



UAH GTA/GRA Lab Safety Training

Presented by:
Office of Environmental Health & Safety





Training Purposes

- ▣ Ensure safety responsibilities are conveyed
- ▣ Promote safe working practices
- ▣ Identify hazardous materials
- ▣ Outline emergency procedures
- ▣ Provide guidance to ensure environmentally sound practices are used



Objectives

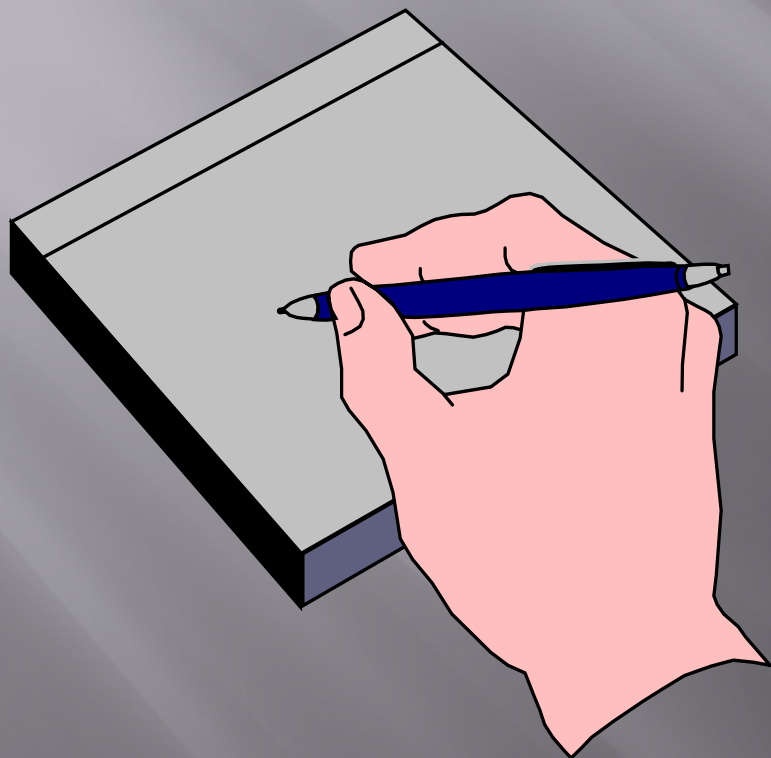
- ❑ UAH lab safety requirements
- ❑ Identify and classify hazards and hazmat
- ❑ Find chemical safety information
- ❑ Minimize exposure
- ❑ Handle chemicals safely
- ❑ Dispose of chemical waste
- ❑ Respond to emergencies
- ❑ Acquire assistance for repairs, emergencies, other safety information
- ❑ Train to recall specific hazard information



UAH Laboratory Safety Program

Laboratory Safety Manual

Review the lab safety manual it is your laboratory BIBLE for planning to work safely and responsibly and handling spills.



Specific Lab Hazards

1. LASER Safety Manual
2. Biological Safety Manual
3. Radiation Safety Procedures

Identify Hazards

Principles of hazard recognition

- Be aware of all potential hazards in a process/situation. Ex: potential for fire, toxic chemical exposure, electrical shock, explosive potential, chemical spray, other.
- Evaluate the potential for each
- Take protective measures to prevent exposure / injury. If unsure, ask the responsible PhD.
- Walk through the lab at the beginning and end of each day to inspect for potential EHS problems.



Identify Hazmat

- OSHA 29 CFR 1910.1450 A chemical in which there is significant statistical evidence that acute or chronic health effects may occur in exposed employees.
- EPA 40 CFR 261.3
 - Listed Wastes
 - Characteristic Wastes
 - Flammable
 - Corrosive
 - Reactive
 - Toxic



Finding Chemical Safety Information

- ❑ Immediate Supervisor
- ❑ Material Safety Data Sheets (MSDS) now SDS under OSHA adoption of the GHS
- ❑ CRC Handbook
- ❑ Chemical Manufacturer
- ❑ Internet Resources
- ❑ OEHS

Safety Data Sheets

OSHA's Lab Standard 29 CFR 1910.1450, (aka subpart Z). This covers *occupational exposure* to hazardous chemicals in labs:

Employers must keep copies of the SDS for each hazardous chemical used or produced in the work place and ensure that they are readily accessible during each work shift when employees are present.

Occupational vs. education vs. research vs. liability

Paper vs. computerized



Safety Data Sheets

- Chemical manufacturers, distributors, or importers must provide SDS as per the Hazcom Standard 1910.1200
 - When deciding what experimental processes will be used ensure that you have reviewed all SDS's and chemical hazards prior to the final decision to use the chemical
 - Substitute a less hazardous chemical whenever possible
 - Order exactly what you will need – hazwaste expense and risk of accidents increase significantly

Hazardous Chemical Hazard Categories

Physical Hazards

- Flammable
- Corrosive
- Reactive
 - Water reactive
 - Pyrophoric (Air reactive ignition)
 - Strong oxidizer
 - Acid sensitive

Health Hazards

- Asphyxiant
- Anesthetic
- Allergic sensitizer
- Systemic toxin
 - Teratogen
 - Carcinogen
 - Neurotoxin
 - Hepatotoxin
 - Nephrotoxin

Flammable Chemicals

- ▣ **Flashpoint:** the minimum temperature at which a flammable or combustible liquids produce enough vapor to form an ignitable mixture with air. Needs ignition source to flash.
- ▣ **Flammable Chemical:** Chemicals with a flash point below 100F(OSHA). Which will flash earliest?
 - ▣ Methyl alcohol(11.10°C)
 - ▣ Benzene(-11°C)
 - ▣ Acetone(-18°C)
 - ▣ Acetaldehyde(-390°C)
 - ▣ Diethyl ether (-45°C)
 - ▣ Gasoline (-45°C)

- **Combustible Chemical:** Chemical with flash point above 100°F and below 200°F (OSHA)
- **Auto-Ignition Temperature:** Minimum temperature at which a substance can ignite in air without an ignition source being present.



When Handling Flammable Chemicals

- ❑ Put flammables in the flamm storage cabinet when not in use.
- ❑ Minimize amounts of flamm substances on lab bench.
- ❑ Do not work with or pour flamm chemicals near an open flame or heat source.
- ❑ Store flamm in a cool, dry, and well-ventilated place.
- ❑ Do not store flamm chemicals with oxidizers.
- ❑ Do not store flamm chemicals in a *non-approved* flammable refrigerator.

Handling Corrosive Chemicals

- ▣ Causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.
- ▣ $\text{pH} \leq 2$ or ≥ 12.5 (EPA)
- ▣ Includes both acids (Ex: sulfuric, nitric, hydrofluoric, etc.), and bases (ammonia, sodium hydroxide, etc...)
- ▣ Don't store acids and bases together!
- ▣ Add acids to water not the reverse. (Remember AA)

Handling Reactive/Unstable Chemicals

- A substance in which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature (OSHA).

Examples:

- Water Reactive (sodium metal)
- Air Reactive (Pyrophoric materials) (t-Butyl-Lithium)
- Strong Oxidizing Agents (sulfuric acid)
- Acid Sensitive (strong bases)
- Peroxides (hydrogen peroxide)

Water Reactive Chemicals

- ▣ Chems that combine with water or moisture in the air to produce heat, flammable, explosive or toxic gases



Examples:

Sulfuric acid

Hydrochloric acid

Sodium azide

Alkali metals



Air Reactive Chemicals *(Pyrophoric)*

- ▣ Pyrophoric chems ignite spontaneously in air at room temp.

Examples:

White phosphorous

Ammonium nitrate

Ammonium perchlorate

Ammonium permanganate

Benzoyl peroxide

Boron hydrides

Dinitrobenzene

Lithium hydride

Tert-butyl lithium



Oxidizing Agents

- ▣ Many are capable of detonation or explosive decomposition under conditions of strong heat, confinement, or a strong shock. Violent reactions occur when strong OA's are mixed with wood or paper.



Acid Sensitive

- Chemicals that react with acids to produce heat, flammable, explosive, and/or toxic gases

Examples: Alkali metals, hydroxides, carbonates, carbides, arsenic, cyanides, sulfides, and most metal.

Peroxides and Peroxide Forming Chemicals

- ❑ Chemicals that are dangerous because of their extreme sensitivity to shock, heat and friction. Peroxides are highly flammable.
- ❑ React with oxygen in ambient air and form shock sensitive peroxide crystals.
- ❑ Opening or shaking the bottle may cause detonation.

Examples: Acrylonitrile, Butadiene, Styrene, Diethyl ether, Tetrahydrofuran, Divinyl ether, Sodium amide.



Toxic Chemicals

- ▣ Acute Toxicity: Caused by contact with a material for a short period of time.
- ▣ Chronic Toxicity: Repeated contact with a material for long period of time.

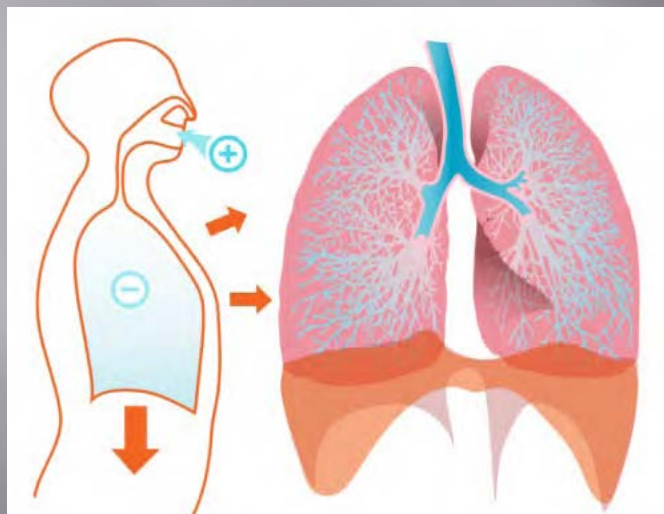
Quantified by:

LD50: the amount of a material, given all at once, which causes the death of 50% (one half) of a group of test animals

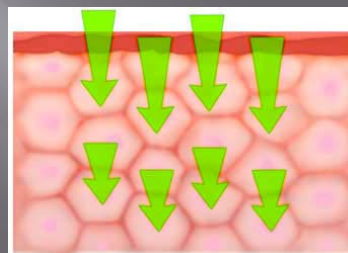
LC50: concentration of the chemical in air or water that kills 50% of the test animals in a given time (usually four hours).

Routes of Chemical Exposure

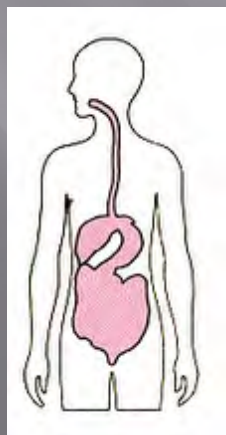
Inhalation



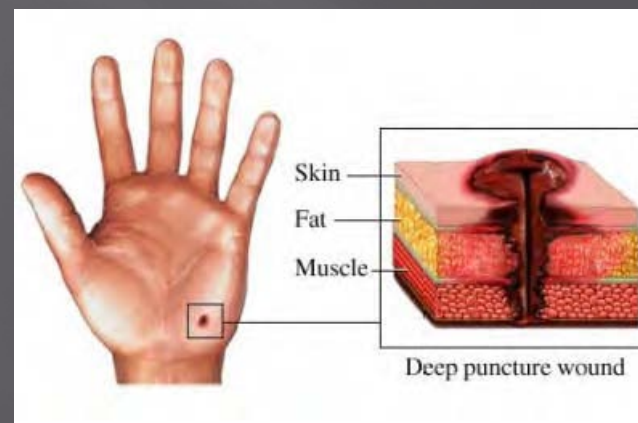
Absorption



Ingestion



Punctures



Chemical Exposure Limits - Air

- **Permissible Exposure Limit (PEL):** OSHA maximum regulatory level of a chemical to which workers can be exposed to over an 8-hour workday, 5 days per week.
- **Threshold Limit Value (TLV):** Annually updated levels that are more current, but not regulatory. Published by the American Conference of Governmental Industrial Hygienists (ACGIH).
- **Threshold Limit Value-Ceiling Limit (TLV-C):** The “ceiling” level that cannot be exceeded at any time.
- **Short Term Exposure Limit (STEL):** Maximum concentration for a continuous exposure period of 15 minutes (with a maximum of four such periods per day, with at least 60 minutes between exposure period)

LD₅₀ Values - Toxicity

>15,000 mg/Kg	Practically non-toxic
5,000-15,000 mg/Kg	Slightly toxic
500-5,000 mg/Kg	Moderately toxic
50-500 mg/Kg	Very toxic
5-50 mg/Kg	Extremely toxic
<5 mg/Kg	Super toxic

Examples

Sucrose: 2970 mg/Kg
Sulfuric acid: 2410 mg/Kg
Benzene: 930 mg/Kg
Formaldehyde: 100 mg/Kg
Nicotine: 3 mg/Kg

Multiply these by 70 Kg to get human LD₅₀

Classes of Toxic Chemicals

- Asphyxiant: Deprive oxygen from the body
ex: Nitrogen, CO₂, He, H₂, Ar, CN, CO, HS
- Anesthetics: Depress the CNS causing drowsiness, disorientation, and stupor.
Ex: Ethanol at high concentrations, chloroform
- Irritants: Cause irritation of the mucous membranes. Ex: strong corrosives (H₂SO₄, HCl, HS)
- Allergic sensitizers: Produce an allergic reaction (skin rash, tearing, sneezing, coughing, bronchitis)
Ex: Isocyanates, formaldehyde, Ni, Cr, latex gloves

■ Systemic Toxins

- Hepatotoxins-Cause liver damage- Carbon Tetrachloride, 1,2-Dichloroethane
- Nephrotoxins-Cause kidney damage
- Neurotoxins-Damage the nervous system-CS₂
- Reproductive toxins-Impair fertility, damage germ cells or disrupt fetal development
 - Mutagens
 - Teratogens
ex: ethylene dibromide, benzene, lead, mercury, cadmium
- Carcinogens-Cause cancer-benzene, asbestos, vinyl chloride, acrylonitrile, ethylene dibromide

Working Safely With Chemicals

- ❑ Use the MSDS to learn about the hazards
- ❑ Read the labels on the containers before use.
- ❑ Avoid distracting or startling others during handling of hazardous chemicals.
- ❑ Do not taste or smell chemicals.
- ❑ Never work alone.
- ❑ Do not eat, drink, or smoke in the lab or any chemical storage area.
- ❑ Use secondary containers when transporting chemicals to avoid dropping or spilling.

- ❑ Keep chemical work areas clean.
- ❑ Confine long hair and loose clothing.
- ❑ Use proper PPE (safety glasses, lab coat, gloves, etc.)
- ❑ Work with chemicals in the fume hood.
- ❑ Notify supervisor immediately of chemical spills. Have a chemical spill kit readily available.
- ❑ Dispose of hazardous waste properly.
- ❑ Consult supervisor or EHS with any questions about chemical you are working with.
- ❑ Ensure all bottles are closed tightly.

Receiving Chemicals

- ❑ The package will be marked if shipped according to DOT regs 19 CFR 171.



- ❑ Check for signs of leakage
- ❑ Insure you have the SDS available to those handling
- ❑ Open under hood when necessary
- ❑ Add to your chemical inventory list
- ❑ Store according to compatibility

Chemical Inventory

- ❑ Chemical Location
- ❑ Responsible person(s) for the area
- ❑ Emergency contact and phone number
- ❑ After hours contact
- ❑ Manufacturers name
- ❑ Chemical Name and CAS
- ❑ Container Size & Quantity
- ❑ Provide inventory to OEHS annually (electronically) and as new or increased quantity of existing chemicals are added
- ❑ Place the inventory in the front of the SDS Binder



Chemical Shipping Container Labels

- ❑ Packages containing chemicals are required by DOT regulations to be labeled and marked to indicate hazards.
- ❑ Packaging is required to be specific to the hazard.



Chemical Labeling

- ❑ Date all incoming chemicals upon arrival to the campus.
- ❑ Time sensitive substances must be tested and disposed of within the active life cycle and prior to becoming more hazardous. (THF, picric acid, peroxide formers)
- ❑ Working solutions must be clearly labeled identifying the contents, concentration, and date of creation.










Globally Harmonized System of Labeling Chemicals (GHS)

- ▣ Read and reread labels carefully to make sure that you use the right chemical and know the hazards
- ▣ Protect yourself based on the hazards
- ▣ Youtube Video (16.5 minutes)

<http://www.youtube.com/watch?v=RvQNf1Y7E84>

Pictograms on Labels

HCS Pictograms and Hazards

Health Hazard  <ul style="list-style-type: none"> • Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity 	Flame  <ul style="list-style-type: none"> • Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides 	Exclamation Mark  <ul style="list-style-type: none"> • Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder  <ul style="list-style-type: none"> • Gases Under Pressure 	Corrosion  <ul style="list-style-type: none"> • Skin Corrosion/ Burns • Eye Damage • Corrosive to Metals 	Exploding Bomb  <ul style="list-style-type: none"> • Explosives • Self-Reactives • Organic Peroxides
Flame Over Circle  <ul style="list-style-type: none"> • Oxidizers 	Environment (Non-Mandatory)  <ul style="list-style-type: none"> • Aquatic Toxicity 	Skull and Crossbones  <ul style="list-style-type: none"> • Acute Toxicity (fatal or toxic)

GHS - Container Label

SAMPLE LABEL

CODE _____
Product Name _____

Product Identifier

Company Name _____
Street Address _____
City _____ State _____
Postal Code _____ Country _____
Emergency Phone Number _____

Supplier Identification

Hazard Pictograms



Signal Word Danger

Keep container tightly closed. Store in a cool, well-ventilated place that is locked.
Keep away from heat/sparks/open flame. No smoking.
Only use non-sparking tools.
Use explosion-proof electrical equipment.
Take precautionary measures against static discharge.
Ground and bond container and receiving equipment.
Do not breathe vapors.
Wear protective gloves.
Do not eat, drink or smoke when using this product.
Wash hands thoroughly after handling.
Dispose of in accordance with local, regional, national, international regulations as specified.

In Case of Fire: use dry chemical (BC) or Carbon Dioxide (CO₂) fire extinguisher to extinguish.

First Aid

If exposed call Poison Center.
If on skin (or hair): Take off immediately any contaminated clothing. Rinse skin with water.

Highly flammable liquid and vapor.
May cause liver and kidney damage.

Hazard Statements

Precautionary Statements

Supplemental Information

Directions for Use

Fill weight: _____ Lot Number: _____
Gross weight: _____ Fill Date: _____
Expiration Date: _____

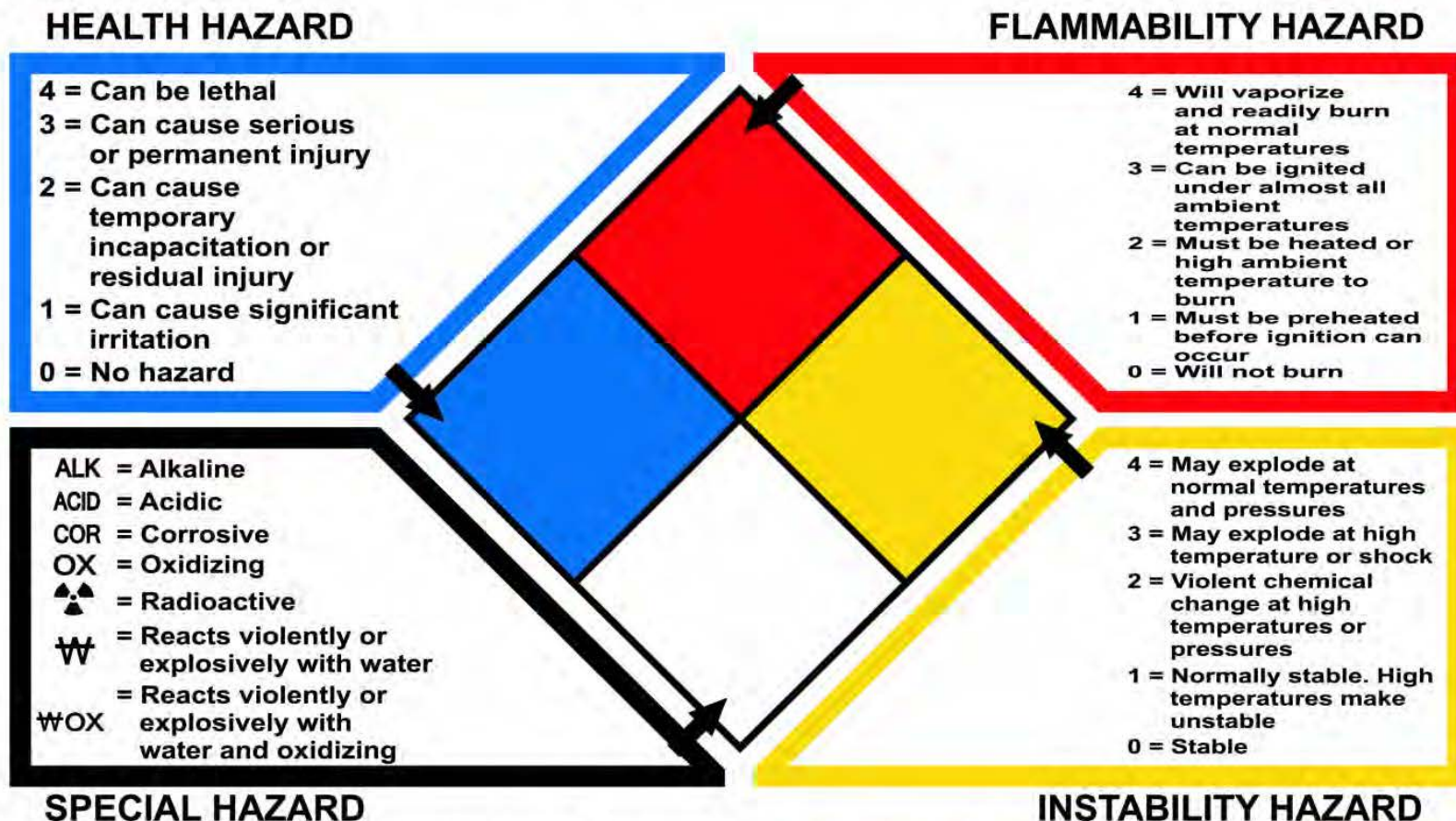
Container Labeling

- Inspect chemical bottle labels



NFPA Diamond

NFPA Rating Explanation Guide



This chart for reference only - For complete specifications consult the NFPA 704 Standard

Product Labels

71536-EU1

Also Known As

MSDS / SDS

Lab Safety Rules

- ❑ Ensure your students/any lab workers know when, where, how of safety showers and eyewashes. These must be flushed on a regular basis.
- ❑ *Only perform work for which you are trained.* Ask your lab supervisor or professor.
- ❑ Notify Professor of all injuries
- ❑ Know the hazards of the chemicals you work with and first aid.
- ❑ Wear protective eyewear, lab coat, gloves, long pants, closed toed shoes, restrain long hair
- ❑ Know emergency procedures
- ❑ Never work alone. Buddy system always.
- ❑ All students must sign the rules form and you must keep a record of this in lab files.

Reduce Exposure to Hazards

- 1: Engineering Controls : remove or reduce hazard by substitution, isolation, or ventilation. Ex: Hood.
- 2: Admin Controls: Reduce exposure time, training, good work practices, hazard recognition, control lab entry.
- 3 PPE: Wear all required PPE and refer to the MSDS for additional information on protecting yourself and students



Proper Use of Fume Hoods

- ▣ **Do not use fume hood as storage area**
- ▣ Look for air flow meter to verify airflow
- ▣ During use:
 - Work 6'' within the fume hood, verify airflow
 - Avoid unnecessary storage of materials inside the hood
- ▣ Close the sash when not in use
- ▣ Do not ignore/silence alarm system
- ▣ After use:
 - Lower the hood sash
 - Cleanup all materials and spills inside the hood

Administrative Controls

- ❑ Implement operational procedures
- ❑ Ensure chemicals are closed tightly
- ❑ Label all chemicals and working stocks
- ❑ Store chemicals in cool, dry, well ventilated location. **Not on counter tops.**
- ❑ Inventory management. Dispose of time-sensitive materials, keep an active inventory list, maintain MSDS, contact EHS for chemical management questions.

Inappropriate Lab Attire

NO open toed shoes

NO loose flowing clothing or hair(long hair tied)

NO dangling jewelry

NO tank tops, shorts, half pants, mini skirts to avoid chemical contact with skin.



Exposure Prevention

- Select PPE based on the chemical
- Mandatory PPE
 1. *lab jacket or apron*
 2. *face shields and or goggles*
 3. *gloves suitable for the chemical in use*
 4. *closed toed shoes made of durable material*



Chemical Hygiene

- Maintain a current chemical inventory and Safety Data Sheet's
- Keep all chemical containers closed while not in use.
- Keep aisles clear and all work surfaces free of chemical residues
- Avoid slipping hazards. Keep floor free from debris and spilled materials



Chemical Hygiene

- Never store materials on the floor or hazardous liquids above eye level
- Use non chromate glassware cleaners for easy disposal.
- Use all solvents under the hood and dispose of solvents in the properly labeled solvent can.
- Close all solvent containers when lab is completed.



Laboratory Hygiene

- Glass - Dispose in designated glass waste containers
- Sharps - Dispose in sharps containers
- Cylinders - Chain to a wall and store with valve cover on, label when empty
- Electrical - Use outlets appropriate for instrument, don't overload circuits

Lab Hygiene

- Lockout/Tagout tags must be removed by maintenance personnel only!
- All safety showers and eyewashes must be clear of lab furniture and electrical equipment
- Cylinders - Chain cylinders to a wall or non-movable table; Store with valve cover on; label when empty and call CRS for pickup.
- Electrical - Use outlets appropriate for instrument, don't overload circuits

Weekly Safety Checks

- ❑ Eye wash (purge)
- ❑ Fire extinguisher
- ❑ First Aid Kit
- ❑ Fume Hood
- ❑ Tubing, pressurized connections
- ❑ Chemical storage





Chemical Waste Disposal

- ❑ All chemical waste must be appropriately labeled
- ❑ Dispose of waste as soon as possible upon generating
- ❑ Submit a UAH Chemical Waste Inventory to the OEHS

Leaving the Lab?

Turn off:

- ☯ Gas
- ☯ Water
- ☯ Power supplies
- ☯ Vacuum lines
- ☯ Compression lines
- ☯ Heating apparatus





Leaving the Lab?

- ☯ Identify and package waste, dispose properly
- ☯ Lock/out and tag/out defective equipment
- ☯ Decontaminate work surfaces and equipment
- ☯ Return unused equipment, apparatus, etc.
- ☯ Leave lab coat in the lab
- ☯ Wash/dry your hands
- ☯ Close and lock door

SECTION II - RESPONDING TO EMERGENCIES



Accident Response

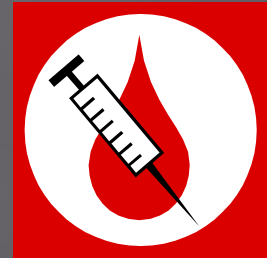
Be prepared for emergencies -

▣ *Emergency Response Steps*

- 1) Alert others in the area to the emergency*
- 2) Protect yourself know escape routes*
- 3) Help any person in need (First Aid Kit Location)*
- 4) Alert appropriate authorities for help call 6911*
- 5) Complete injury consultation form & accident report*

Bloodborne Pathogens

- ▣ AIDS
- ▣ Hepatitis
 - Hep-B vaccines for designated persons
- ▣ No contact with blood or body fluids
- ▣ Wear protective equipment, especially gloves & safety glasses
- ▣ Biohazard Waste - “Red Bag”
- ▣ Sharps disposal containers

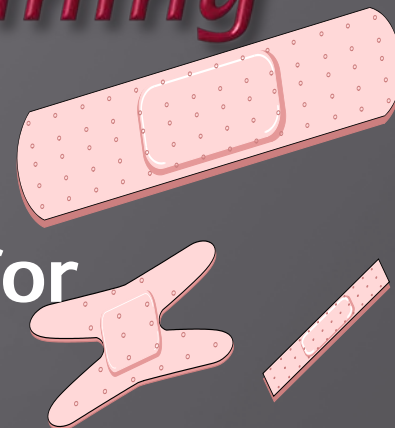




First Aid Safety training

OEHS offers the following classes for a small fee to UAH employees

- Red Cross Standard First Aid (3 years)
- American Red Cross CPR/AED (2 years)
- Refresher classes for American Heart CPR/AED & Red Cross First Aid





Chemical Spill Clean-up

- Small spills (<5 liter) of materials that do not require respiratory protection
 - spill kits must be available in chemical stock rooms and in areas of high chemical use
 - departments are responsible for replenishing the spill kit items when used
 - Call Police at 911 for all immediate response services



Chemical Spill Clean-up

- ❑ Police Officers must clear the area, collect chemical information and contact the OEHS
- ❑ If there are injured persons and the chemical is not identifiable pull the fire alarm and call 6911 from a campus phone

Types of Fire Extinguishers

Water – Class
A Fires



CO2 – Class
B & C Fires



Dry Chemical
– Class A,B,C

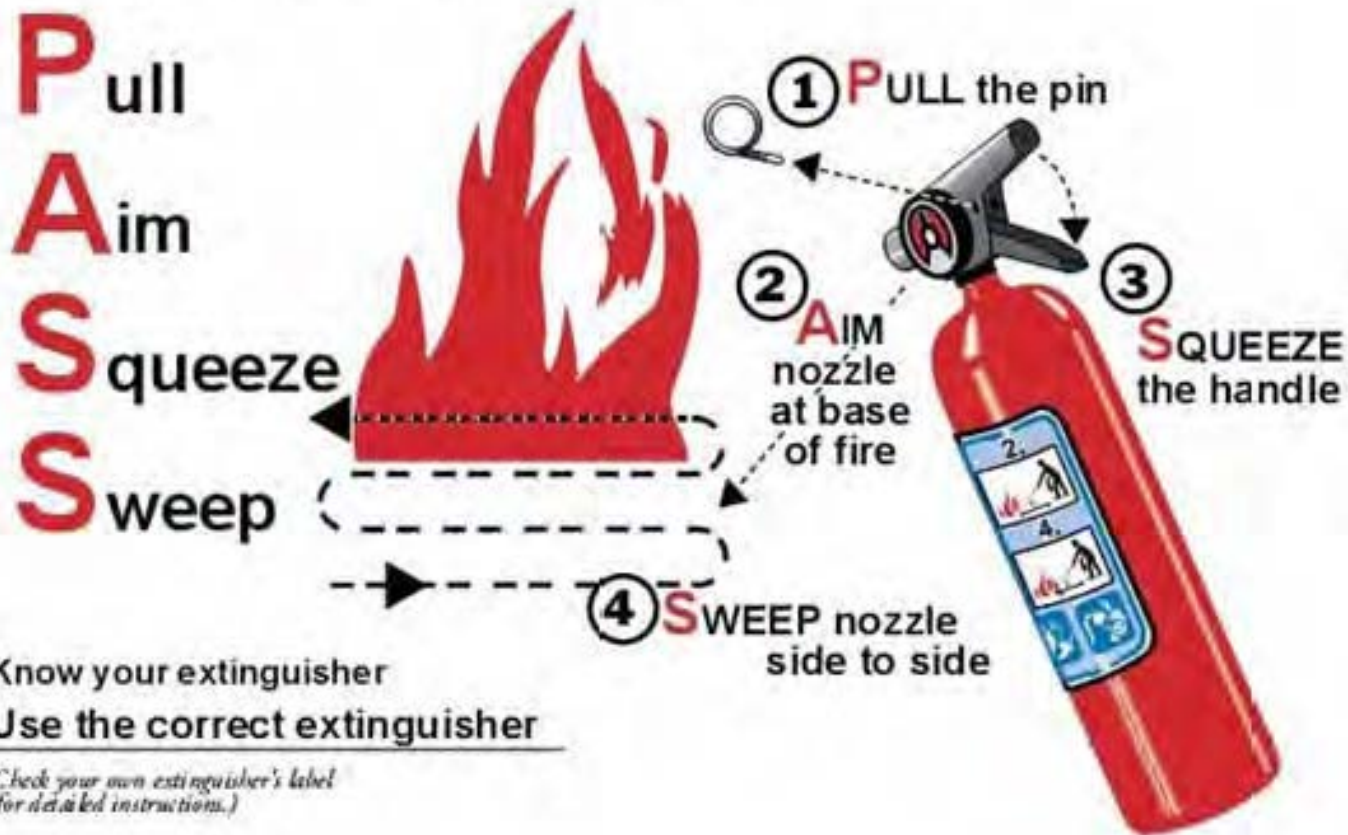


Met-LX –
Class D



Fire Extinguisher Use and Availability

To operate an extinguisher:



In Case of a Fire: R.A.C.E.

- ▣ Remove anyone from the area
- ▣ Activate closest pull station
- ▣ Call 911
- ▣ Extinguish if safe and Evacuate

These steps do not have to be followed in sequential order. Assess the situation and determine the appropriate course of action.

Evacuation

- ❑ Notify people in the immediate area
- ❑ Lead students to the nearest stairwell and evacuate down. Never up.
- ❑ Mobility impaired persons should be taken to the stairwell and left on the landing. Tell the floor captain immediately if there are any persons on landings or remaining in the bldg.
- ❑ Proceed to the assembly area, insure all are accounted for.
- ❑ Do not leave or re-enter until the floor captain provides notice.

Severe Weather Refuge

- Upon notification of severe weather immediately take yourself and your class to the protective areas designated on Emergency Maps.
- If unsure where this is or there is not one designated go to the lowest innermost part of the building away from windows, doors, stairwells.
- Do not return to the classroom until the all clear is received from the floor captain.



Safety Practices

- ▣ Inspect work area daily
- ▣ Be an observer - stay alert
- ▣ Hygiene, Hygiene, Hygiene
- ▣ Best safety device - Plan ahead
- ▣ If you're not sure - Ask someone!!
- ▣ Report Injuries/Incidents/Illnesses to lab supervisor
- ▣ Report safety issues to the lab supervisor or OEHS

Conclusion

- ▣ Safety practices protect all UAH occupants and the surrounding communities.
- ▣ Make sure safety practices are first priority in all lab work.
- ▣ Direct Questions to OEHS at x6053 or for additional information, go to www.uah.edu/oehs

[Link to Training](#)
[Acknowledgement](#)