



# **Chemical Safety**

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### Learning objectives

- To increase the awareness of chemical hazards in laboratories
- To learn where to seek information about chemical hazards in the laboratory



- To understand the standardized approach for communicating hazards effectively
- To methods for controlling and mitigating chemical hazards

### Elements of safety

- Three main elements of safety
  - Hazard awareness: Recognizing risks associated with chemicals and laboratory operations
  - Hazard protection: Implementing measures to minimize exposure to hazards
  - Emergency procedure: Understanding the measures to be taken in case of chemical spill or exposure

### General lab safety

- No food or drink in the lab
- No smoking
- Dispose of laboratory waste properly
- Handle broken glassware carefully
- Wash hands with soap and water frequently. Hands should be washed after handling any hazardous materials, after the removal of gloves, and before leaving the laboratory.
- Emergency exits should be always clear
- Follow electrical safety protocol
- Only authorized trained personnel may enter the lab
- Avoid mouth pipetting and use mechanical pipettes instead.
- Place different lab wastes in their containers. Do not place them in the regular trash.
- Pay attention to sharps in the lab. Place them in their designated container. Do not place them in the regular trash.
- Autoclave biological hazards before getting rid of them in the regular trash.
- All containers should be labeled properly (even water bottles should be labeled to avoid confusion with other chemicals).
- Wear appropriate lab attire:
  - Lab coats
  - Closed-toe shoes
  - Gloves



- Safety glasses
- Be thoughtful of other personnel in the lab, environment, animals, and sea life.
- Maintain clear and effective communication with colleagues to prevent accidents.

### Routes of Exposure

- Ingestion: Accidental swallowing of chemicals.
- Inhalation: Breathing in vapors, fumes, or dust.
- Injection: Accidental punctures through the skin.
- Skin contact: Direct exposure leading to irritation or absorption.

### Control of Chemical Hazards:

- Use fume hoods for volatile substances.
- Implement proper ventilation.
- Store chemicals properly.
- Ensure that safe handling procedures are followed.

### Tools for Communicating Hazards

- GHS pictograms
- Label
- SDS sheet
- Laboratory door signs

### Hierarchy of controls:

- **Elimination:** Remove hazardous chemicals when possible
- **Substitution:** Use less hazardous alternatives
- **Engineering Controls:** Use safety equipment such as fume hoods
- **Administrative Controls:** Implement policies, training, and safety procedures.
- **Personal Protective Equipment:** Use gloves, lab coats, and goggles.

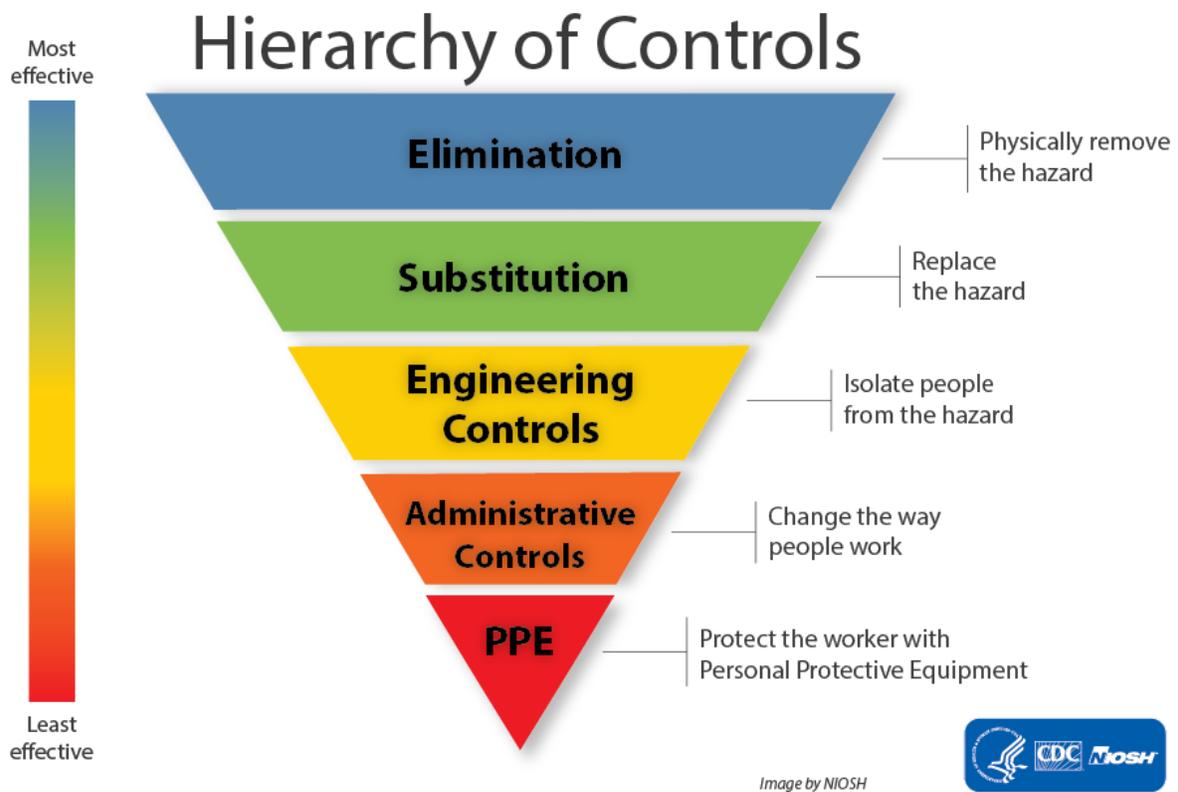


Figure 1. Hierarchy of Controls (Adapted from CDC).

## GHS Pictograms

- Nine pictograms are used to communicate different chemical hazards
- These pictograms are based on the Globally Harmonized System (GSH).
- To learn more about GHS and these pictograms follow the [link](#)



Figure 2. GHS pictograms (adapted from First American Safety).

<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> <li>• Desensitized Explosives</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 (harmful)</li> <li>• Narcotic Effects</li> <li>• Respiratory Tract Irritant</li> <li>• Hazard Not Otherwise Classified (non-mandatory)</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> <li>• Chemicals 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>

Figure 3. Pictograms and Hazards (adapted from [www.osha.gov](http://www.osha.gov)).



## Safety Data Sheet (SDS)

The According to Hazard Communication Standard (HCS), the chemical manufacturer, distributor, or importer should provide Safety Data Sheet (SDS), previously known as MSDSs.

SDS contains 16-section.

Section 1: Identification

Section 2: Hazard identification

Section 3: Composition/information on ingredients

Section 4: First aid measures

Section 5: Firefighting measures

Section 6: accidental release

Section 7: Handling and storage

Section 8: Exposure controls/ personal protection

Section 9: Physical and chemical properties

Section 10: Stability and reactivity

Section 11: Toxicological information

Section 12: Ecological information

Section 12: Disposable considerations

Section 14: Transport information

Section 15: Regulatory information

Section 16: other information

Basically, most of the information you need to know about your chemicals, their hazards, and how to handle these chemicals can be found in the SDS. SDS is your invaluable resource in the lab.

How to get the SDS for a chemical: It's pretty easy to find the SDS for a chemical compound. You can simply search for it using this [link](#) for Sigma Aldrich or this [link](#) for ThermoFisher Scientific. You can also google it by typing the name of the chemical followed by SDS Sigma Aldrich or SDS ThermoFisher Scientific, below are examples:

Chloroform SDS Sigma Aldrich

[Chloroform](#)

Or

Chloroform SDS ThermoFisher Scientific

[Chloroform](#)

For more details about SDS please follow the link below

<https://www.osha.gov/sites/default/files/publications/OSHA3514.pdf>



## Labeling

All containers should be labeled properly. Labels should include the following:

- Full name of the chemical.
- Concentration.
- Chemical hazard.
- Chemical formula (optional).

## Spill kits and Emergency Procedures

- Spill kits must be available for chemical spills.
- Procedures include:
  1. **Minor Spills:** Contain with absorbent.
  2. **Major Spills:** Evacuate the area, notify safety personnel immediately.
- Eye wash stations and safety showers must be accessible.



## Storage of Chemicals

- Store chemicals according to compatibility groups.
- Keep flammable chemicals in approved safety cabinets.
- Store corrosive and reactive chemicals separately.
- Maintain an updated inventory of stored chemicals.

## Chemical Waste Management

- Follow university guidelines for disposal.
- Label waste containers correctly.
- Never pour chemicals down the drain unless explicitly allowed.
- Dispose of hazardous waste through authorized channels.

## Auditing and Compliance

- Follow university guidelines for disposal.
- Label waste containers correctly.
- Never pour chemicals down the drain unless explicitly allowed.
- Dispose of hazardous waste through authorized channels.

## Training

- All personnel must receive training on chemical safety.
- Periodic refresher training should be conducted.