal

## Non-approved or inventoried chemicals

- Teachers must not bring in chemicals that have not been reviewed by the chemical hygiene officer and/or committee and have not been placed on official SDS inventory
- Staff must not conduct ad hoc or off the cuff experiments

# Bell jars, and pressure hazards

- Vacuum vessels can implode, but that means fragments, such as glass, will then be propelled in the other direction, and can still be a hazard
- All over and underpressures present hazards
- Be sure of temperature and pressure limitations on all vacuum/pressure equipment

# Pressure, vacuum hazards

- Be sure all equipment is in good condition with no chips, cracks, defects, etc.
- Insure all in area are wearing safety glasses
- Insure all vacuum and pressure gauges are functioning properly, calibrated or otherwise inspected for accuracy regularly

# Personal Protective Equipment

- PPE- Gloves, Glasses, Aprons, Earplugs, Respirators, etc.
- All teachers and students should wear safety glasses in lab classes, all the time
- Safety glasses do not protect from liquid splashes
- For transferring corrosives, etc., use face shields, chemical splash goggles





## Splash visor



# Gloves

- Many, many styles and types of gloves
- For students- nitrile exam gloves
- Must have multiple sizes, for largest to smallest hands
- May need other types for chemical stockroom, cleaning, handling chemicals
- Utility gloves thicker, longer, other materials

# Gloves

- Do not use natural rubber latex- allergy and poor chemical resistance
- Nitrile, pvc, or polyethylene substitute
- Nitrile has widest chemical resistance, most cut resistant, and is synthetic so no latex allergy
- Materials such as butyl, neoprene, etc. for utility gloves- thicker and longer

# Gloves and chemical resistance

- Gloves are NOT “impermeable”
- Glove material must be resistant to the chemical for an appropriate length of time
- Use guidance from SDS or NIOSH or glove manufacturer’s chemical resistance tables for proper material choice
- “Rubber is not rubber,” but butyl or nitrile or neoprene or latex rubber is

# Nitrile exam gloves are best....







# Respirators

- A big subject
- Use is highly regulated by PESH/OSHA except for dust masks
- Should not be necessary in K-12 science courses, or for school lab personnel
- Dust masks- paper “filtering face piece” masks, for dust and *nuisance* levels of chems

# Respirators and Nuisance

- Some teachers have developed sensitivities
- Nuisance level organic vapor or acid gas respirator (dust mask type) are relatively inexpensive, not heavily regulated, and may solve problems so teachers can continue their careers



# Organic Vapor Nuisance Respirator



# Hygiene Issues

- Students should not get chemicals or other science materials on their hands or skin
- Students and teachers should be washing their hands after class
- No chemicals or materials should get on the clothes, use lab coats, aprons, as necessary

# Eyewashes and Emergency Showers

- Irrigation is the first step in first aid to halt tissue damage after chemical contact
- Use of eyewash and showers is secondary prevention (first aid)
- Better to prevent exposure by insuring proper use of PPE, face shields, goggles, etc.
- Governed by ANSI Z358.1

# Eyewash and Shower



# ANSI Z358.1 Significant elements

- Units should be activated weekly or on a regular schedule, and receive a more thorough evaluation annually
- Units should be within 10 seconds travel, on the same level (floor or area) and the path of travel must be free of obstructions
- Units should have clearly visible signage

# Eyewash



# Eyewash and shower elements

- Control valves should open within one second and remain on until closed
- Spray nozzle outlets must be protected from airborne contaminants when idle, and covers must not require separate motions to remove
- Eyewash units must deliver at least 1.5 liters (0.4gallons) potable water per minute for 15 minutes to both eyes simultaneously

# Eyewash and Shower elements

- Water must be tepid, between 60 and 100 degrees F. for full use cycle
- Too cold inhibits use for full necessary 15 minutes, too hot can increase chemical damage
- Amoebas, bacteria, rust, other very unpleasant contaminants can build up if the units are not regularly flushed



# Eyewash and shower elements

- Lack of flushing, obstruction of the access path, and provision for proper temperature water are the most frequent problems
- Latest edition of standard 2014
- Do not try to neutralize chemicals in the eye with other chemicals, do not try to remove contacts except with water

# Training

- Actual use instructions are quite simple, but how, when, where, and how long to use should be discussed, and what to do after or during the irrigation
- ANSI standard expects weekly flow checks- PESH will also, in the wake of an incident
- Annual inspection also required

# Hazard Communication/SDS

- Hazard communication/SDS regulations part of OSHA/PESH rules that apply to all workplaces- 29 CFR 1910.1200
- Require complete chemical inventory, SDS sheets for each chemical/product, written plan, proper labeling of each primary and secondary container, and training in chemical hazards, training in GHS symbols

# Hazcomm Updated by OSHA to GHS

- “Globally Harmonized System”
- Training required by December 1, 2013
- New labeling and SDS requirements to be phased by June 1, 2016
- Still 5 elements- inventory, written plan, SDS’s available, all chemicals and products labeled, and employees trained

# 2017- Hazard Communication must be fully compliant with PESH GHS

- Globally Harmonized System for hazard communication
- Use of pictograms and standardized hazard statements
- Standard format SDS's

# Hazard Communication Training

- Extremely important
- Cited by PESH in schools
- Can be offered for chemical families
- Important to train in special hazards-  
carcinogenicity, extreme flammability  
(methanol) etc.
- How to detect release of the chemical

# SDS's and inventory

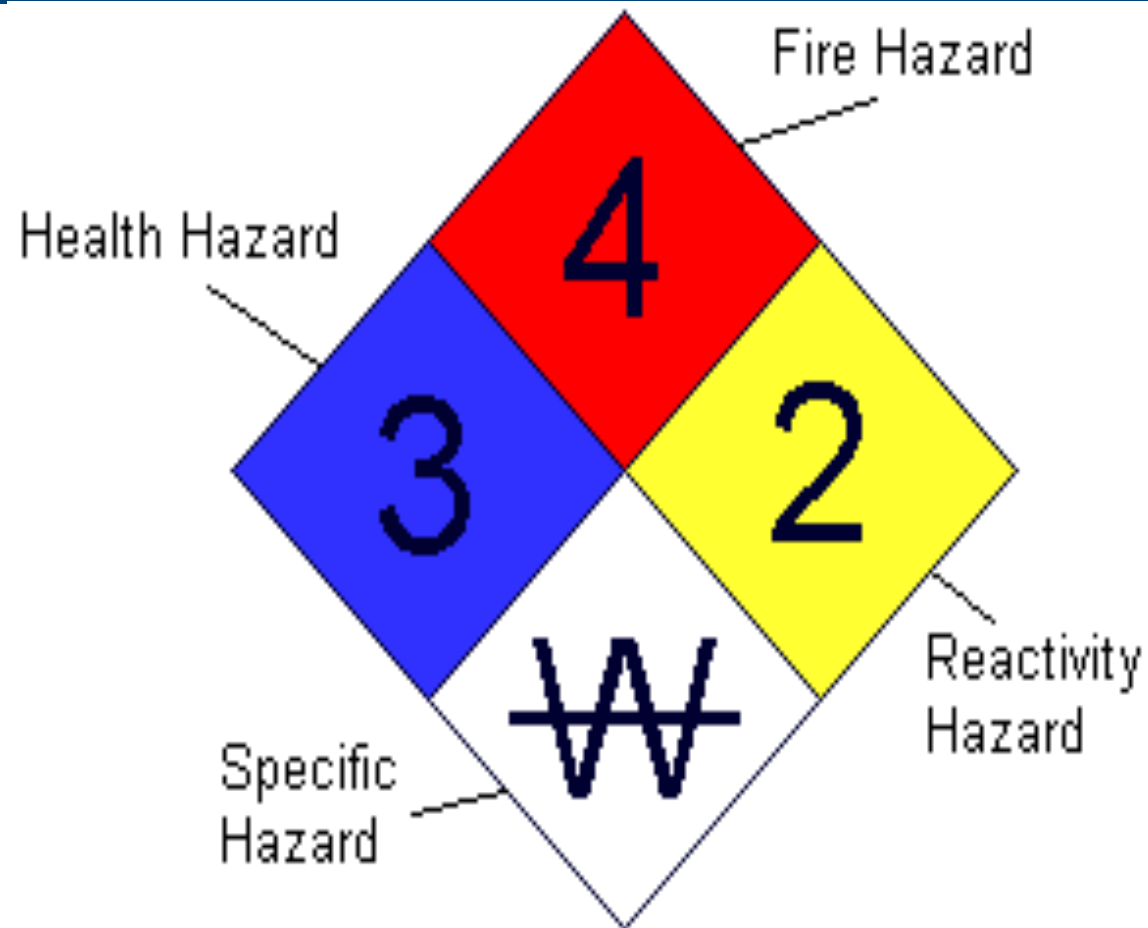
- Can be on computer system if available to all employees
- Must be requested from suppliers if not supplied with shipments
- SDS's often available online, from major chemical companies

# Labeling

- Do not remove or deface original container labels
- Secondary containers must be labeled if they are not used up by the person who filled them on the shift they are filled!
- NFPA system, name of product are adequate on secondary container



# NFPA Diamond



# Science Teachers and Labels

- Label ALL containers and tanks in classroom
- That includes cold and hot water in carboys, pressurized air tanks, etc.
- Why? For students, fire-fighters at midnight, maintenance personnel, etc.
- Methanol and water look the same in clear containers.....

# What's in it? Label water too....



# Fires and Emergency Action Plans

- Evacuation of room and procedures for response to fires inside and outside the room should be planned for, discussed with students, and drilled
- Of most concern are fires and explosions from chemicals, burners, other science materials

# Methanol Burners? Or natural gas...still can cause fires....



## Methanol



Colorless, volatile liquid; slight alcohol odor. Irritating to eyes/skin/respiratory tract. Toxic. Also causes: headache, nausea, convulsions, kidney damage, visual disturbances including blindness. Chronic: visual impairment. Flammable.

CAS No. 67-56-1

# Critical Issues to discuss and plan

- Do teachers use extinguishers to fight the fire? Under what circumstances? Are they annually trained in how to properly use extinguishers?
- OSHA has guidelines for fires that can be fought with an extinguisher, such as the fire is limited to the original material, and it is contained such as in a wastebasket

# Critical Issues

- If someone's clothes are on fire, the fire must be fought
- Who organizes evacuation if the teacher is fighting a fire?
- Means for reporting the fire
- Evacuation procedures and emergency escape routes
- Accounting for individuals after evacuation

# Fires and Emergency Evacuation

- OSHA has an excellent website covering this material
- See [www.osha.gov](http://www.osha.gov), compliance assistance, etools, evacuation plans and procedures



# Electrical Safety

- Insure all wires, wiring, and outlets are in good condition with no worn or cut insulation
- Insure that outlets are ground fault protected if electrical appliances are used in or near water
- Be aware of and do not overload outlets
- Do not use extension cords as permanent wiring- common OSHA/PESH violation

# Always use GFCI around water...

## Ground Fault Circuit Interruptor



# Electrical Safety

- Most problems relate to overloaded power strips- leads to fires
- Be aware of total amperage of loads
- Know where cut offs (switches, circuit breakers) are located for outlets and other electrical loads
- Do not obstruct access to switches, panels
- Check all grounding

**Before...**



**After...**



# Panel and Obstruction





# Animals

- Animals and students must be protected
- Use gloves when handling, and wash hands afterward
- Have vet evaluate any animal that dies unexpectedly

# Plants

- Inquire about allergies in students
- Never allow plants to be tasted or eaten without clear directions from the teacher
- Use gloves if necessary



# Disinfection

- Disinfect biology classroom surfaces for microorganisms, fecal matter, DNA, etc. using 5% Lysol, other approved disinfectants, or 10% fresh household bleach solution. Discard contaminated materials in biohazard bags.
- Keep all cages, aquariums clean

# Formalin/Formaldehyde

- Formaldehyde is corrosive, carcinogenic, causes severe respiratory reactions
- Heavily regulated by OSHA/PEOSH, as carcinogen- 1910.1048
- Should not be used in new specimens in K-12 dissection
- Displays? OK if sealed, containers protected from breakage- double contained, etc.

# Resources

- CDC/NIOSH- National Institute for Occupational Safety and Health – [cdc.gov/niosh](https://www.cdc.gov/niosh), many free resources such as pamphlets
- OSHA website- [osha.gov](https://www.osha.gov), very large website

## Resources

- Chemical Safety Board, [csb.gov](http://csb.gov), have alert and video on methanol explosions in classrooms, industrial chemical accidents that are good chemistry material
- Council of State Science Supervisors

# Science Health and Safety

- Other issues/concerns?
- Questions?