Lab Safety for Teaching Assistants

USF
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Contacts and Objectives

http://www.usf.edu/eh&s/	**OPM 100**	**813-974-4036**
Waste Management	Occupational Safety	
Industrial Hygiene	Property Insurance/Risk Management	
Asbestos/Indoor Air Quality	Lab Safety	
Fire Safety	Waste Management	

Training Objectives

- To discuss preparations and safety measures for teaching labs
- To provide USF lab safety procedures and guidelines on handling hazardous chemicals
- To provide hazardous waste management procedures for the teaching lab
- To increase awareness of emergency procedures for teaching labs

Individual Responsibilities

- Follow safety procedures that are outlined in the Chemical Hygiene Plan and in Standard Operating Procedures (SOPs) for lab protocols
- Be sure that you attend all necessary trainings and communicate this information to students
- Let a supervisor know of any unsafe conditions in the lab (disruptive students, horseplay, or disobedience.)

Supervisor/Lab Manager Responsibilities

- Determine specific safety and compliance procedures to be followed within an experiment. These procedures should be written within an SOP and available to the Teaching Assistant
- Provide all personal protective equipment that is needed for the staff and students
- Ensure that all staff are attending safety training prior to working in the lab
- Correct any hazards that are reported to them. Contact EH&S if additional assistance is needed.
- Report all staff/faculty injuries or illnesses to workers' compensation and to EH&S.

Contents

How to be a good TA

Prepare before class

- Read the laboratory procedure. Read it again and repeat until you know it by heart.
- Look up the SDS for any unfamiliar chemical.
- Try to anticipate areas where the students might have trouble.
- Make sure there are enough supplies, that they are organized, and the equipment is functioning correctly. Have backups.
- Know what to do in case of spill or exposure.

Act during class

- Explain the laboratory procedure slowly and in detail. Emphasize safety precautions.
- Point out the locations of emergency equipment (shower, eyewash, fire extinguisher).
- Explain student responsibilities and expectations (behavior, protective equipment, incident reporting).
- Mingle with students (learn their names!) and watch for improper handling of chemicals and equipment.
- Messy bench tops can lead to mistakes. Emphasize the importance of a clean and neat lab bench.
- Be fair, have a positive attitude, and be enthusiastic.

Debrief after class

- Think about what worked and what didn't.
- What would you do differently next time?
- What did students understand well and what did they have trouble with?

Recognizing Hazards: Resources

1.) Manufacturer's Label

The manufacturer of a chemical must provide a label that indicates:

- Full name of chemical
- Hazard warnings
- Name and address of manufacturer

* Chemical containers without manufacturer's labels should be returned to the manufacturer.

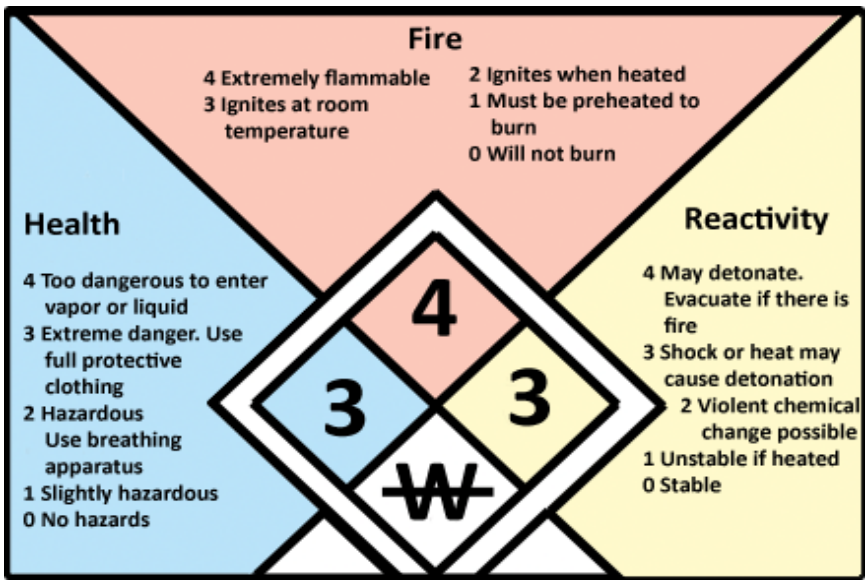
2.) Safety Data Sheets (SDS)

A SDS is a document, prepared by the manufacturer, which contains safety information for materials containing hazardous chemicals. It contains information about:

- Material components
- Dangers
- Safe handling of material

Be sure that you have immediate access to the SDS for chemicals you are working with.

3.) NFPA Label



This label was developed by the National Fire Protection Association to identify and rank a material's hazards. Hazards are rated from 0 (no hazard) to 4 (extremely hazardous).

Fire Hazard – labeled in red

Health Hazard – labeled in blue

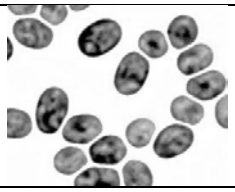
Reactivity Hazard– labeled in yellow

Specific Hazard – labeled in white (OX=oxidizer, ~~W~~=use no water, CORR=corrosive, ALK=alkali)

Recognizing Hazards: Hazard Classes

FLAMMABLE • A material that may catch fire and burn in air • Any liquid having a flashpoint below 100 degrees F (37.8 degrees C). • Flammable vapors are usually heavier than air (vapor density > 1), so it is possible for the vapors to travel along floors and, if an ignition source is present, result in a flashback fire. • Store flammable liquids only in specially designed flammable storage cabinets and refrigerators/freezers away from ignition sources and oxidizers.	
OXIDIZER/REACTIVE • An unstable material that may ignite, explode, or produce toxic gas under certain conditions • Examples include sodium, t-butyl lithium, aluminum nitrate, perchloric acid, nitric acid, and sodium peroxide. • Store away from flammable materials and place in a secondary containment when stored with incompatible materials.	
CORROSIVE • A material that destroys metal and can cause destruction of tissue • Has a pH of less than 2 or greater than 12.5 • Examples include strong acids such as hydrochloric acid and sulfuric acid, and strong bases such as potassium hydroxide and sodium hydroxide.	
POISON/TOXIC • A material that is harmful or fatal if ingested or absorbed • Toxic chemicals have an LD50 of 50 - 500 mg/kg, single oral dose for rats. Highly toxic chemicals have an LD50 of < 50 mg/kg, single oral dose for rats. • Store in a secure, sealed container below shoulder level. Use only in designated areas.	

Recognizing Hazards: Special Hazards

BIOSAFETY • Wash hands before leaving lab, wear gloves and a lab coat, do not pipette by mouth, do not eat, drink, or apply cosmetics in the lab • USF Biosafety Program offers a Biosafety course, phone: (813) 974- 5638	
COMPRESSED GAS CYLINDER • Must be attached to a permanent fixture or they may injure someone if they fall • May rupture, sending metal shards flying or becoming a missile-like projectile from the force of the escaping gas • Leaking cylinders are asphyxiation, poisoning, or fire hazards depending on the type of gas • Do not roll or drag cylinders	

ELECTRICAL/FIRE • Do not run wires where they may be damaged. To avoid shock, remove metal jewelry from hands and make sure hands, tools, equipment, and floor are dry. Know the location of the emergency power off. • Do not use extension cords, daisy-chain power strips, block exit doors or corridors, store items within 18" of a sprinkler head, or prop open fire doors • EH&S offers a Fire Safety training course	
GLASS • Before using glassware, inspect glass for cracks or chips. Follow careful handling and storage procedures to avoid damaging glassware. • Clean up broken glass with tongs or a broom and a dust pan, never your hands. • Dispose of glass in a designated cardboard box lined with a plastic bag	
HOT PLATES • Read and follow manufacturer's directions • Do not cover heating surface with foil • Do not leave unattended while heating • Do not heat volatile materials using a hot plate	
SHARPS • Dispose of needles and needle-syringe units in a red plastic biohazard box • Never recap needles • Razors, scalpels, and sharp pieces of glass, metal, or plastic must be boxed or wrapped securely before disposal as regular trash	

Minimizing Hazards: Chemical Storage

- Do not store chemicals above eye level, especially corrosive liquids. Do not store chemicals in the fume hoods, on bench tops, or on the floor.

Figure 1: Sample Chemical Storage Scheme

- As a general rule, separate chemicals by hazard class. Some chemicals belong to more than one.
- Flammable liquids must be stored in approved flammable cabinets and flammable-rated refrigerators
- Acids and bases(caustics) should be stored in chemical resistant cabinets either separately or in secondary containment
- **Acetic acid** is a flammable acid and should be stored in the flammable cabinet.
- **Nitric acid** should be stored away from other acids or in secondary containment.
- Store oxidizers and toxics near a fume hood

Minimizing Hazards: Exposure and Risk

Chemicals can enter the body four different ways:

- Absorption through the skin
- Inhalation
- Ingestion (eating and drinking)
- Injection (needles or sharp pieces of glass, plastic, or metal)

Whether or not an exposure will result in injury depends on:

- Exposure frequency
- Exposure duration
- Age, sex, and genetics

Assess the risk by considering these questions:

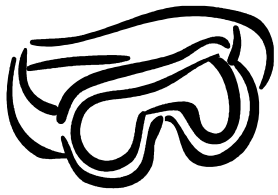
- What are the hazards?
- What is the worst thing that could happen?
- What can be done to prevent this from happening?
- What can be done to protect from these hazards?
- What should be done if something goes wrong?

Exposure risk can be minimized using:

- Substitution of less hazardous materials
- Engineering controls (example: working in the fume hood)
- Administrative controls (Chemical Hygiene Plan, training)
- Personal protective equipment (PPE)

Minimizing Hazards: Personal Protective Equipment

Everyone in the lab, including visitors, should wear long pants and shoes that cover the entire foot. Persons working with hazardous chemicals or equipment must have on additional protective equipment.

EYE PROTECTION • Safety glasses protect eyes against flying debris • Splash goggles protect eyes against liquid splashes • Full face shields over splash goggles provide extra protection when working with corrosive chemicals • UV-rated glasses protect against UV exposure, such as while using a transilluminator • In 2005, The National Institute for Safety and Health (NIOSH) recommended that contact lens wear be permitted during work with hazardous chemicals provided suitable eye protection was worn and written guidelines and a hazard assessment were in place.	

GLOVES • Wear when handling hazardous materials, sharp, or very hot or cold items • Latex, vinyl, or nitrile gloves are appropriate most of the time • Glove compatibility charts provide information for specific chemicals, see http://www.chemrest.com/	
LAB COATS AND APRONS • Regular lab coats provide minimal protection. Flame-resistant lab coats should be worn if working with flammable liquids or pyrophorics. • Impervious aprons provide extra protection against corrosive liquids • Do not take lab coats home to wash, use a professional dry cleaner qualified to launder lab coats exposed to chemicals (contact EH&S for a list)	
RESPIRATOR • Consult EH&S before use. Federal regulations prohibit the use of respirators by untrained personnel or students. If EH&S determines use is necessary, the individual must participate in the University's respirator program. This includes an annual medical evaluation, respirator fit test, and training.	
FUME HOOD • Protects against exposure to hazardous fumes or dusts • Keep sash as low as possible when using, close sash when not using • Work at least six inches inside sash and avoid sudden movements • If fume hood alarms, contact EH&S at 813-974-4036	

Emergency Response: Spills

Small spills may be cleaned up by the lab as long as personnel have proper supplies, knowledge, PPE, and are comfortable doing so.

- Consult the SDS of the spilled chemical & put on proper PPE prior to clean-up.
- Spread absorbent around spill site and over liquid's surface and wait 15 minutes.
- Collect wet absorbent & transfer to a plastic bucket or bag using dustpan & brush.
- Dispose of as hazardous waste.

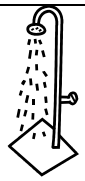
SPILL KIT • Store in an accessible location • Absorbent material, goggles, gloves, broom, dustpan, bucket • For biohazardous spills, also have 10% bleach or other disinfectant	

If one of the following conditions occurs, call EH&S:

- Spill is large
- Spill involves extremely hazardous chemicals
- Ventilation is inadequate
- No spill clean-up materials
- Personnel uncomfortable handling clean-up
- If a spilled chemical enters the drain, soil or water body

Emergency Response: Accidents

If there is an emergency, call 911 and be prepared to give detailed information about your location.

EYEWASH • If chemicals get into eyes, flush eyes for 15 minutes • Seek medical attention • Lab personnel must flush eyewash weekly and keep a record • Do not block with glassware or equipment	
SHOWER • If chemicals get onto clothes/skin, rinse for 15 minutes, removing contaminated clothing • Seek medical attention • USF tests showers annually • Do not store items under shower	
FIRST AID KIT • Know location • Check completeness and expiration dates • Administer first aid for minor injuries and advise a visit to Student Health Services	

Emergency Response: Incident Reporting

Fill out an incident report form, available online at http://www.usf.edu/administrative-services/environmental-health-safety/reporting/index.aspx

Workers' Compensation (WC) covers faculty, staff, and official volunteers at the University of South Florida. Teaching and graduate assistants are included as employees.

If you are injured on the job:

- Notify your supervisor
- Supervisor will contact AmeriSys at 800-455-2079
- Proceed to approved medical facility
- Send injury report to WC office within 24 hours
- Forms are available on the Workers' Compensation website, http://www.usf.edu/hr/

Emergency Response: Fire

You are not expected to fight the fire. Follow these emergency procedures to assure your safety:

1. Yell out FIRE FIRE FIRE!
2. Alert other building occupants by activating the fire alarm by using the manual pull station.
3. Attempt to extinguish fire, if it is small and you know how to use an extinguisher.
4. Close all doors behind you as you evacuate the building.
5. Call 911 as soon as possible outside the building.
6. Give as much information as possible to the emergency dispatcher.
7. Meet in the designated relocation area at least 150 feet from the building.

FIRE EXTINGUISHER • USF Tests annually • EH&S offers training, call for more information • To use, remember **P.A.S.S.** (**P**ull the pin, **A**im at the base of the fire, **S**queeze the lever, and **S**weep back and forth)	

Hazardous Waste

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA). This law gave the Environmental Protection Agency (EPA) the authority to regulate all individuals who generate and accumulate hazardous wastes. All labs, studios, and shops that generate and accumulate hazardous wastes are subject to unannounced inspections from the Florida Department of Environmental Protection and/or EPA and are thus subject to fines.

Universal Waste

These materials are subject to hazardous wastes regulations unless they are managed or recycled according to the universal waste regulations.

- Nickel Cadmium, Lithium Ion, Nickel Metal Hydride, Lead Acid, Mercury or Silver Hydride batteries must be segregated and collected in a container labeled with its contents.
- Fluorescent and High Intensity Device (HID) lamps (either used or broken) must be stored in a plastic lined box or metal container labeled with its contents.
- Mercury thermometers, thermostats, and barometers must be stored in a plastic lined box or metal container labeled with its contents.

Chemical Waste

- At USF, all chemical waste must be treated as hazardous waste and must be collected. Dumping of hazardous wastes, including rags, in the trash or down the drain is not permitted.
- Empty chemical containers can be disposed in the lab trash or reused to store hazardous wastes, EXCEPT for empty containers that stored acutely hazardous wastes (EPA P-listed). These have green warning labels. They cannot go in the trash and must be disposed of through EH&S.
- Before disposal, remove or deface the label with a marker and write “Empty” on the bottle. The lids on empty flammable containers should be removed before disposal. Remember to remove the chemical from inventory.
- Lead solder remnants must be collected and disposed of as hazardous waste.
- Only completely empty spray cans with intact nozzles can be put into regular trash. If the nozzle is missing or the container is not empty it is hazardous waste.

Figure 2: Chemical Waste Handling

Collect Waste

- Containers for solid or liquid waste, tags, and labels are available through USF's Hazardous Inventory Tracking System (HITS)
- Must be labeled "Hazardous Waste" and include the date, the percent content of each chemical, and a description of its hazard class (for example: toxic)
- Attach a yellow waste tag when waste is first added

Store Waste

- Keep in a Satellite Accumulation Area (SAA)
- Do not use food or drink containers to store waste
- Floor storage must have secondary containment
- Containers must be kept closed, funnels removed

Waste Pick-up

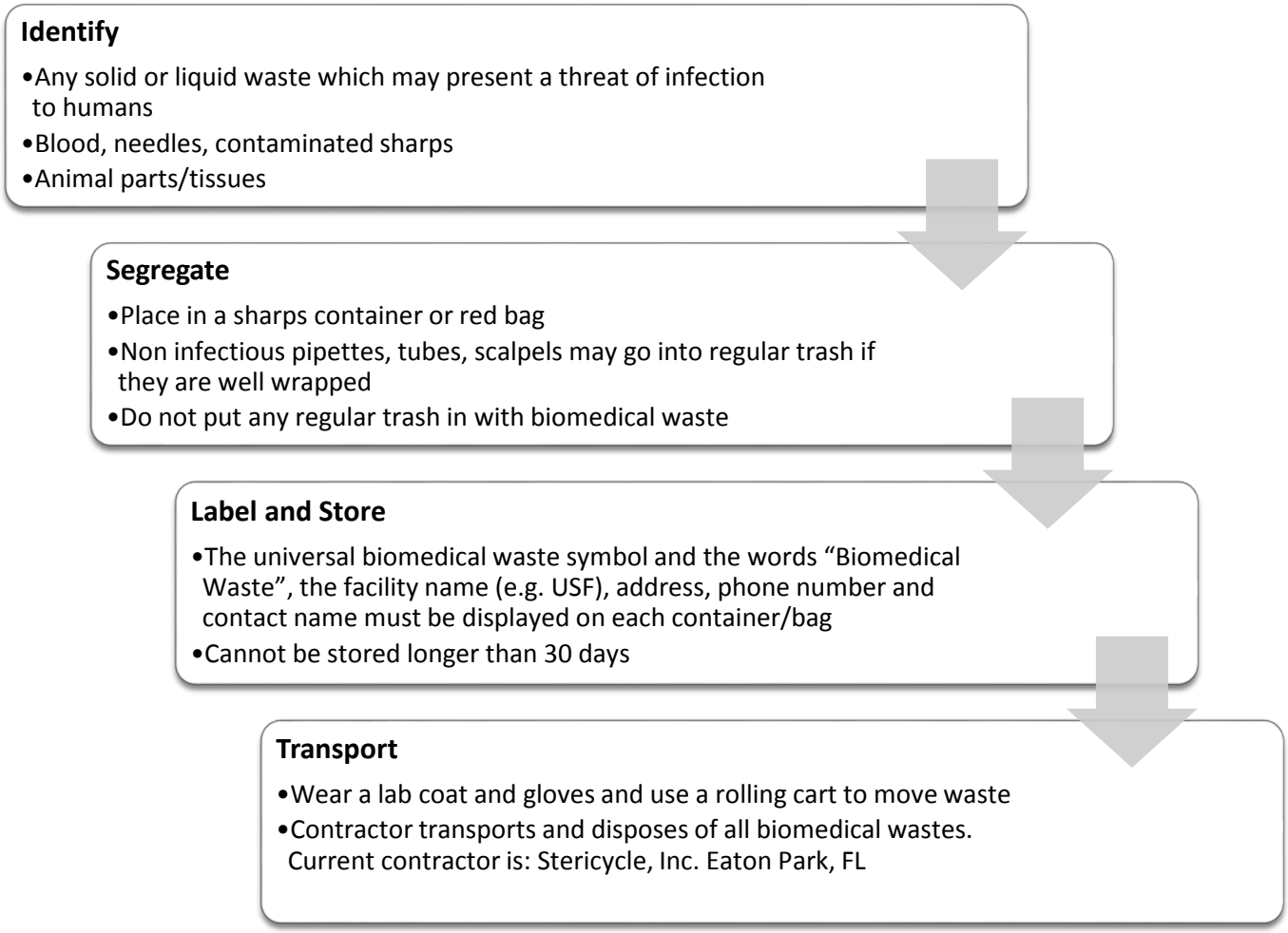
- Log on to HITS at to request pick-up
- Use the Lab Cleanout form to request pick-up of more than 20 items
- Contact Facilities Management to pick up universal waste lamps and batteries

Biomedical Waste

Figure 3: Universal Biomedical Waste Symbol

- Any solid or liquid waste which may present a threat of infection to humans.
- Biomedical (or Biohazardous) waste is managed under the Florida Administrative Code (FAC) 64E-16 (https://www.flrules.org/gateway/ChapterHome.asp?Chapter=64e-16) and USF's Written Biomedical Waste Plan (http://www.usf.edu/administrative-services/environmental-health-safety/programs-services/hazardous-waste/biomedical-waste.aspx).
- All needles, whether infectious or not, must be disposed of as biomedical waste. Never recap needles.
- Biomedical waste mixed with chemical waste must be managed as hazardous waste. Please separate biomedical waste from biomedical waste mixed with chemical or radioactive waste.
- Place red bags into an outer container prior to use. The outer container must be rigid, leak-resistant and puncture-resistant. Reusable outer containers shall be constructed of smooth, easily cleanable materials and shall be decontaminated after each use.
- USF's biomedical waste service provider, Stericycle, removes waste. The custodial staff will not remove any biomedical waste.

Figure 4: Biomedical Waste Handling



References

Department Of Labor, Occupational Safety and Health Administration Industry Standards, 29 CFR Part 1910
http://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1910

Ethics Point collects anonymous reporting of activities that may involve misconduct, unsafe conditions, or other violations of USF System policies https://secure.ethicspoint.com/domain/media/en/gui/14773/index.html

NIOSH (2005). *Contact Lens Use in a Chemical Environment*. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005–139. http://www.cdc.gov/niosh/docs/2005-139/pdfs/2005-139.pdf

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version 2011. Full text available online at http://www.nap.edu/catalog.php?record_id=12654

RCRA Online is a database of documents covering the management of non-hazardous, hazardous, and medical waste http://www.epa.gov/rcraonline

USF Biomedical Waste Management Plan provides the requirements for the proper management of biomedical waste at USF http://www.usf.edu/administrative-services/environmental-health-safety/hazardous-waste/biomedical-waste.aspx

USF Chemical Hygiene Plan is a broad outline of chemical safety procedures and is required to be read by all Principal Investigators, students, lab workers, and volunteers http://www.usf.edu/administrative-services/environmental-health-safety/programs-services/laboratory-safety/lab-reviews.aspx

USF Hazardous Waste Management Plan outlines the regulations and procedures governing the accumulation and management of hazardous waste http://www.usf.edu/administrative-services/environmental-health-safety/programs-services/hazardous-waste/index.aspx

Wireless Information System for Emergency Responders (WISER) provides information on hazardous substances and is available as a standalone application on computers and mobile devices https://wiser.nlm.nih.gov/

Appendix 1: In memory of those who have lost their lives in laboratory accidents

Date	Name	Description
2012	Richard Din	San Francisco, 25 year-old VA Hospital lab worker dies from exposure to bacterial strain causing septicemia and meningitis
2011	Adrian Martin	Menlo Park, CA, Researcher died in lab methane explosion
2011	Michelle Dufault	Yale University, Chemistry Department lathe
2009	Sheri Sangji	UCLA, T-butyl lithium fire
2005	Kenton Joel Carnegie	University of Waterloo, geological engineering student, wolf attack during field work in Athabasca basin (northern Saskatchewan)
2004	Unknown	St. Paul, Minnesota, Vet Tech Hospital, an employee was trapped inside steam washer used to clean animal cages. He was fatally burned.
2003	Raquel Vieira de Savariego	University of Texas, Geology Department, Visiting Scholar was killed when his vehicle rolled over on the way to the field camp
1999	Unknown	Edmonton, Canada, Agat Laboratories, toluene inhalation death
1997	Karen Wetterhahn	Dartmouth College, Dimethylmercury poisoning
1996	Michael Hanly	New York City, Discarded hydrofluoric acid kills sanitation worker
1995	Unknown	San Diego, UCSD biology grad student, hanta virus exposure in field work
1992	Unknown (2)	Hong Kong, University instructor and grad student suffocated in cold room when liquid nitrogen spilled
1990	Unknown	Okinawa, Japan, High school student drowns during oceanography class
1989	Unknown	New Jersey, High school student electrocuted working on TV in physics class
1988	Dawn Collins	Tacoma, WA, Pierce College, A&P lab drinking saline containing sodium azide
1988	Unknown	California high school custodian goes into coma and dies following inhalation of old chemicals discarded in dumpster by new high school teacher
1980	Unknown	Boston, MA, University of Massachusetts student dies drinking water from a lab faucet in a “clean” beaker
1979	Unknown	Arizona State University organic extraction solvent fire kills graduate student in geochemist’s laboratory
1979	Unknown	Washington State, High school student died when the nitroglycerine he had synthesized blew up in his pocket on the way to the football field
1976	Unknown	Texas high school student dies of injuries sustained in alcohol fire. He was trying to refill the lamp while it was still lit
1972	Unknown	Cambridge, MA, MIT grad student electrocuted working on live circuits
1969	Unknown	University of Washington, Sodium explosion in chemistry lab kills student
1967	Unknown	P-Chem undergrad died of burns sustained in an explosion and fire possibly caused by making cleaning solution with nitric instead of sulfuric acid
1966	Unknown	Princeton, NJ, Princeton University grad student killed when struck by unchained gas cylinder that fell, ruptured, and went through cinderblock wall
1966	Unknown	Providence, RI, Brown University biology grad student electrocuted doing electrophoresis
1966,	John Gallant	Westbrook, Maine, High school student electrocuted by oscilloscope
1953	Unknown	Chicago, Morton Salt, Chemist killed in explosion opening bottle containing peroxides
1940	Unknown	Illinois, Graduate student killed in explosion of chemicals stored in a household refrigerator.

http://www.resources.labsafetyinstitute.org/MemorialWall.html

Appendix 2: Lab experiment example with safety procedures

Synthesis of solid acid, 12-Tungstosilicic acid, $H_4SiW_{12}O_{40}\cdot 7H_2O$

In this laboratory exercise you will prepare a heteropolymetalate species which is a solid acid. The object of the experiment is to:

a) Prepare the compound 12-tungstosilicic acid using a solvent extraction method.

b) Quantitatively determine the available protons in this material.

c) To test the material as a solid acid catalyst.

2. PROCEDURE

This entire procedure should be carried out in the fume hood. Ensure that there is no naked flame in the hood or close to you. Lab coat, gloves, and goggles should be worn at all times during this experiment.

Dissolve 15 g of sodium tungstate dihydrate, $Na_2WO_4 \cdot 2H_2O$, in 30 ml of water and add 1.16 g of sodium silicate solution (density 1.38 g/cm^3). Stir the solution vigorously at just below the boiling point, and add concentrated hydrochloric acid (10 mL) drop wise over a period of about 30 minutes, using a dropping funnel. Cool the solution to room temperature, then filter it, add a further 5 mL of concentrated hydrochloric acid slowly, and transfer it into a separatory funnel. Shake the solution with diethyl ether (12 mL); at this point you should observe three layers in the funnel. If not, add a little more ether, shake and again allow to separate. Withdraw the bottom, oily ether layer and save it in a beaker.

Safety procedures are included within the procedure to ensure that the experiment is conducted in a fume hood and PPE is worn at all times.

NOTES

- Laboratory Safety Training
- Hazardous Waste Refresher
- Biomedical Waste Refresher
- Hazardous Communication
- Personal Protective Equipment
- Slips, Trips, and Falls
- Hearing Conservation
- Golf Cart Training
- Asbestos Awareness Training
- Fire Prevention Safety Training

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