



## Online Chemistry Course (OLCC)

# Chemical Safety: Protecting Ourselves And Our Environment

Paper: 9

Discussion: October 30 – November 6, 2004

Title: *How Can I Prevent Laboratory Accidents?*

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Posted: 10/16/2004

Website: [http://science.widener.edu/svb/olcc\\_safety/index.html](http://science.widener.edu/svb/olcc_safety/index.html)

# How Can I Prevent Laboratory Accidents?

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A working understanding of the prevention of laboratory accidents is integral to any scientific discipline, has legal ramifications, and is a skill that employers expect scientists to have.

Four topics can be considered the foundation of this working knowledge. They include hazard recognition and evaluation, risk evaluation, elimination / minimization of identified risks, and attention to tasks being performed.

This paper will define laboratory accidents; review the four topics critical to developing a working understanding of how to prevent lab accidents, and detail some additional elements of an effective accident prevention program.

## Laboratory Accidents

- Injuries - Chemical or Biological exposure, Thermal or Electrical Burns /Cuts /Other
- Illness - Chemical or Biological exposure, chemical allergies or sensitization, repetitive trauma disorders
- Damage/loss to equipment or facility - Fire/Explosion, work time lost to facility evacuation
- Power failures
- Ventilation failure/ malfunction
- Incidents/near miss situations
- Other

## Causes of Lab Accidents

- Lack of working understanding of hazards
- Improper or unintended use of equipment or reagents
- Inexperienced scientist
- Distractions, lack/loss of attention to task
- Broken, damaged glassware or equipment
- Other

## Prevention of Lab Accidents

The best way to prevent lab accidents is to be prepared and knowledgeable about what you are working with, be it equipment, chemicals or biological materials. Having a range of knowledge for each type or chemical/biological class of hazard you will work with, in advance, is what I call a “working understanding” of your environment in the lab.

A working understanding for prevention of lab accidents and incidents is developed by learning how to recognize and evaluate hazards, evaluate risks of those hazards, elimination / minimization of identified risks, and by attention to tasks being performed.

### Hazard Recognition and Evaluation

Please refer to all three presentations in Topic I for an excellent review of chemical exposure, evaluation of hazards of laboratory chemicals and equipment. You should be able to outline the relative hazards for any class of compounds you work with, determine appropriate procedures, choose protective equipment and safely perform experiments based on recognition and evaluation of hazards.

### Eliminate/Minimize Hazards

How can you eliminate or minimize the identified risks? Standard methods include:

- Substitution -Substitution a less hazardous reagent for a hazardous one
  - Administrative Control - Modify your procedure or reaction scheme to minimize the risk the hazardous step
  - Personal Protective Equipment\* – Use appropriate PPE
- \*A last resort when other methods fail. Using PPE as a primary hazard control is considered a poor safety practice.

### Evaluate Potential Risk

How likely is an accident, based on hazard severity and frequency of potential occurrence?

Most scientists are quite good at identifying high probability/low severity risks, but may ignore low probability/severe outcome risks – at their peril!

Risk is dependant upon *probability and severity* of outcome of an event:

High probability / low severity

- Automobile crash
- Chemical spill in your fume hood

Low probability / high severity

- Airplane crash
- Large fire in a Chemistry Building

We all take some risks in life where we feel the benefit is of more value than the potential negative outcome. Some questions you must ask yourself before performing an experiment where hazards cannot be eliminated.

- Is it worth doing?
- Would the hazardous outcome be unacceptable to my supervisor, my institution, and me?
- Are there legal ramifications, and am I (my supervisor, my institution) comfortable accepting the risk if everything that could go wrong did go wrong?

### Maintain Focus on Your Experiment

Paying attention to the task you are performing is critical in preventing accidents in the laboratory. Try to do one thing at a time, and do it well. Anticipate and minimize distractions such as phone calls, radios, talking while performing your experiments.

### **Personal Protective Equipment (PPE)**

Personal protective equipment, PPE, is available to provide additional protection to scientists. PPE selection must be based on hazards, experimental conditions of each unique experiment.

Some commonly used types of PPE include:

- Eye Protection - glasses, goggles, face shield
- Gloves - Thin barrier, thick protective, laminate, chemical resistant
- Clothing - Lab coat, whites, scrubs, plastic aprons, other
  - Open-toe shoes or sandals are **never** appropriate in the lab
  - Cotton clothing, long pants combined with a lab coat are most effective when working with caustic, flammable or toxic materials
  - Lab coat should always be worn to protect exposed skin, street clothes
- Respirators – many types available, some may require medical evaluation & fit testing before first use

### **Unattended Operations and Working Alone**

Each laboratory should have clearly communicated policies on unattended lab operations, and working alone. Some lab operations are hazardous enough to require a “buddy” when performed after hours, or they must be done during normal hours of operation.

Perform a hazard evaluation with your supervisor or PI to determine if an experiment is appropriate for off hours or working alone.

### **Safety Training**

Employer specific information and requirements of regulatory standards are also provided in typical Safety Training sessions.

Safety Training in most industrial situations consists of providing employees with sources and resources for information. Scientists must utilize these resources to make evaluate hazards, and to make decisions on how they will plan experiments, choose PPE, etc. The final outcome is expected to be science that is productive and as safe as is achievable.

### **Safety Inspections**

Safety inspections are intended to identify safety issues or problems that may not be observed or identified as such by the day-to-day occupants of a laboratory.

Safety inspections should be consistent, regular and the results publicized within the department where they occur. Safety issues identified during inspections should be tracked to completion. Periodic review of inspection findings and completion information will help identify systemic problems that may need to be addressed differently.

Without tracking to completion and periodic review of lab safety inspection findings, some issues present themselves again and again and can become the potentially dangerous “fix it and forget it until someone reminds us of it again next month” type of inspection finding.

If an item is repeatedly identified as a problem, yet no permanent solution is found, there can be legal repercussions if an injury or accident happens related to that inspection item.

### **Expectations of Industrial Employers for Laboratory Employees**

Industrial employers expect that science graduates will have a basic understanding of laboratory safety, and experience implementing safety knowledge in experimental design and operations. In industry, safety is not someone else’s job; it is an integral part of YOUR job each day. A few basic expectations include:

- Integrate safety into your job
- Understanding safety principles and performing lab work safely is as important as knowledge of chemical reactions, scientific lab techniques
- Expect to be evaluated on safety as a part of your overall performance as a scientist

### **Legal Aspects of Laboratory Safety**

It may come as a surprise to know that in an industrial environment “You are the Expert!” on chemicals, biologicals and laboratory equipment you are using, storing and/or transporting. That means that you will need to be knowledgeable about these materials before you ever use or transport them on your site. Be prepared to advise people to stay away and to ask for assistance from the site emergency response team if you have a spill or accident outside your laboratory.

You and your employer (industry or academic) have an obligation to protect yourself, others in the lab, and the facility as a whole from materials in your possession, and from negative consequences of your laboratory experiments.

### **Reporting and Communication of Laboratory Accidents**

Despite the best planning, laboratory accidents do happen. All laboratory injuries, illness, and exposures should be reported immediately to the lab supervisor and your facility’s Medical Department.

Keep in mind that some chemical exposures may result in delayed symptoms or problems. Hydrazine inhalation is a good example; an inhalation exposure to hydrazine may not cause any immediate symptoms, but symptoms of damage to the lungs (including pulmonary edema) can present up to 8 hours later. It may be very valuable to have lung evaluation immediately after exposure; changes in lung function that occur hours later can be compared to a baseline function.

Near miss and non- injury incidents should also be reported immediately to the lab supervisor. Communication of near miss and non- injury incidents, as well as information on accidents that caused injury, can prevent similar dangerous situations.

## **Summary**

A working understanding of the prevention of laboratory accidents is integral to any scientific discipline, has legal ramifications, and is a skill that employers expect scientists to have.

Employers expect you to understand what you are working with, and how to evaluate and minimize hazards based on your knowledge. Protecting yourself and others from your experimental hazards will be a part of your job as a scientist. Knowing that your actions in the laboratory have potential legal ramifications should be taken into account when evaluating risks and planning experiments.

In today's scientific world, your safety in the laboratory, and your success as a scientist are closely related. Why not begin now to build your foundation of knowledge about laboratory safety?!

## **Online Resources**

HHMI Online Safety Courses <http://www.practicingsafescience.org/>

Laboratory Safety Institute <http://www.labsafety.org/freedocs.htm>

NIOSH Traumatic Occupational Injuries <http://www.cdc.gov/niosh/injury/trauma.html>

NIOSH Health Hazard Evaluations <http://www.cdc.gov/niosh/hhe>