Introduction

Conducting chemistry experiments can be fun, intellectually satisfying, and productive - but only if these experiments are conducted safely.

In a chemistry laboratory - or other science lab - where chemicals are used, there will be hazards. Well-educated chemists and well-educated chemistry students need to understand the hazards of chemicals and of various chemical procedures in order to work safely in the lab. For the ability to work safely, it is key to not only recognize a hazard but also assess the actual risk it poses. Remember safety is everyone’s responsibility.

At the end of each day in the lab, the goal is for you to go home just as you came - with no injuries or illnesses as a result of your lab experience.

Safety Culture

The components of a strong safety culture require you to do your part. There are four areas that should receive your attention: leadership, learning safety, building a positive safety attitude, and learning lessons from safety incidents.

Leadership: You can show your leadership by following the safety given to you by your instructors, by always wearing your required personal protective equipment, by reporting all safety incidents (however minor), and by taking time to consider the risks involved in an experiment.

Learning Safety: It is crucially important to your personal safety (and to the safety of others) that you really try to learn about and to understand (continued on pg. 2)
The understanding that hazards in the lab. This understanding can save you or others from injuries or other adverse incidents. As you learn chemistry - or any other science - you should endeavor to learn as much about safety as you can. The hope is that you will be learning about safety throughout your career and will not view safety as just a set of rules to memorize.

Building a positive safety attitude:
If you continuously learn about safety during your education, and its importance is constantly reinforced, you should be building a positive safety attitude. The proper attitude for safety is reflected in the safety ethic: value safety, work safely, prevent at-risk behavior, promote safety, and accept responsibility for safety.

Learning lessons from safety incidents:
Finally, adverse safety incidents can sometimes happen. When these happen - even minor incidents - they need to be shared so that we can all learn lessons from missteps that were made. Learning lessons is an important part of our work as scientist, so keep this in mind as you learn about safety.

Your Responsibility for Safety in Labs
Incident prevention is a collective responsibility, which requires the full cooperation of everyone in the laboratory. Although everyone is responsible for safety in the lab, you, the experimenter, can most directly prevent incidents.

Personal Protective Equipment (PPE)
PPE is used to eliminate or minimize exposure to some hazards encountered when working in the chemistry lab. PPE commonly includes gloves, eye protection, lab coats, and aprons. Don't depend solely on PPE to protect you because it is often the final barrier between you and exposure.

Proper Gear for This Lab

Hair and Apparel (Dressing for Lab):
Clothing worn in the lab should offer your skin basic protection from splashes and spills. It is always prudent to minimize the amount of skin exposed to the lab environment. Bulky and loose-fitting clothing is not appropriate in the lab. Constraining long hair and loose clothing will help prevent lab items from being knocked over, being dragged through chemical spills, and minimize fire hazards with open flames.
In the lab, wear shoes that completely cover your feet and toes. This will offer your feet the best protection from spills and dropped items. Lab footwear should also offer stability for standing and walking.

Eye Protection:
Everyone in the laboratory, including visitors, must wear eye protection at all times, even when not performing chemical operations. Some experiments present splash hazards, thus goggles rated for chemical splash protection are the required eye protection. In other cases, safety glasses can suffice if the hazard assessment determines them to be appropriate eye protection for the experiment being performed. Normal prescription eyeglasses do not provide appropriate lab eye protection. Serious injuries have resulted from the wearing of normal prescription eye-wear with out chemical splash goggles or safety glasses.

Gloves:
Gloves are an important part of personal protection and come in come in a wide variety of materials. Glove material must be selected based on the chemical being used (See Lesson Learned: Does the Right Glove Material Matter). Always check your gloves before each use to ensure the absence of cracks and small holes. To avoid unintentionally spreading chemicals, remove your gloves before leaving the work area and before handling such things as:
- cell phones
- calculators
- laptops
- door knobs
- writing instruments
- laboratory notebooks
- textbooks

Disposable gloves and gloves that have been permeated by chemicals should not be reused. The gloves cannot be reused safely because the chemical cannot be totally removed. Contaminated gloves may be considered to be a hazardous waste material, but this is not always the case. In all instances, dispose of your gloves in the designated hazardous waste container or as otherwise instructed.

Laboratory Protocols

Laboratory Environment:
Before working in the lab, take note of your surroundings. Locate the exits, fire alarm pull stations, eyewash fountains, safety showers, fire blankets, first aid kits and fire extinguisher. While working in the lab, you should remain alert to your actions and to the actions of those around you.

Never eat or drink in the lab, to ensure that there is no chance that any contamination can lead to ingestion of a lab chemical. No food or drink should be carried into or stored in the lab.

Housekeeping:
In the lab and everywhere else, keeping things neat generally leads to a safer environment. Keep aisles and access to safety equipment free of obstructions such as chairs, boxes, open drawers, backpacks, and waste receptacles. Avoid storing items such as chemical bottles on the floor. This presents a tripping hazard and in the event a bottle should leak or rupture, secondary spill containment should be provided.

Chemical bottles should be capped tightly, stored upright, segregated according to hazard class. Chemicals should be stored (continued on pg. 4)

Does the Right Glove Material Matter?
In August 1996, Dr. Karen Wetterhahn, a very accomplished researcher, was working in her laboratory on her current project, which required creating a standard by binding a mercury compound to a protein to be studied by nuclear magnetic resonance (NMR) spectroscopy. The recommended binding compound was dimethylmercury, which was known to be a very toxic compound. Recognizing the hazard, Dr. Wetterhahn made several attempts to prepare the standard using less toxic mercury chloride salts. When those products gave disappointing results, she decided to proceed with using dimethylmercury to prepare the standard.

Dr. Wetterhahn was working in a laboratory hood, wearing latex (natural rubber) gloves, and using accepted prudent laboratory practice. During the course of a transfer, two tiny drops of dimethylmercury dripped onto her latex glove. Not realizing the gravity of this, she finished her work for the day, cleaned up, and did not report the incident.

Within a year, she developed severe signs and symptoms of acute mercury poisoning and eventually slipped into a coma and passed away.

Her colleagues later tested the breakthrough time for the action of dimethylmercury on latex and found it to be 15 seconds or less. One lesson that can be learned from this tragic event is to make sure the glove you choose has been tested by the manufacturer for the chemical being used and that the manufacturer’s recommendations are followed—especially for chemicals where one mistake could be catastrophic.

To read the full story, see “A Tribute to Karen Wetterhahn.”
and spaced by distance, partition or secondary containment. Avoid stacking chemical bottles.

Bench-tops should be wiped down and items returned to storage at the end of each day. Floors should be clean and free of any spills or obstructions. Laboratory should be kept neat and orderly.

**Labeling Chemicals:**
Improper or insufficient labeling of chemical containers has resulted in numerous adverse incidents. Labels are typically referred to as "manufacturer" and "secondary". It is important that a manufacturer label never be altered, covered, or otherwise changed until the container is verified as being empty. Often empty containers will be reused, for example for solutions prepared by students. At a minimum these containers should have a secondary label temporary use. This label should have the name of the chemical, the name of the person who filled the container, the date it was filled, and the hazards. Containers prepared for longer storage should have a label that meets the standards of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

**Disposal of Chemicals:**
Proper handling of reaction by-products, surplus, waste chemicals, and contaminated materials is a major element of incident prevention, and there are very strict rules for disposing of chemicals. Improper disposal can result in serious damage to the environment and can also result in legal issues for your institution. Everyone is responsible for ensuring that these wastes are handled in a manner that minimizes personal hazard and recognizes the potential for environmental contamination.

Typically, your reaction by-products and surplus chemicals will be poured into appropriately labeled waste or hazardous waste containers for proper disposal. Most likely different containers will be used for different classes of chemicals. Sometimes your reaction by-products can be neutralized or deactivated as part of your procedure, and this can help to reduce waste handling, which lowers the cost of disposal. What ever the situation may be, handle your waste materials in the specific ways designated.

**Preventing Chemical Spills:**
Chemical spills are probably the most common lab incidents. Good housekeeping habits will help you avoid spilling chemicals. Keep lab items well away from the edge of your lab bench or other workspace. You should measure chemicals accordingly and avoid taking excess chemicals. Return reagent bottles to their proper location once you have procured the minimum amount needed for your experiment. Address any obstructions in the aisles or walkways of the lab space. Walk slowly and carefully in the lab. Rushing may cause you to bump into others or into cabinets and lab furnishings.

**Prepare to Respond to a Chemical Spill:**
If you or someone near your workspace has a chemical spill, you and the other individuals in the area should move away from the spill. If a flammable liquid is spilled, warn others in the area to extinguish all flames and turn off electrical equipment, if you can do so without putting yourself in harm’s way. If the spill occurs in a chemical hood, close the hood sash to allow the vapors to be removed more effectively. You should report the spill to your instructor or PI immediately. You, your instructor or your PI should know how to handle the spill.

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**E-mail regarding an actual event in the USU chem department that was not handled properly.**

**March 28th, 2018**

**Faculty/Staff/Students,**

Today about 1:30 pm someone reported a strong vinegar smell and some liquid on the stairs of the West Maeser stair case between floor 1 and floor 2. It was lab grade acetic acid, that should have been cleaned up immediately by the person who spilled it. This is very irresponsible behavior.

Please remind everyone in your lab areas of individual responsibility to a spill, to report and/or clean up as appropriate and safe to the situation.

In response to the above e-mail, the following sections are meant to introduce safety topics regarding chemical spills as taught to first and second year university students.
If a significant amount of flammable, toxic or volatile material is spilled, it may be necessary to vacate the entire laboratory or building.

If a small spill of solid material occurs, you, your instructor, or PI may direct you or others to use a dustpan and brush, typically stored in the lab, to clean up the material. If a small spill of a liquid material occurs, you, your instructor, or PI may direct you or others to use paper towels or another absorbent to soak up the liquid. To pick up broken glass, use tongs or wear leather or cut resistant gloves. Broken glass can also be swept up using a small brush and dustpan. Dispose of material, including paper towels, in the proper waste containers.

If a large spill of material occurs, or if the material is toxic or flammable, your institution will have a formal procedure for handling the spill. Follow the directions given by your institution, instructor, or PI on how to properly handle these spills.

Trained personnel may contain larger spills on the floor by surrounding the involved area with an absorbent retaining material. The absorbent material used may be one that neutralizes the spilled material (limestone or sodium carbonated for acids, sodium thiosulfate solution for bromine, etc.). There are commercial absorbent kits (e.g. Oil-Dri and Zorb-All), but other ready available absorbents, such as vermiculite or small particle (about 30 mesh) of clay-based kitty litter can also be used effectively. Just make sure that absorbent used is compatible and correct for the spill. Once the spill is remediated, double check the area and notify the correct individuals if the area seems unsafe for any reason.

Chemical Spills — Minor or Major?

Determining whether you are qualified to clean up a spill requires understanding the variables. Consider the following.

Minor or simple spill:
- A spill that can be managed by one person
- A spill that does not spread rapidly other than by direct contact
- A spill that does not pose immediate danger to the environment
- The hazards (physical, health environmental, toxicity, flammability, corrosivity, and reactivity) are understood by workers
- Personal protective equipment (PPE) and a spill kit are available

Major or Complex spill:
- A spill that also involves injury
- A spill of a highly toxic or flammable material requiring immediate evacuation of the area
- A spill in a stairwell or other high-traffic area
- A spill that has serious potential for impact on the environment
Resources, Future Topics and, Acknowledgements for Exceptional Safety Habits

Departmental Safety Committee:

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Future Topics:

To be announced.

If you have a specific topic you would like featured in a future newsletter, please contact Katie Lundell. With so many diverse areas in our department, we would like to know what safety concerns you are interested in.

Individuals Acknowledged for Outstanding Safety Habits:

No individuals were recognized for this issue.

If you have anyone you would like to acknowledge for exceptional safety habits please contact a member of your departmental student safety committee.

Questions or Concerns?
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