

# Laboratory Safety Training

Colorado School of Mines  
Environmental Health and Safety



# Laboratory Safety Training

## Who is required to attend?

- Any Mines student (undergraduate and graduate), staff, faculty, or other personnel that may be exposed to hazardous materials or activities in a laboratory environment

## When do you need to take Lab Safety?

- BEFORE beginning lab duties

**Laboratory Safety Training is required one time, and recommended annually**



The Environmental Health and Safety (EHS) Department at Mines works hard to keep students, faculty, and staff safe. EHS is here to advise, assist, and ensure compliance on everything safety-related on campus.

# Environmental Health and Safety (EHS)



## What does EHS do?

- Lab Safety
- Industrial Hygiene & Occupational Safety
- Environmental Health
- Health Physics (Radiation Safety)
- Chemical Procurement & Distribution
- Sustainability
- Emergency Response
- Fire Safety



The Environmental Health and Safety (EHS) Department at Mines works hard to keep students, faculty, and staff safe. EHS is here to advise, assist, and ensure compliance on everything safety-related on campus.

## School Of Mines EHS Locations

### Main Office

- McNeil Hall

Chemical Storage and  
Distribution Facility (CSDF)

- Coolbaugh Hall 030

**EHS is Available 24/7**

**Phone: 303-273-3316**

**Email: [EHS@mines.edu](mailto:EHS@mines.edu)**



EHS is located at two locations on campus. EHS Main Office is located in McNeil Hall, just south of the Geology museum. And, the CSDF is located on the north side of Coolbaugh Hall in the basement (CO 030). Both locations can provide safety equipment, hazardous waste containers and labels, and more!

## School Of Mines EHS Locations

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- 1318 Maple St.
- Next to Parking Services

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*“Research conducted at university laboratories is often on the forefront of technology and innovation. It is important that this research continues and thrives. But it must be done within a **strong safety culture** where **preventing hazards** is an important value.”*

Dr. Rafael Moure-Eraso  
Chairperson, Chemical Safety Board

## Lab Incident at Texas Tech, 2010

### Damage:

- Graduate student
  - Lost 3 fingers
  - Burns on hands and face
  - Eye damage

### Causes:

- Scaled up production of energetic material (100mg → 10g)
- Poor communication between supervisor and Graduate Students
- Two “Near Misses”



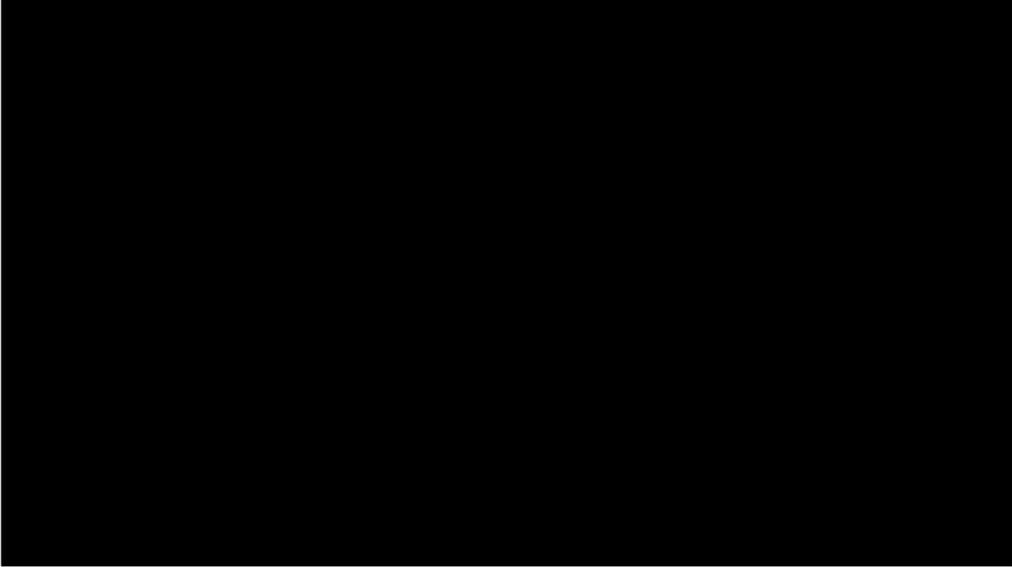
Texas Tech University - two graduate students at Texas Tech University were conducting research funded by the U.S. Department of Homeland Security on energetic or explosive compounds.

The two principal investigators for the research believed they had verbally established a 100 milligram limit on the production of energetic materials, but the Chemical Safety Board (CSB) investigation found there was no formal system for communicating this limit or verifying compliance. Few of the graduate students interviewed during the investigation believed that a strict 100 mg limit existed.

The CSB found that initially, the compound was made in small batches of less than 300 milligrams, but the two students were concerned about potential variability among different small batches of the compound which could affect later test results. They decided to scale up the synthesis to make a single batch of approximately 10 grams, enough for all of their testing. The graduate students believed that keeping the compound wet with a solvent would prevent it from exploding. After producing the larger batch, the more

senior graduate student observed that it contained clumps that he believed needed to be broken using a mortar and pestle up prior to testing. As the pestle pressed against the compound, it detonated. The graduate student was seriously injured: his left hand severely damaged by the force of the explosion, causing the loss of three fingers, perforation of his eye, and cuts and burns to other parts of his body.

There had been two previous near-misses. While no one was injured, there were similarities in the causes of these previous incidents to the January 2010 explosion. But these key lessons were missed at the time of the earlier incidents.



## Lab Incident at UCLA, 2008

### Damage:

- Graduate student died from burns

### Causes:

- Poor training
- Not wearing a lab coat
- Improper equipment



A Research Assistant (Sheri Sanji) at UCLA was transferring tert-butyllithium, a pyrophoric chemical that spontaneously combusts in air, into another container using a plastic syringe. During the transfer, the syringe came apart and chemical caught on fire, burning graduate student severely. She died from her burns more than two weeks later.

Pyrophoric chemicals, like tert-butyllithium, should never be transferred using a plastic syringe with a short needle. The researcher was not using appropriate lab equipment. Additionally, the researcher was not wearing a lab coat, which exacerbated her burns.

The researcher was never properly trained in lab safety or the safe use of handling pyrophoric chemicals by her lab supervisor.

## Who Is Responsible for Safety?

*Everyone is responsible for safety and must be involved in developing a safety culture in your laboratory*



- **Primary responsibility lies with YOU**
  - Review lab specific training and Chemical Hygiene Plan (CHP)
  - Ensure hazards are identified and evaluated in written Safe Operating Procedures (SOPs)
  - Document and communicate all incidents and near-misses to supervisor and EHS
  - Stop Work Authority – Report Unsafe Conditions



Everyone at CSM is responsible for ensuring a safe work environment around campus, and especially in the laboratory. As a lab worker, you are primarily responsible for your own safety.

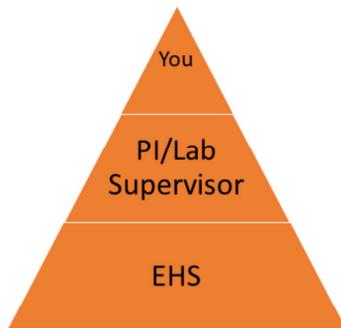
This training provides an overview of laboratory safety, but it is important that each individual in the lab participates in Lab Specific Training led by a lab supervisor. Lab Specific Training will identify the hazards in your lab, and provide information on how to mitigate these hazards. An important resource available to Mines lab workers is the Chemical Hygiene Plan (CHP), which outlines policies and guidelines for safe lab practices. Every Lab Worker should read and understand the CHP.

Hazardous activities and chemicals require the use of written Safe Operating Procedures (SOPs). SOPs instruct lab workers on the hazards of certain activities (including hazardous material handling), and how to properly perform an experiment or procedure.

Mines requires all incidents (injuries, chemical exposures, chemical spills, fires, and near misses) to be reported to a supervisor and EHS. This reporting requirement helps us identify hazards on campus and continually work to make campus a safer place.

Every lab worker has the right to Stop Work Authority. Stop Work Authority is the right and responsibility to stop work when an unsafe condition is perceived without consequence to the individual who stops the work. EHS also strongly encourages the reporting of unsafe conditions on campus.

## Who Is Responsible for Safety?



### EHS

- Advise and Recommend Safe Operating Procedures
- Maintain Chemical Hygiene Plan
- Monitor Compliance
- Conduct Training
- Emergency Response

### PI/Lab Supervisor

- Ensure Lab Specific Training of all Lab Workers
- Check/Inspect Emergency Safety Equipment
- Develop Safe Operating Procedures

EHS plays an important role in keeping CSM's laboratories safe. EHS is a resource for lab workers to offer advice and recommendations of Safe Operating Procedures. Additionally, EHS maintains and updates the Chemical Hygiene Plan to reflect changes in research activity on campus. We monitor compliance at the city, county, state and federal levels. We offer in-person and online training to lab workers including: Lab Safety Training, Hazardous Waste Generator Training, Radiation Safety Training, Laser Safety Training, Bloodborne Pathogen Training, and more. EHS is also on call 24/7 to respond to emergencies like chemical spills, fires, and other emergencies.

Finally, your lab supervisor or Principle Investigator is required to ensure adequate training of all members of the lab, and ensure the effectiveness of emergency equipment and emergency preparedness. PI/Lab Supervisors are required to understand the CHP and develop Safe Operating Procedures within the guidelines outlined by the CHP.

# Working Safely with Chemicals

## *Three Steps:*

### **1. PLAN AHEAD**

- Determine potential hazards **before** beginning experiment

### **2. MINIMIZE EXPOSURE**

- Wear Personal Protective Equipment & Use Fume Hoods

### **3. BE PREPARED FOR ACCIDENTS**

- Identify emergency equipment and evacuation procedures

# Working Safely with Chemicals

## Step 1: Plan Ahead

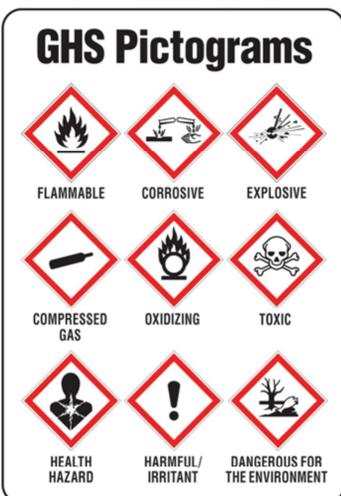


### ▪ Hazard Communication

- Be familiar with chemical hazards and exposure symptoms
- Read Safety Data Sheet (SDS) before using a chemical
- Create and/or read Safe Operating Procedures (SOP) before beginning an experiment
- Review Mines Chemical Hygiene Plan
- Talk with EHS to discuss new experiments

# Working Safely with Chemicals

## Step 1: Plan Ahead



### ▪ Globally Harmonized System (GHS)

- Standardized system for classifying and labeling chemicals across the world

### ▪ Under GHS ALL Chemicals Must be Labeled with:

- Nine Universal Pictograms (Figure 1)
- Signal Word:
  - **DANGER** (More Severe Hazard)
  - **WARNING** (Less Severe Hazard)\*

\*Very low hazard chemicals will not be labeled with a signal word

The Globally Harmonized System is a standardized system to help communicate the hazards of chemicals across the world. Every chemical must be labelled with any of the nine applicable universal pictograms that illustrate hazards. Additionally, chemicals must be labelled with a signal word. DANGER and WARNING are the only two signal words available. DANGER is used for chemicals with a severe hazard, while WARNING is used for chemicals with less severe hazards.

# Working Safely with Chemicals

## Step 1: Plan Ahead



NFPA Rating Explanation Guide					
RATING NUMBER	HEALTH HAZARD	FLAMMABILITY HAZARD	INSTABILITY HAZARD	RATING SYMBOL	SPECIAL HAZARD
4	Can be lethal	Will vaporize and readily burn at normal temperatures	May explode at normal temperatures and pressures	ALK	Alkaline
3	Can cause serious or permanent injury	Can be ignited under almost all ambient temperatures	May explode at high temperature or shock	ACID	Acidic
2	Can cause temporary incapacitation or residual injury	Must be heated or high ambient temperature to burn	Violent chemical change at high temperatures or pressures	COR	Corrosive
1	Can cause significant irritation	Must be preheated before ignition can occur	Normally stable. High temperatures make unstable	OX	Oxidizing
0	No hazard	Will not burn	Stable	☢	Radioactive
				☠	Reacts violently or explosively with water
				☠OX	Reacts violently or explosively with water and oxidizing

The NFPA 704 Fire Diamond is a standard system for the identification of hazards of materials for emergency response. It is used, primarily by emergency personnel, to quickly and easily identify risks posed by hazardous materials. You will often see this NFPA Fire Diamond on individual chemical containers, or chemical storage areas.

The four divisions are color coded, and rated on a scale from 0 (No Hazard) to 4 (Highest Hazard).

BLUE: Health Hazard

RED: Flammability Hazard

YELLOW: Instability Hazard

WHITE: Special Hazard (Alkaline, Acidic, Corrosive, Oxidizing, Radioactive, Water Reactive)

# Working Safely with Chemicals

## *Safety Data Sheet (SDS)*

- Read and understand Safety Data Sheets (SDS) **before** handling chemicals
- SDS **MUST** be available at or near where chemical is being used
  - Paper or Electronic SDS are OK
- Make sure to get an SDS for new chemicals
- Be sure all SDSs are current and complete

### Where Can I Get an SDS??

- Chemical Vendors (Sigma Aldrich, Baker, Fisher, VWR, ...)
- EHS
- Internet

# Working Safely with Chemicals

## Safety Data Sheet (SDS)

### What's in an SDS?

#### 16 Sections of Information:

- Product Information
- Hazardous Ingredients/Identity
- Physical/Chemical Characteristics
- Fire/Explosion Hazard
- Reactivity
- Health Hazard
- Safe Handling and Use
- Control Measures
- And more!

**SIGMA-ALDRICH** sigmaaldrich.com

**SAFETY DATA SHEET**  
Version 3.12  
Revision Date 02/04/2019  
Print Date 12/10/2017

**1. PRODUCT AND COMPANY IDENTIFICATION**

1.1 Product identifiers  
Product name : Perchloric acid  
Product Number : 111421  
Brand : Aldrich  
CAS-No. : 7601-90-3

1.2 Relevant identified uses of the substance or mixture and uses advised against  
Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet  
Company : Sigma-Aldrich  
3000 Service Street  
SAINT LOUIS MO 63103  
USA  
Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

1.4 Emergency telephone number  
Emergency Phone # : +1-703-627-3887 (CHEMTREC)

**2. HAZARD IDENTIFICATION**

2.1 Classification of the substance or mixture  
GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)  
Oxidizing liquids (Category 1), H271  
Corrosive to metals (Category 1), H290  
Acute toxicity, Oral (Category 4), H302  
Skin corrosion (Category 1A), H314  
Serious eye damage (Category 1), H318  
Specific target organ toxicity – repeated exposure (Category 2), H373  
For the full list of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements  
Pictogram : 

Signal word : **Danger**

Hazard statement(s):  
H271 : May cause fire or explosion, strong oxidizer.  
H290 : May be corrosive to metals.  
H302 : Harmful if swallowed.  
H314 : Causes severe skin burns and eye damage.  
H318 : Causes serious eye damage.  
H373 : May cause damage to organs (Thyroid) through prolonged or repeated exposure.

**3. COMPOSITION INFORMATION ON INGREDIENTS**

3.2 Name(s) : PCA  
Synonyms :  
Formula : HClO<sub>4</sub>  
Molecular weight : 100.46 g/mol

Hazardous components		Classification	Concentration
Perchloric acid	CAS-No. : 7601-90-3 EC-No. : 231-832-4 Index-No. : 010-008-00-4	Cor. Liq. 1, Met. Cor. 1, Acute Tox., H. Skin Cor. 1A, Eye Dam., 1, STOT RE 2, H271, H290, H302, H314, H318, H373	100 %

For the full list of the H-Statements mentioned in this Section, see Section 16.

**4. FIRST AID MEASURES**

4.1 Description of first aid measures  
General advice  
Move out of dangerous area. Consult a physician. Show this safety data sheet to the doctor in attendance.  
Name : 111421 Page 1 of 3

**5. FIRE FIGHTING MEASURES**

5.1 Indication of any immediate medical attention and special treatment needed  
No data available

**6. PRECAUTIONARY MEASURES**

6.1 Personal protective equipment  
Respiratory protection  
Eye protection  
Skin protection  
Hand protection  
Foot protection  
Additional protective measures  
Special precautions for fire fighting  
Special precautions for transport  
Special precautions for disposal

# Working Safely with Chemicals

## Step 2: Minimize Exposure

### Routes of Exposure

1. Inhalation
2. Skin Contact
3. Ingestion
4. Injection\*

**Inhalation** and **Skin Contact** are the Primary Routes of Exposure in the Laboratory



\*Sharp pipette tips may pose an exposure risk via injection



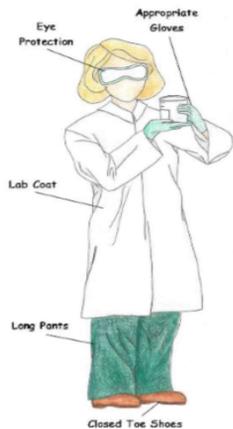
In order to minimize exposure to chemicals, it is important to understand the Routes of Exposure, or the means by which chemicals can enter your body. The four routes of exposure are listed in this slide. In the laboratory, inhalation (breathing chemicals) and skin contact (splashing chemicals on your skin) are the primary routes of exposure.

Ingestion of chemicals usually occurs involuntarily due to poor hygiene, like not washing chemicals off your hands before eating or smoking. If you do not wash your hands before eating or smoking, residual chemicals on your hands may be accidentally ingested.

Injection can be caused by a dirty needle stick, or other contaminated sharp object cutting your skin and injecting chemical into your body.

# Working Safely with Chemicals

## Step 2: Minimize Exposure



### Personal Protective Equipment (PPE)

- Mines Requires at a Minimum:
  - Long pants
  - Closed-toe shoes
  - Lab coat
  - Safety glasses
  - Gloves
- No sandals, shorts, dangling jewelry
- Pull back long hair



Safety Equipment is Available at EHS! Come Visit!



Appropriate attire (long pants, closed toe shoes, lab coat, safety glasses, and gloves) is required at ALL times in CSM laboratories and workshops. Dangling jewelry and long hair can get caught in moving machinery, or can get in the way of safely conducting lab or workshop activities. Always tie up long hair, and remove dangling jewelry.

EHS provides safety equipment (lab coats, safety glasses and goggles, cut resistant gloves, chemical resistant gloves, hearing protection, and more!) for free, or at a small cost. Please stop by and request safety equipment.

# Working Safely with Chemicals

## Step 2: Minimize Exposure: Eye/Face

- **Five Classes of Eye/Face Protection**

- Safety Glasses
- Face Shield
- Goggles
- Laser Safety Goggles
- Welding goggles/Helmet

EYE PROTECTION MUST ALWAYS BE WORN IN LABS



**Safety Fact: Every day ~2000 US workers receive a work-related eye injury requiring medical treatment**

Safety glasses are required, at a minimum, at all times in labs and workshops. When pouring or working with chemicals, splash proof goggles or a face shield are recommended. Please contact EHS if you are working with lasers. Lasers emit dangerous wavelengths of light, and the correct eye protection must be worn depending on the type of laser.

# Working Safely with Chemicals

## Step 2: Minimize Exposure: Gloves

### Protection from Physical Hazards

- Extreme Temperatures
- Sharp Edges



### Protection from Chemical Hazards

- One Glove Does NOT Fit All Hazards
  - Be sure your glove is resistant to the chemicals you are using



Physical hazards like hot, cold, and sharp edges can be avoided using the right kind of glove. Make sure to identify the appropriate glove for your physical hazard.

Chemical resistant gloves come in many different flavors. Chemical resistant gloves do not protect you from every chemical. Use a chemical glove selection guide (links below) to help choose the right glove for your chemicals.

[https://www.ansellpro.com/download/Ansell\\_8thEditionChemicalResistanceGuide.pdf](https://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf)

[https://www.honeywellsafety.com/Supplementary/Documents\\_and\\_Downloads/Gloves/19327356486/1033.aspx](https://www.honeywellsafety.com/Supplementary/Documents_and_Downloads/Gloves/19327356486/1033.aspx)

# Working Safely with Chemicals

## Step 2: Minimize Exposure: Gloves

Glove Selection Guide	Viton	Silver-shield	Neoprene	Butyl	Nitrile
Acetaldehyde	NR	>6 hr	21 min	9.6 hr	NR
Acetone	NR	>6 hr	5 min	>17 hr	NR
Benzene	6 hr	>8 hr	NR	31 min	27 min
Carbon disulfide	>8 hr	>8 hr	NT	<4 min	20 min
Chloroform	9.5 hr	10 min	12 min	NT	NR
Cyclohexane	>7 hr	>6 hr	159 min	4 min	>480 min

NR = not recommended      NT = not tested

Figure 1

### Chemical Glove Guidelines

- Wear gloves when working with ANY chemical
- There are many different types of chemical resistant gloves
- Use a *Glove Selection Guide* to pick the right glove (Figure 1)



Chemical resistant gloves come in many different flavors. Chemical resistant gloves do not protect you from every chemical. Use a chemical glove selection guide to help choose the right glove for your chemicals.

In the chart above, chemicals are listed vertically down the left, and types of gloves are listed across the top. The breakthrough time (the amount of time a glove will protect against a certain chemical) is listed in the body of the chart.

Using this chart, we can use the chemical acetone as an example. Silver-shield and butyl gloves would provide excellent protection against acetone. But, nitrile and Viton gloves are not recommended to use when working with acetone.

[https://www.ansellpro.com/download/Ansell\\_8thEditionChemicalResistanceGuide.pdf](https://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf)

[https://www.honeywellsafety.com/Supplementary/Documents\\_and\\_Downloads/Gloves/19327356486/1033.aspx](https://www.honeywellsafety.com/Supplementary/Documents_and_Downloads/Gloves/19327356486/1033.aspx)

# Working Safely with Chemicals

## Step 2: Minimize Exposure: Fume Hoods

*Chemical fume hoods protect against inhalation of volatile chemicals and aerosols*

### ▪ Fume Hood Guidelines

- Use fume hood when working with volatile chemicals
- Keep hazardous materials at least 6 inches inside hood (Figure 1)
- Do not put your head in a fume hood
- Work with sash in lowest possible position
- Close sash when not in use
- Do not store excess chemicals or clutter in a fume hood
- Call EHS if you need your fume hood checked

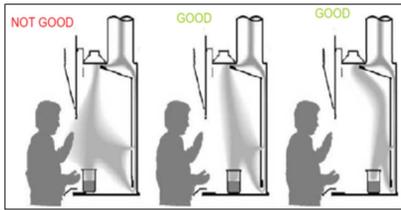


Figure 1



Fume hoods protect against inhalation of chemicals, as well as offer some splash protection when the sash is closed. In order for a fume hood to function properly, never store excess chemicals or equipment in a fume hood. Items stored in a fume hood may disrupt air flow, and chemical vapors may escape out of the hood.

To prevent vapors escaping when working in a fume hood, all chemicals should be at least six inches from the front of the hood (see Figure 1).

Chemical fume hoods pull air in from the laboratory, and expel the airflow up and out of the hood into the building's ductwork. Therefore, you never want to put your head into a fume hood, because you will be in the path of the airflow.

EHS and Facilities Management periodically check fume hoods to ensure proper airflow (~80-120cfm). If you need your fume hood tested, please call EHS.

# Working Safely with Chemicals

## Step 2: Minimize Exposure: Fume Hoods

*Certain activities or chemicals require special laboratory hoods*

- **Perchloric Acid Wash-Down Hood**
  - Required if heating perchloric acid
- **Acid Digestion**
  - Designated hoods for acids (HF, Picric acid, etc...)
- **Filtered Fume Hood**
  - Toxic or Radioactive Particulates
- **Glovebox**
  - Air or moisture reactive chemicals
- **Biosafety Cabinet**
  - Not for use with Chemicals



# Working Safely with Chemicals

## *Step 2: Minimize Exposure: Respirator*

*Respirators provide protection against a variety of inhalation hazards.*

**If your research requires a respirator:**

- EHS Will Provide
  - Medical monitoring
  - Proper respirator training
  - Fit testing

*You must contact EHS if you need a respirator*



Respirators are a last line of defense against inhalation of hazardous materials, and are seldom used on campus in laboratories. Respirators are used when there are no other effective ways (e.g. fume hoods) to minimize exposure to the inhalation of hazardous chemicals.

If you think you that your research requires the use of a respirator, contact EHS immediately.

# Working Safely with Chemicals

## Step 3: Be Prepared for Accidents

*Ask Yourself: What's the worst thing that could happen?*

Know Emergency Equipment Locations:

- Fire extinguisher
- Eye Wash
- Safety Shower
- Emergency Exits
- First Aid Kit
- Telephone
- Fire Alarm Pull Station
- Emergency Shut Off



Before you begin work in a laboratory or a workshop, you must identify the locations of emergency equipment. This equipment may save your life, and you don't want to be looking for it during an emergency. Plan ahead!

# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents: Chemical Spill*

### ▪ **Chemical Contact on Skin**

- Wash contaminated body parts for at least 15 minutes
  - Use safety shower or eye wash station
  - Remove contaminated clothing
- Call 911 if you are injured
- Report Incident to your Supervisor and EHS

### ▪ **Chemical Spill**

- Imminent Threat of Fire or Explosion?
  - Pull Fire Alarm and Call 911
- Call EHS at 303-273-3316
  - Spill Response Team 24hr



Chemical contact on your skin or eyes can cause very serious injuries. If chemicals are spilled onto your skin or clothes, you must rinse it off immediately to minimize exposure. Rinse contaminated areas for at least 15 minutes. Remove the contaminated clothes and call emergency personnel for help.

EHS will clean up all chemical spills 24 hours a day/365 days a year. Do not hesitate to call 303-273-3316. If the spill presents an imminent threat of fire or explosion, evacuate the lab and pull the fire alarm or call 911.

# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents: Working Alone*

**Never Work Alone in a Laboratory or Machine Shop**

# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents: Fire*

### **Pull Fire Alarm and Evacuate Building**

- Provide first responders with details of fire

# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents*

### **70% Nitric Acid Spill**

Splashed On Your Skin, Lab Coat and  
Pants.

**What do you do?**



# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents*

### **70% Nitric Acid Spill**

Splashed On Your Skin, Lab Coat and Pants.



### **What do you do?**

1. Use emergency shower to rinse acid. Remove contaminated clothing and rinse for **15 minutes**.
2. Get help from lab members
3. Get medical attention
4. Notify your advisor and EHS

**Do NOT worry about flooding the hallway**

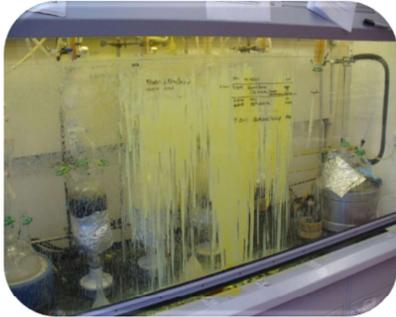
# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents*

### **Exploded Hazardous Waste Container**

### **What do you do?**

Thankfully the sash was closed, no injuries occurred, and the spill is contained in the hood

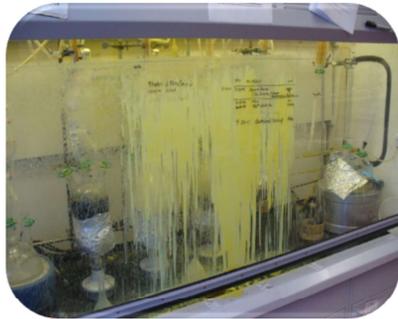


# Working Safely with Chemicals

## *Step 3: Be Prepared for Accidents*

### **Exploded Hazardous Waste Container**

Thankfully the sash was closed, no injuries occurred, and the spill is contained in the hood



### **What do you do?**

1. Get out of the lab and call EHS at 303-273-3316
2. Provide as much detail concerning the materials and waste containers stored in the hood
3. Do not attempt to clean this up
4. Be sure to clean up/neutralize small incidental spills

**Two students at Mines received skin burns this year from residual acid or caustic spills in labs.**

**HAZARDOUS MATERIALS  
EMERGENCY INFORMATION**  
(Post by Laboratory Telephones)

**Chemical Spills:**  
Small spills: The Environmental Health & Safety (EHS) Dept. provides a chemical spill team equipped to clean up small-scale chemical spills (54 liters). For small spills contact EHS at 303-273-3316 at any time.

Larger spills: In the event of a significant spill that poses an imminent threat where an immediate evacuation seems advisable, lab personnel should:

1. Leave the area.
2. Activate the fire alarm from a pull station to initiate an evacuation.
3. Call 911 and provide dispatch with all requested information.
4. Meet emergency response personnel and direct them to the incident.

**Chemical Exposure:** Be familiar with chemical hazards in your lab. Refer to Safety Data Sheets (SDS)  
For inhalation medical emergencies: For skin or eye contact:

1. Leave the area.
2. Call for help.
3. Call 911.
1. Shout for help while getting to an eyewash or safety shower.
2. Immediately wash the affected areas.
3. Call 911.
4. Continue to use the eyewash/safety shower for at least 15 minutes or as directed by medical responders.

For non-medical emergency chemical exposures, report concerns immediately to your advisor and EHS by calling 303-273-3316.

**Hazardous Waste:** DO NOT DUMP CHEMICALS DOWN THE DRAIN OR IN THE TRASH. The School provides hazardous waste collection and disposal services. All chemical waste generated in laboratories is presumed to be "Regulated Hazardous Waste" unless determined otherwise by EHS. Transport and disposal of regulated waste by any other method is prohibited.

- |  |   |
|--|---|
| <p><b>Fire Alarms</b></p> <ul style="list-style-type: none"> <li>• Immediately evacuate the building.</li> <li>• Move at least 100 feet away from the building.</li> <li>• Wait until the "all clear" is given by an emergency responding official.</li> </ul> | <p><b>Reporting an Injury</b></p> <ul style="list-style-type: none"> <li>• Seek help and call 911.</li> <li>• Notify your advisor as soon as you are able.</li> <li>• Your advisor will notify EHS who may follow-up to complete an incident report.</li> </ul> |
|--|---|

**EMERGENCY PHONE NUMBERS**

**Environmental Health & Safety Department  
303-273-3316**

The Emergency Coordinator monitors calls 24 hours/7 days a week

CSM Public Safety .....	911
Fire, Police, Ambulance .....	911
Rocky Mountain Poison Center .....	303-739-1100

# Hazardous Materials Emergency Information Poster

## Emergency Guidelines for:

- Chemical Spills
- Chemical Exposures
- Hazardous Waste
- Fire
- Injuries

***Every Lab Must Have a Hazardous Materials  
Emergency Information Poster!***

# Working Safely with Chemicals

## *Incident Reporting*



- PLEASE REPORT ALL:**
- ACCIDENTS
  - FIRES
  - INJURIES
  - CHEMICAL EXPOSURES
  - NEAR MISS EVENTS
  - SPILLS

**Report to your supervisor and to EHS**



Mines requires all incidents (injuries, chemical exposures, chemical spills, fires, and near misses) to be reported to a supervisor and EHS. This reporting requirement helps us identify hazards on campus and continually work to make campus a safer place.

Report incidents to your supervisor, and EHS at 303-273-3316

# Working Safely with Chemicals

## *Chemical Storage*

- Always segregate and store chemicals based on hazard class.
  - The most common hazard classes are:
    - Flammables, Acids, Bases, Oxidizers, Toxics, Compressed Gases, Water Reactive
    - Store each hazard class in separate storage areas
- Label storage areas with the hazard class found in that area
- Accidental contact between incompatible chemicals can result in fire, explosion, release of toxic or flammable gases, or other dangerous reactions.
- DO NOT store chemicals in a sink.
- DO NOT store chemicals alphabetically, unless they are compatible!

## Chemical Storage Chart

 <b>Flammable liquids</b>	 <b>Acids</b>	 <b>Bases</b>	 <b>Oxidizers</b>	 <b>Toxics</b>	 <b>Compressed gases</b>	 <b>Poison inhalation</b>	 <b>Water reactive</b>
<p>Do not store with acids or oxidizers</p> <p>Only store in refrigerators rated for flammables</p>	<p>Do not store with bases, flammables, or cyanides</p> <p>Do not store under the sink</p>	<p>Do not store with acids</p>	<p>Do not store with flammable liquids or solids</p> <p>Do not store under the sink</p> <p>Avoid storage on wooden shelves</p>	<div style="text-align: center;"></div> <p><b>And other Health Hazards</b></p> <p>Store on sturdy shelves below eye level or in secured cabinets</p>	<p>Secure at all times even when empty</p> <p>Store away from heat sources</p> <p>Store with cap when regulator is removed</p>	<p>Store in a vented gas cabinet or a chemical fume hood</p> <p>Secure at all times</p>	<p>Do not store under the sink</p> <p>Store away from aqueous solutions</p>
<p><b>Examples</b></p> <p>Acetone Methanol Ether Hexane</p>	<p><b>Examples</b></p> <p>Sulfuric acid Hydrochloric acid Nitric acid Acetic acid</p>	<p><b>Examples</b></p> <p>Sodium hydroxide Potassium hydroxide Bleach</p>	<p><b>Examples</b></p> <p>Silver nitrate Ammonium persulfate Sodium periodate</p>	<p><b>Examples</b></p> <p>Sodium cyanide Sodium azide Aniline Ethidium bromide</p>	<p><b>Examples</b></p> <p>Helium Nitrogen Oxygen Hydrogen</p>	<p><b>Examples</b></p> <p>Carbon monoxide Chlorine gas Ethylene oxide Ammonia gas</p>	<p><b>Examples</b></p> <p>Sodium borohydride Hydrazine Sodium metal Phosphorus</p>

# Working Safely with Chemicals

## Chemical Storage

### Flammable Material Storage

- Never store flammables with oxidizers or any other hazard class
- **Do not** store more than 10 gallons of flammable liquids outside of an approved flammable storage cabinet
- **Do not** use domestic style refrigerators to store flammables
  - Domestic Fridges may explode due to build up of vapors
- Refrigerators used to store flammables must be rated for flammable storage



# Working Safely with Chemicals

## *Food and Drink in the Lab*

### **NO Food and Drink in the Lab!**

- Do Not Eat or Drink in the Laboratory
- Do Not Store Food or Drink in the Laboratory

***Laboratory Freezers, Refrigerators, and  
Microwaves MUST be Labelled:***

**“No Food or Drink”**



# Working Safely with Chemicals

## *Purchasing Chemicals*

- All chemicals must be purchased and received through the Chemical Storage and Distribution Facility (CSDF)
- DO NOT buy chemicals with a credit card
- DO NOT transport chemicals in your personal vehicle

You **MUST** attend an EHS Hazardous Waste Generator Training before purchasing chemicals



The Chemical Storage and Distribution Facility (CSDF) orders, receives, and distributes ALL chemicals on campus. The CSDF barcodes and inventories every chemical on campus. It is important to inform the CSDF (CSDF@mines.edu) when you empty or move any chemical on campus.

It is against Mines policy to purchase hazardous materials using a personal or Mines affiliated credit card. Additionally, you are not allowed to transport chemicals in your personal vehicles, according to the Colorado Department of Transportation.

In order to purchase chemicals, you must first complete Hazardous Waste Generator Training through EHS.

# Working Safely with Chemicals

## *Transporting Chemicals*

### Transporting Chemicals Across Campus

- Always use proper chemical carriers during transport
- Wear Personal Protective Equipment
- DO NOT transport chemicals in your personal vehicle



# Safe Lab Rules

- Label ALL Chemical Containers and Waste Containers
  - Include: Chemical Name(s), Concentration, Date
- Segregate Chemical Storage by Hazard Class (not Alphabetically)
- Never Work Alone (Buddy System)
- Wash Your Hands Often and When Exiting the Lab
- Wear Proper Attire and PPE
- Keep Labs Clean and Clutter-Free



## Other Laboratory Hazards

- Compressed Gases
- Cryogenic Materials
- Radioactive Materials (Requires Specific Training)
- Lasers (Requires Specific Training)
- Laboratory Equipment



# Other Laboratory Hazards

## Compressed Gases

### TRANSPORTING GAS CYLINDERS

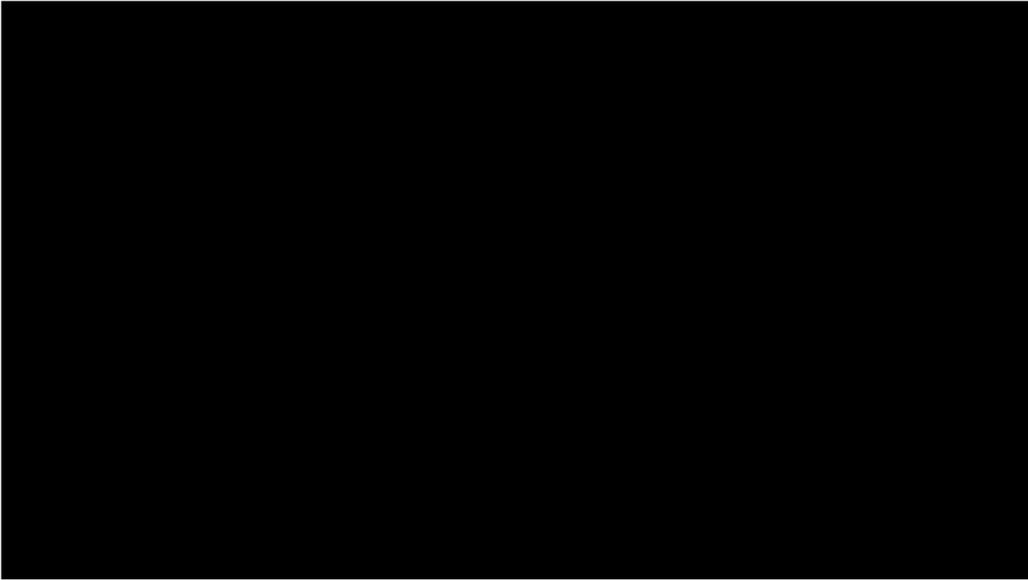
- Make sure cylinder cap is in place
- Verify cylinder contents
- Use cylinder cart to transport
  - Ensure cylinder is strapped to cart
- NEVER roll or carry a cylinder



### SAFELY STORE GAS CYLINDER IN YOUR LAB

- Secure the cylinder (with a chain) to a wall or other fixed point
- Only use appropriate regulator and tubing to deliver gas
- Close cylinder valve when not in use





# Other Laboratory Hazards

## *Cryogenic Materials*

### Extremely Cold

- Personal Protective Equipment:
  - Insulated Gloves
  - Goggles
  - Face Shields

### Asphyxiation Hazard

- Expand into a large volume of gas and may displace breathable oxygen!
  - DO NOT use in confined spaces
    - DO NOT ride in elevators with cryogenics
    - Use in well-ventilated areas



Cryogenic materials like: liquid nitrogen, liquid oxygen, and liquid argon are common hazards in the lab. Cryogenic liquids are extremely cold and have boiling points less than 238 degrees F. Be sure to always wear PPE when transferring, pouring, or working with cryogenic materials (insulated cryogen gloves, goggles, face shield, long pants and sleeves).

Cryogenic liquids boil rapidly at room temperature. A very small amount of liquid cryogen will evaporate into a large amount of gas. It is important to never work in a confined space, or ride in an elevator with liquid cryogenics because they may displace the breathable oxygen in small areas. This means you may suffocate.

Even Dewars used to transport liquid cryogenics (see the picture in the above slide) vent periodically to relieve pressure. So, it is never safe to be in a confined space with a Dewar with liquid cryogen.

## Other Laboratory Hazards

### *Radioactive Materials*

Work with radioactive material requires specific training.

- Contact Haitao Dong  
Campus Radiation  
Safety Officer X3573



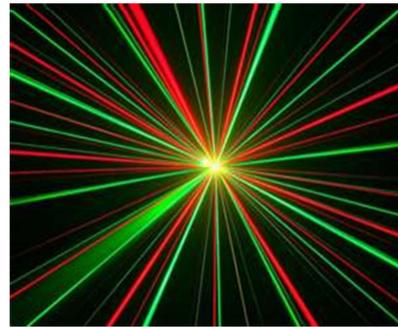
# Other Laboratory Hazards

## *Lasers*

### Work with Lasers Requires Laser Safety Training

- Laser specific training covers:
  - Appropriate eyewear
  - Operating procedures
  - Laser generated air contaminants

**Contact EHS for Training  
303-273-3316**



## Machine Shop Safety

- You are most likely to be injured by equipment that you are not familiar with
- Obtain training before operating equipment



The machine shops at Mines contain a lot of dangerous equipment. It is your responsibility to be properly trained on EVERY machine BEFORE using.

# Lockout Tagout (LOTO)

- What is Lockout Tagout (LOTO)?
  - LOTO is a technique used to prevent energy from being released during the servicing of equipment
  - LOTO is accomplished by placing locks and tags on energy isolation devices prior to starting work
  - LOTO is completed to ensure that the person servicing the equipment remains safe
- DO NOT attempt to start up equipment that been isolated, locked, blocked and/or tagged
- DO NOT remove or damage locks and tags. Removal of locks and tags may place you and the person performing servicing work at risk of injury
- Mines uses red master locks and labels indicating "DO NOT OPERATE Equipment Locked Out"



# Life and Fire Safety



# Life and Fire Safety

Know the locations of emergency equipment:

- Fire Extinguishers
- Fire Alarm Pull Stations
- Emergency Exits
- Safety Shower/Eyewash

**DO NOT** obstruct access to emergency equipment!



Do not block access to fire extinguishers

## Life and Fire Safety



### Fix Displaced Ceiling Tiles

- Displaced ceiling tiles allow smoke to travel quickly throughout a building in a fire



### Do Not Prop Doors Open

- Many doors on campus are designed to withstand flames and prevent a fire from spreading

## Life and Fire Safety

Emergency Equipment  
should be easily accessible!



Access to emergency phone is obstructed by a table. Keep this area clear!

## Life and Fire Safety

Keep the area around safety showers and eyewashes clear of clutter!



## Life and Fire Safety

DO NOT block doors!



*Fire Extinguishers are used:*

- To assure your escape path
- To knock down a small fire before it spreads

*If one extinguisher does not put out the fire, there is no time to get another one. Get out!*

Remember the **PASS** Word

**P**

**Pull**

**Pull** the pin (or other motion) to unlock the extinguisher.



**A**

**Aim**

**Aim** at the base (bottom) of the fire and stand 6 - 10 feet away.



**S**

**Squeeze**

**Squeeze** the lever to discharge the agent.



**S**

**Sweep**

**Sweep** the spray from left to right until the flames are totally extinguished.



# Life and Fire Safety

## Laboratory Refrigerators

- **Do not** use domestic style refrigerators to store flammables
  - Domestic fridges may explode due to build up and ignition of vapors
- Refrigerators used to store flammables **must be rated for flammable storage**



## Safety Review

- Wear safety glasses/goggles, long pants, lab coat, & closed toe shoes.
- Wear gloves when handling hazardous materials.
- Never eat or drink while working in a laboratory.
- Make sure all chemical containers are sealed.
- Clean your work area before leaving the lab.
- Wash your hands when you leave the lab.
- Music ear buds in the lab? No

# Hazardous Waste Generator Training

*Want to Buy Chemicals or Submit Hazardous Waste??*

## **Who is required to attend?**

- Any Mines student (undergraduate and graduate), staff, faculty, or other personnel that work with hazardous chemicals, generates hazardous waste, or purchases chemicals on campus.

## **When do you need to take Hazardous Waste Generator Training?**

- BEFORE working with or purchasing hazardous chemicals or waste.

**Hazardous Waste Generator Training is required annually**

Sign up at: <https://inside.mines.edu/EHS-Training>

Thank You

**Contact EHS if you Have ANY Questions!**

**Test Score of 80% is Required for Course Completion**