

## Introduction

Welcome to the Chemical Safety Training (CS101) Course Material. This training course is a part of your [Right-To-Know](#). Anyone handling potentially harmful chemicals during their work at UAB must complete this course.

## Objectives

After this course, participants will be able to:

1. Identify and classify a hazardous chemical's class and type.
2. Demonstrate ways to assess and manage the hazards associated with chemicals.
3. Re-label any new transfer bottles.
4. Implement the proper procedures for responding to spills, emergencies, or injuries.
5. Maintain an accurate chemical inventory.

## Regulatory Agencies

**Department of Transportation (DOT)** has the responsibility of governing the packaging, markings, and transporting of hazardous materials. The [DOT](#) also sets standards for shipping labels, containers, and carriers.

**Occupational Safety and Health Administration (OSHA)** has the responsibility of developing and maintaining the [OSHA Laboratory Standard](#). UAB uses this standard as a model for its programs.

**Environmental Protection Agency (EPA)** has the responsibility of regulating the storing and disposing of hazardous chemicals and materials. **Alabama Department of Environmental Management (ADEM)** and **Jefferson County (JeffCo)** has the duty of governing the disposal of hazardous waste.

**UAB Department of Environmental Health and Safety (EHS)** oversees UAB health programs and conducts random lab safety reviews. Lab reviews check for hazardous agent use, handling techniques, and controls used to prevent exposure.

## Recognizing Hazards

### Hazards Defined

#### *Hazardous Substance*

A hazardous substance is a material or substance that poses a physical or health hazard. **Health Hazards** occur when a chemical produces an acute or chronic health effect on exposed individuals. Physical properties of a substance determine a **Physical Hazard**.

#### Physical Hazard Examples:



Flammable

Explosive

Pyrophoric

Corrosive

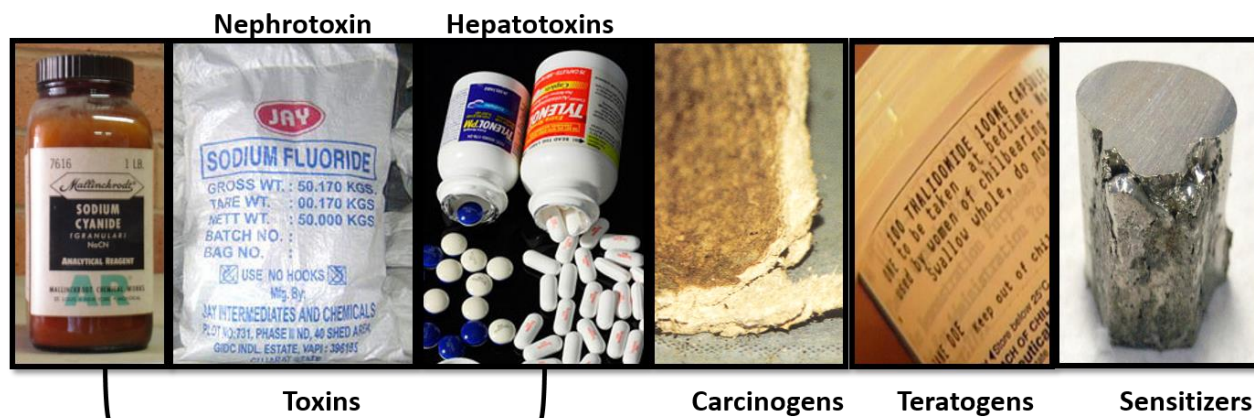
Reactive

Peroxide  
Former

#### Health Hazard Examples:

- **Nephrotoxin:** A toxic chemical that damages the kidneys (e.g., Cisplatin, Aminoglycoside, Antibiotics, Indomethacin).
- **Hepatotoxin:** A toxic chemical that damages the liver (e.g., Ethanol, Halothane, Carbon Tetrachloride).
- **Teratogen:** A toxic chemical that causes the malformation of an embryo (e.g., Alcohol).

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For more detailed information on health and physical hazards, see [Two Group of Hazards](#).

## Acute vs. Chronic

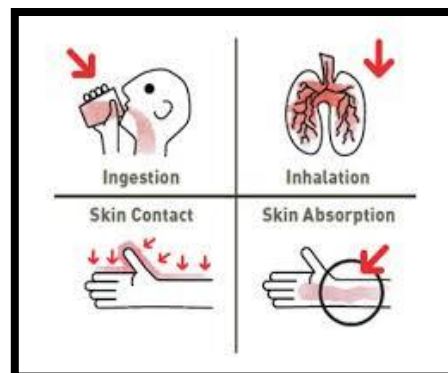
**Acute Hazards** cause immediate harm (e.g., Carbon Monoxide poisoning, Cyanide inhalation, etc.). **Chronic Hazards** do not cause immediate harm (e.g., Mesothelioma from Asbestos exposure, lung cancer from smoking, etc.).

## Routes of Exposure

The four routes of exposure are ingestion, inhalation, injection, and skin contact.

## Toxicity

The degree to which a toxic chemical can cause damage. Dosage, duration, and exposure to chemicals affect toxicity.



## Labeling










### Requirements

The original label of the chemical is the best source of information to acquire knowledge about the hazards, emergency information, and storage. Original labels are required to have the following:

- Product Identifier
- Supplier Identification
- Precautionary Statements
- Pictograms
- Signal Words: (Danger or Warning). Danger means there is a severe hazard present, and warning is a moderate to low hazard present.
- Hazard Statement
- Supplemental Information



## Pictograms

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

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## NFPA Diamond

The National Fire Protection Association (NFPA)

Diamond helps determine if any specialized equipment, procedures, or precautions are needed. The four divisions are typically color-coded with red (flammability), blue (level of health hazard), yellow (chemical reactivity), and white (special hazards). Examples of special hazards:



- OX: Burns without an air supply
- ~~W~~: Reacts with water violently
- SA: Simple Asphyxiant Gas



Within these different color-coded squares you may see a number (1-4) or a letter. Higher the number, the more severe the hazard will be.

## Secondary Containers

Secondary containers (e.g., squeeze bottles, spray bottles, flasks, tubes, etc.) are required to have:

- Same name as the original container
- All hazard class and target organ information as listed on the original bottle
- Date transferred

### Xylene

Irritant and Flammable!

Toxic to blood, kidneys,  
nervous system, liver

Date Transferred 06/30/2017

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## Safety Data Sheets (SDS)

Employees are strongly recommended to review the SDS before starting to work with any new chemicals. An SDS must be available to all employees working in the area. Contact UAB's Department of Environmental Health and Safety (EHS) at (205) 934-2487 if you need assistance in obtaining Safety Data Sheets (SDS). The hazard severity ratings on SDS's are the opposite of the NFPA System. The number one on an SDS is the most hazardous, and five is the least hazardous.

An SDS will contain:

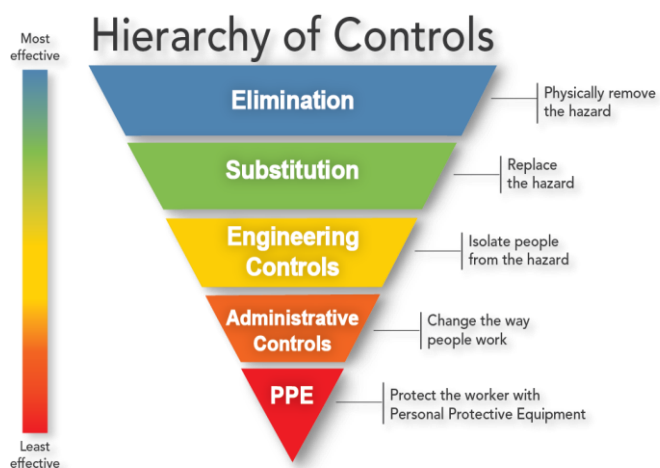
- Chemical Name and Identification
- Hazard Identification: Pictograms and Signal Word
- Personal Protective Equipment (PPE)
- Disposal Requirements

## Minimizing Hazard

### Hierarchy of Controls

#### Elimination vs. Substitution

**Elimination** is removing a hazard (e.g., not using Ether in your process). **Substitution** is using a less hazardous material (e.g., using Hexane in place of the known carcinogen Benzene).



## Engineering Controls

If a hazard cannot be eliminated or substituted, the best approach is to use engineering controls to keep the hazard from reaching the worker. Examples are fume hoods, glove boxes, and biosafety cabinets.



## Administrative (Work Practice) Controls

### Chemical Hygiene Plan (CHP)

A CHP is a detailed [written plan](#) explaining the hazards present, how to manage them safely, and be specific to the individual lab or research group. Must be available to all employees working in the area.

### Chemical Hygiene Officer (CHO)

Department heads or the Principal Investigator (PI) will appoint someone to this position. A CHO is also known as a Lab Coordinator. A CHO is responsible for:

- Serving as liaison with UAB Occupational Health and Safety (OH&S).
- Implementing, updating, and administering the CHP (including the provisions for obtaining prior approval for dangerous procedures).

### Standard Operating Procedures (SOP)

An SOP is a set of step-by-step instructions that help employees carry out routine laboratory operations, improve efficiency, and reduce miscommunication. PI's or Department Head's develops the SOP, ensures control measures are in place, and there is adequate protective equipment. EHS reviews these SOPs during the annual laboratory safety reviews and makes recommendations.



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## Storage

You should store chemicals according to compatibility and hazard class. Storing them alphabetically, or by carbon number, or by physical state, etc. are not acceptable practices. EHS recommends segregating them by [EPA Segregation Guidelines](#).

- Storing flammable liquids in quantities greater than 10 gallons in a flammable storage cabinet.
- Acids and bases stored separately and storing oxidizers away from organic materials that could react to cause a fire.
- Always store corrosive and other hazardous chemicals below the eye level. Never store chemicals on the floor. Use secondary containment for liquids.

## Special Requirements

### *Explosives*

There are two types of explosive chemicals.

1. **Explosive Chemicals:** Designed, produced, or used as an explosive (e.g., TNT, Explosive Bolts, Bullets, Blasting Caps, and Fireworks). Research labs do not use these.
2. **Potentially Explosive Chemicals (PECs):** Over time, these chemicals become explosive when subjected to heat, light, friction, or mechanical shock (e.g., Diethyl Ether, Tetrahydrofuran, Sodium Amide, and Picric Acid).

### *Peroxide Formers*

[Peroxide Formers](#) are a class of chemicals with high instability and are one of the most dangerous chemicals used in laboratories. Shock, heat, or friction can cause unexpected explosions of peroxide forming chemicals. Since peroxide crystals form on the lid and detonate when the cap is twisted, it is advised not to open a container if you suspect the formation of peroxides. Some common classes of compounds that form peroxides include Ethers, Tetrahydrofuran, Aldehydes, and Acetals. Ether is no longer used as an anesthetic agent. If you need more information on animal anesthesia, please contact the ARP at (205) 934-3553.

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You should do the following:

- Limiting the number of containers stored in the lab.
- Ensuring that the following is on the label:
  - Warning “PEROXIDE FORMER”
  - Date of purchase
  - Date of opening
  - Required discard date (within 24 months)
- Storing in airtight containers away from heat and light.
- Inspecting for signs of peroxide formation (e.g., crystallization, discoloration, stratification, etc.).
- Testing all opened containers of such materials every three months for peroxides. Obtain test strips from laboratory or safety supply vendors.
- Disposing of containers before the expiration date.

### *Particularly Hazardous*

The use of particularly hazardous substances, such as select carcinogens, reproductive toxins, or acute toxins may require prior review/approval to ensure adequate controls are in place to protect the workers. EHS will be available to review and make recommendations for additional employee protection protocols.

## UAB Chemical Inventory

EHS maintains an online [chemical inventory](#) that meets Federal and State requirements. This system utilizes barcodes and a web-based interface. The chemical inventory allows users to track the chemicals that are on-hand. Also, the inventory fulfills an agreement with local emergency response agencies, allowing them to access information regarding possible chemical hazards. All hazardous chemicals with an NFPA rating of two or above belong in the [chemical inventory](#). The users are required to update the inventory every six months.

If you are changing labs and need to move your inventory, you should contact EHS first. Contact EHS at (205) 934-2487 if you have questions or need assistance with your chemical inventory.

## Personal Protective Equipment (PPE)

All persons, including visitors, who enter areas where hazardous chemicals are used or stored, must wear PPE. All PPE should be kept inside the lab to minimize the possibility of spreading contaminants to public areas. Your PPE is the “last line of defense” against potential exposures. It is never a substitute for engineering controls or strict work practices.

### Lab Coats

- **Must never be worn outside the work area.**
- Protect your skin and personal clothing from any incidental contact.
- Provide a removable barrier in the event of an incident involving a spill or splash of hazardous substances.
- Must be offered in different types and styles. Your selection **must match** the type of hazard present in the lab.
- Must be clean, buttoned, and long-sleeved to provide limited protection from chemical splashes.
- Must be of 100% cotton or treated with a flame retardant material.
- Wear an impenetrable apron and sleeves for more protection if needed. When working with highly toxic substances, you must tuck the sleeves into the gloves.



### Gloves

Selecting the right glove depends on your work, substance used, SDS Recommendation, and breakthrough time. **No one type of glove protects against all [chemicals](#).** You should:



- Check gloves for holes and tears before use.
- Change disposable gloves as soon as they become contaminated.
- Wash hand with soap and water before leaving the lab.

## Glasses, Goggles, and Shields

Before donning glasses, goggles, or face shields, make sure that you are wearing the appropriate one for the job. Remember, safety glasses do not protect from chemical splashes. You should be:

- Using safety glasses whenever there is a chance of objects striking the eye. They are not appropriate protection from a chemical splash.
- Wearing splash goggles when working with liquids.
- Wearing a face shield with splash goggles when the splash hazard is high, or the chemicals are particularly dangerous.



## Respirators

The selection and use of respirators require specialized training. Before wearing a respirator, employees must undergo medical screening, training, and testing. Anyone who needs to wear a respirator for their work should contact EHS at (205) 934-2487.

## Preparing for Emergencies

### Safety Equipment

#### Fire Extinguisher

A fire extinguisher is a device that dispenses water, foam, gas, or other material to extinguish a fire. You can find them in hallways, meeting rooms, and near exit doors, etc. Fire extinguishers must be selected and positioned based on the possible type and size of the fire that can occur.

- **Class A:** NFPA recommends that locations such as offices, classrooms, and assembly halls contain a Class A Extinguisher. OSHA requires that all persons have access to this type of extinguisher within 75 feet of their workspace.



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- **Class B:** NFPA recommends that locations such as workshops, storage areas, research operations, garages, etc., contain a Class B Extinguisher. OSHA requires that all persons have access to this type of extinguisher within 50 feet of their workspace.

### *Eyewash Station*

An eyewash station is a device that protects workers against chemical-related eye injuries. Most stations have a shower-like sprayer that, when pressed, sprays water down on the worker's eyes. Eyewashes should be inspected weekly by the lab personnel and maintained according to the manufacturer's instructions. For more information, see [Emergency Eyewash Testing](#).



### *Safety Shower*

A safety shower is a device that washes an individual who has come into contact with hazardous chemicals. A user may need to remove contaminated clothing. Safety showers are inspected annually by UAB Maintenance.



## Spills

### *Small vs. Large*

**Spills** of 500ml or less are considered **small**. Spills of more than 500ml are considered **large**. However, spills of less than 500ml may be regarded as large if the material involved is particularly hazardous.



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### *Spill Kits*

Purchase or create your spill kit if the laboratory or area does not have one. However, when purchasing a spill kit, make sure that you get one that is best suited for your lab and the hazards in it. Chemical and biological spill kits are available to purchase from most vendors. For more information on spills, spill kits, and cleanup review see [Emergency Spill Kits](#).

### *The EHS Spill Response Team*

The EHS Spill Response Team has been specially trained to handle hazardous chemical spills. The EHS Support Facility Manager will contact the Spill Response Team, which will have full authority over the cleanup operation. The EHS Support Facility Manager or his designee will be responsible for calling any additional personnel needed at the site of the spill. Anyone deliberately hindering the Spill Response Team at the site of a spill is jeopardizing the health and safety of other UAB employees, and will be subject to disciplinary action.



Call the UAB Police at (205) 934-3535 from an UAB campus landline (these apply to all emergencies). Calling 911 from your cell phone, will notify Birmingham Police and delay the response time.

### Conclusion

This section concludes the course material for the Chemical Safety (CS101) training course. If you have not taken the assessment, please do so now. You must score 90% or higher to pass.

### Other Training

- **Compressed Gases:** If you are handling, storing, packing, or manifesting compressed gases, you must complete the [Managing Compressed Gas Cylinders \(OHS200\)](#) training course.
- **Hazardous Waste:** If you are handling, storing, packing, or manifesting hazardous waste, you must complete the [Hazardous Waste Handling and Packing \(CS055\)](#) training course.
- **Biosafety Cabinets and Fume Hoods:** Anyone that will be conducting work or research in a Biosafety Cabinet, Fume Hood, or Clean Air Station, must complete [Biosafety Cabinets and Fume Hoods \(BIO304\)](#).
- **Pyrophoric Chemicals:** If you are handling, storing, packing, or manifesting pyrophoric chemicals, you must complete the [Working Safely with Pyrophoric Chemicals at UAB \(CS305\)](#) training course.

EHS has many training courses available to all UAB active employees and students. There is a [decision tree](#) to assist you in choosing the right course to match the knowledge/skills you may need at work every day. If you have any questions or comments, contact EHS at (205) 934-2487.