# General Laboratory and Chemical Safety

**University of Houston Clear Lake**

**Environmental, Health and Safety Department**

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## Outline

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- Minimize or Eliminate Biohazards
- Engineering Controls & Injury Prevention
- How to Remove Gloves
- Hand Hygiene
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- Spill Clean Up
- Sharps Injury Log
Safety is Everyone’s Responsibility

• Provide you a safe laboratory work environment
• Give you proper instruction on procedures
• Train you on safely handling potential laboratory hazards
• Ensure all safety and laboratory equipment is in good condition
• Make every attempt to keep hazardous chemical exposures low to keep you safe
• Design experiments with safe practices to eliminate as many hazards as possible
Your Responsibility

- Follow all safety guidelines, instructions and procedures
- Follow all instruction given by your instructor and teacher’s aid (TA)
- Read and understand all experiment procedures, and material given in lectures
- Know how to safely operate equipment or instruments prior to use
- Understand and follow all product warning labels
- Read, understand and follow all (Material) Safety Data Sheets
- Always correctly wear proper Personal Protective Equipment when in the laboratory
- Expect that some hazards are always present in a chemistry laboratory
- Always report any unsafe conditions to your instructor

OSHA’s adoption of the Globally Harmonized System (GHS) for Hazard Communication 2012, has brought significant changes to Material Safety Data Sheets (MSDS).

- The new Safety Data Sheets (SDS) are an essential component of GHS, and are intended to provide comprehensive information about a substance or mixture for use in workplace chemical management.

- SDS are intended to promote a consistent, user-friendly source of info about hazards, including environmental hazards, and to obtain advice on safety precautions.
SDS Sections

- **Section 1 – Product and Company Identification**
  Includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.

- **Section 2 – Hazards Identification**
  Includes all hazards regarding the chemical; required label elements.

- **Section 3 – Composition/Information On Ingredients**
  Includes information on chemical ingredients; trade secret claims.

- **Section 4 – First-Aid Measures**
  Includes important symptoms/effects, acute, delayed; required treatment.

- **Section 5 – Firefighting Measures**
  Lists suitable extinguishing techniques, equipment; chemical hazards from fire.

- **Section 6 – Accidental Release Measures**
  Lists emergency procedures; protective equipment; proper methods of containment and cleanup.

- **Section 7 – Handling and Storage**
  Lists precautions for safe handling and storage, including incompatibilities.

- **Section 8 – Exposure Controls/Personal Protection**
  Lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).

- **Section 9 – Physical and Chemical Properties**
  Lists the chemical's characteristics.

- **Section 10 – Stability and Reactivity**
  Lists chemical stability and possibility of hazardous reactions.

- **Section 11 – Toxicological Information**
  Includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.

- **Section 12 – Ecological Information**
  This section provides information to evaluate the environmental impact of the chemical(s) if it were released to the environment.

- **Section 13 – Disposal Considerations**
  This section provides guidance on proper disposal practices, recycling or reclamation of the chemical(s) or its container, and safe handling practices.

- **Section 14 – Transport Information**
  This section provides guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea.

- **Section 15 – Regulatory Information**
  This section identifies the safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS.

- **Section 16 – Other Information**
  Includes the date of preparation or last revision.
Section 5 – Firefighting Measures
Lists suitable extinguishing techniques, equipment; chemical hazards from fire.

Section 6 – Accidental Release Measures
Lists emergency procedures; protective equipment; proper methods of containment and cleanup.

Section 7 – Handling and Storage
Lists precautions for safe handling and storage, including incompatibilities.

Section 8 – Exposure Controls/Personal Protection
Lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).

Personal Protective Equipment (PPE) and Pictograms
Describes the best materials for your PPE. For example, choosing the best material type of glove tissue.

Materials for protective clothing
Describes the best materials for your PPE.
Section 9 – Physical and Chemical Properties
Lists the chemical’s characteristics.

Auto-Ignition Temperature
Lowest temperature where a material will ignite without an external source of ignition. Heating to this point may result in an explosion.

Section 10 – Stability and Reactivity
Lists chemical stability and possibility of hazardous reactions.

Acetone Safety Data Sheet

Section 11 – Toxicological Information
Includes routes of exposure, related symptoms, acute and chronic effects, numerical measures of toxicity.
**Section 12 – Ecological Information**

- Acute oral toxicity: No data available
- Acute dermal toxicity: No data available
- Acute eye irritation: No data available
- Skin corrosion/irritation: No data available
- Respiratory sensitization: No data available
- Skin sensitization: No data available
- Germ cell mutagenicity: No data available
- Reproductive toxicity: No data available
- Neurotoxicity: No data available
- Carcinogenicity: Not classifiable as to its carcinogenicity to humans (Group 3, IARC Group 3, US EPA Group C, Canadian Carcinogen Database C4)
Section 16 – Other Information
Includes the date of preparation or last revision.

NFPA (National Fire Protection Association) Ratings
Rating order from Severe (4) to Minimal (0).
Example shown would be “NFPA 704M Rating: 1-3-0”

GHS – is an acronym for the Globally Harmonized System (GHS) of Classification and Labeling of Chemicals developed by the United Nations for Hazard Communication purposes.

- It is not a global law or regulation, but it has been adopted by over 65 countries.
- It is a worldwide system for standardizing hazard classification criteria and the communication of chemical hazards.

GHS system includes these 6 label elements:

1. Signal Word
2. GHS Symbols (Hazard Pictogram)
3. Manufacturing Information
4. First Aid
5. Hazard Statements
6. Product Name / Identifier
**GHS Label Elements**

1. **Signal Word** – Indicates the hazard level. “Danger” is used for the most severe, “Warning” is less severe.
2. **GHS Hazard Pictograms (Symbols)** – Identifies hazardous products, commonly grouped by chemical/physical risk, health and environmental risk.
3. **Manufacturing Information** – Manufacturer’s name, address telephone number.
4. **First Aid** – Describes general preventative, response, storage or disposal precautions.
5. **Hazard Statements** – Describes the nature of hazardous products and degree of hazard.
6. **Product Name/Identifier** – Identifies the product or chemical name.

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**Acetone**

**Hazard**

- **Explosive**
  - Highly Flammable liquid or vapor. Causes severe burns.
  - Keep away from heat, sparks and flame – No smoking. Take precautionary measures against static discharges. Keep from direct sunlight. Keep containers closed when not in use. Store in a cool/low temperature, well-ventilated place away from heat and ignition sources. Use only in a well-ventilated area.

- **Chemical/Physical Risk**
  - Avoid contact with eyes, skin and clothing. Wear appropriate personal protective equipment, avoid direct contact.

- **Health Risk**
  - IF CONTACT WITH EYES: Flush eyes with water for at least 15 minutes while holding eyelids open.
  - In case of fire, use water spray, for or mist. Dry chemicals, Halon. Powder, foam or CO2.

- **Environmental Risk**
  - See Safety Data Sheet for further details regarding use of this product.

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**GHS Hazard Pictograms**

- **Explosive**
  - Explosive, self-reacting, organic peroxides

- **Flammable**
  - Flammable gases, liquids, solids, self-reacting, self-heating

- **Oxidizing**
  - Oxidizing, exothermic; gases, liquids, solids

- **Gas Pressure**
  - Compressed gases; liquefied gases, dissolved gases

- **Corrosive**
  - Corrosive to metals

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**OXIDIZERS:**
Chemical may cause a fire when they come in contact with other chemicals and are extremely reactive.
Some chemicals react to exposure to air.
Other related cautionary names: Peroxide, Peroxidizable
These mean the same thing, Oxidizer.

**OXYSOLS:**
Oxy

**CORROSIVES:**
All of these will damage (burn) metal, eyes, and skin.

- **Acid** — Acidic, pH < 7.0
- **Alkali** — Basic, pH > 7.0
- **Corrosive** — General term, can be either acidic or basic

**TOXICITY:**
Adverse effects occur within a short time after exposure, sometimes after a single exposure.
Effects may be severe or fatal. Sometimes labeled “ACUTE,” “SEVERE.”

**Narcotic effects:**
Skin sensitizer, respiratory, skin and eye irritant. Possible acute toxicity. May be hazardous to ozone layer (non-mandatory warning). Sometimes labeled, “ACUTE,” “IRRITANT,” “HARMFUL.”

**Carcinogenic:**
Possibly causes cancer

**Teratogenic:**
(aka Mutagenic) Possibly causes embryo and fetus (birth) defects

**Hepatotoxic:**
Possibly causes liver damage

**Nephrotoxic:**
Possibly causes kidney damage

**Neurotoxic:**
Possibly causes nervous system damage

**Hematopoietic Damage:**
Possibly causes blood cells and/or bone marrow damage

**Clastogenic:**
Possibly causes chromosomal breaks in cells, which causes mutated cells possibly leading to cancer. Benzene and Arsenic are examples known to cause this.

**Systemic poison:**
Can cause severe poisoning or death by remote exposure such as a small amount onto the skin. Phenol, Hydrofluoric Acid, and Methyl Mercury are examples of systemic poisons. Extreme care and special protective equipment and procedures are required for the use of these materials.

Manufacturers are required to study toxicity of new chemicals and report new adverse effects.
The (M)SDS gives information about toxicity which should help guide you to the proper PPE and handling safeguards to prevent exposure.

**However,** toxicity of chemicals are not always known, so they should always be handled with caution.
Chemicals sometimes have more than one name.

Acetone, for example, is also called Aceton, Dimethyl Ketone, and 2-Propanone.

The Chemical Abstracts Service (CAS) assigns a unique CAS Number, to each compound.

You will find this universal number in the (M)SDS on the original container label (as shown).

Emergency personnel can use this number to readily access safety information for the correct compound.

Prior to the introduction of GHS and its hazard rating system, there was the National Fire Protection Association (NFPA) diamond on (M)SDS. The new SDS's GHS hazard rating system is opposite of NFPA's diamond hazard score.

<table>
<thead>
<tr>
<th>NFPA</th>
<th>New GHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal Hazard</td>
<td>Severe Hazard</td>
</tr>
<tr>
<td>Slight Hazard</td>
<td>Serious Hazard</td>
</tr>
<tr>
<td>Moderate Hazard</td>
<td>Moderate Hazard</td>
</tr>
<tr>
<td>Serious Hazard</td>
<td>Slight Hazard</td>
</tr>
<tr>
<td>Severe Hazard</td>
<td>Minimal Hazard</td>
</tr>
</tbody>
</table>

Always be aware which hazard system you are viewing.
Health Hazard
4 – Severe
3 – Serious
2 – Moderate
1 – Slight Hazardous
0 – Minimal

Fire Hazard
4 – Below 75°F
3 – Below 100°F
2 – Above 100°F not exceeding 200°F
1 – Above 100°F
0 – Will not burn

Reactivity/Instability
4 – May Detonate
3 – Shock & Heat May Detonate
2 – Violent Chemical Change
1 – Unstable If Heated
0 – Stable

Special Hazard
— – N/A (Can also be left blank)
☢ – Radioactive
W – Use NO Water, Water Reactive
— – Explosive
ACID – Acid
ALK – Alkali
COR – Corrosive
OXY – Oxidizer
SA – Simple Asphyxiant

Some MSDS forms abbreviate the diamond. Example shown would be: "NFPA 704M Rating: 1-3-0"

Peroxidizable
Material that can form peroxides during storage, generally after contact with the air. Special precautions must be taken to test for peroxides and routinely discard. Commonly used compounds can explode upon heating or distilling, but some may also be sensitive to shock or opening the container.

NOTE: Never open or use any of these compounds that do not have the date opened written on the container or any test data within a year of opening.

Pyrophoric
Material that reacts or ignites upon contact with air at temperatures below 45°C, or sometimes the moisture in air, or water itself.

Spontaneously Combustible
Material that can ignite without an external source of heat, perhaps by reaction with oxygen in the air, by absorption of moisture, or from heat generated during processing.
Other Health Hazard Terms

- **Asphyxiant**
  Displaces air and/or reduces the level of oxygen in the body to dangerous levels. No pain is felt, the only indication may be light-headed or sleepiness.

- **Sensitizer**
  Causes reaction, often to the skin, possibly after repeated exposure

- **Irritant**
  Causes inflammation of the skin, mucous membranes, or lungs

- **Hygroscopic**
  A material which attracts moisture. Some dry forms may create a solution upon contact with air, and some may dry out the skin

- **Vessicant**
  Causes severe, painful skin, eye and mucous membrane irritation often referred to as chemical burns or water blisters

- **Lachrymator**
  Causes tears and eye irritation

- **Sternutator**
  Irritates the nasal and respiratory passages and causes coughing, sneezing, lachrymation (tearing of the eyes), and possibly vomiting

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SDS Exposure Terms & Limits

- **LD50 – Lethal Dose to 50% (of the population)**
  When this amount of chemical is taken (by contact or ingestion) 50% of the test subjects (usually mice) die. Reported in mg of substance per kg body weight. The smaller the number, the more lethal the substance is.

- **TLV – Threshold Limit Value**
  The maximum believed amount that a worker may be exposed to in the 8-hour day/40-hr week work environment for a working lifetime without adverse effect. Reported in mg/m³ or ppm as a volume of air space in the room. Again, the smaller the number, the more harmful the substance is.

- **PEL – Permissible Exposure Limit**
  A legal standard of exposure in the workplace for a typical 8-hr work day. This value may not be exceeded.

- **STEL – Short Term Exposure Limit**
  The maximum amount believed (not necessarily known to be) safe for a single short term exposure (<15 minutes), which should not be exceeded. There is also a maximum instant or ceiling value within this.

- **IDLH – Immediately Dangerous to Life and Health**
  An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or could cause irreversible or delayed adverse health effects or interfere with an person's ability to escape from a dangerous atmosphere. [29 CFR 1910.120]
Common Routes of Exposure

- **Inhalation**
  This is the most common mode of exposure. Some chemicals have no odor (like Mercury); some odors you get used to after a while (attenuated) or your nose loses the ability to smell it. Strength of odor is not equal to how toxic it may be or how concentrated it is. Chemical vapors, gases, aerosols, or mists can be absorbed through the mucous membranes of the mouth, nose, or throat.

- **Skin Contact**
  You may think of skin as barrier, but chemicals can penetrate the skin. Contact may be indirect such as when you adjust your glasses while wearing dirty gloves and then later adjust your glasses with gloves off, or contact with items contaminated by others. Chemical vapors, gases, aerosols, or mists can be absorbed through the skin.

- **Eye Contact**
  Eye exposure can be indirect through vapors, or direct via a splash (when not wearing goggles), or touching your eye while your hand or glove is contaminated by a chemical. Chemical vapors, gases, aerosols, or mists can be absorbed through the mucous membranes of the eyes.

- **Ingestion**
  Ingestion is usually by accident. It is avoided by never eating or drinking in the laboratory, and washing your hands after working with chemicals, not touching your face or mouth when working with chemicals (cross-contamination), etc.

- **Injection**
  This can occur by skin puncture with a dirty piece of glassware or apparatus or accidental needle injury. Breaking a piece of glassware is a common route; chemicals can enter through a cut.

Manufacturer's Container Labels

- Chemicals distributed prior to 1985 may not include hazard warnings on these labels as it was not a requirement then.
- Anything manufacturers labels after 1985 is required to specify known hazards, and the most important information from the (M)SDS sheet.
- It is **ILLEGAL** to remove or deface the original manufacturer label information as long as the container still contains the chemical.
  - You are however, allowed to add information to the primary container.
- The Hazard Communication Act requires re-labeling of primary containers if the label becomes illegible.
- If you have to replace the original label, the replacement label **MUST** include:
  - Identity of the chemical as listed on the MSDS.
  - Appropriate hazard warnings (words, pictures, symbols, combinations) for the chemical's physical and health hazards, including target organs effected.
  - Manufacturer's name and address.

This container still contains chemical and the manufacturer label on this container is not legible. It is **BY LAW** to be re-labeled.
**Secondary Container Labels**

- When a chemical is transferred to another (secondary) container, the new container **MUST** be labeled with:
  - The chemical name as listed on the MSDS (chemical formula may be used, but **NO** acronyms or abbreviations or structures) in English.
  - Hazard warnings including words, pictures/symbols or combinations that provide general information on the hazards of the chemical.
- Unless the container is for the immediate use of the individual who made the transfer, the contents **MUST** be written on the container before it is left unattended in the lab.
- All experiment solutions prepared for other people, or for use later, **MUST** also be labeled with all the chemical contents and hazards.

**Alternative Labeling Systems**

There are some allowable alternatives to full labeling requirements of containers to make labeling easier for multiple or small containers:

- **Laboratory Notebook (logbook)**
  Multiple or smaller containers may have a unique ID or acronym and be formally documented in this book, readily accessible to anyone.

- **Signage**
  A sign nearby which explains what it is can also be used.

- **Outer Container**
  Labeling for multiple smaller containers of an identical material. The outer container can have the full label.

- **Equipment Process Logs**
  For containers with constant material changes, such as those inside equipment. Signs, process/log sheets, operating procedures, or other similar written materials may be used in lieu of affixing labels. The alternative method must identify the containers to which it is applicable and convey both the name and hazards required.
Chemical / Hazardous Waste

- It is your responsibility to clean up during and after your experiments.
- Used glassware should be properly solvent rinsed out, cleaned and put away.
- All chemical wastes are collected for disposal by an outside waste vendor.
- Chemical or biological waste shall be collected in their respective properly labeled waste containers.
- **Never** dump hazardous waste in regular trash or broken glass container or down the sink.
- **Never** dump contaminated glass in broken glass container. Dispose of as hazardous waste.

This is our waste label with the information the UHCL Environmental Health & Safety Department needs to properly treat and dispose of waste.

Hazardous Waste, Cont’d

- The moment a container is started for waste accumulation, it MUST contain a Hazardous Waste label, filled out completely.
- Hazardous Waste Labels must include all contents (even water) and concentrations.
- The name is a contact to ask any questions regarding the waste.
- The Hazards are required by both waste and hazard communication regulations.
- The date filled is the date it is done being used, so this is written on the last day of the experiment or when the container is full.
Hazardous Waste, Cont’d

Hazardous Waste includes chemicals that are one or more of the following:

- **Toxic Components** – 40 listed chemicals (Benzene, Lead, Mercury…)
- **Reactive** – Unstable, reacts violently with water or air, potentially explosive
- **Ignitable** – Liquid flash point <140°F, or non-liquid spontaneously combustible at STP
- **Corrosive** – Liquid with pH <2 or >12.5 (highly acidic or basic)
- Specific lists of chemicals regulated as hazardous that carry these characteristics, for example common solvents like Acetone or Methanol

Because of the lists and other waste requirements, all Chemical Waste is handled as Hazardous Waste until evaluated by EHS.

Non-Hazardous Waste

**Non-Hazardous Trash/Solid Waste**

- Paper products, plastics, and other uncontaminated, non-hazardous substances may be placed in the trash containers with these labels.
- **Never** place any glass (broken or not) in these trash containers.
- **Never** place any needles or sharps in these trash containers.

**Broken Glass**

- Broken glass and/or glass waste must disposed of in a special cardboard box container (as shown).
- Before glass is thrown away, it must be clean of chemicals and biological contamination.
- **Never** place non-hazardous trash/solid waste as described above in these containers.
- **Never** place any needles or sharps in the glass boxes.
Sharps
- Needles, razorblades, scalpels, probes, or other small sharp objects that could puncture a trash bag and broken glass box go in rigid sharps containers.
- Note and adhere to the maximum “full” line at ¾ full
- One cited source of Needlestick injuries (and spread of infectious diseases) is from overfilled sharps containers.
- Chemically contaminated sharps get picked up by chemical waste vendor
- Sharps contaminated with blood, human bodily fluid, or biological materials get picked up by medical waste vendor

Chemical splash safety goggles
Safety goggles must be worn in the lab with liquids. They must be indirect vented so liquids don’t get in the eyes. These offer the best overall protection and are recommended (pictures shown). These are available in the UHCL bookstore.

Contact lenses
May be worn in the laboratory, but you MUST also wear approved safety goggles for liquids or safety glasses when working with dry materials only. Contact lenses may melt or trap chemicals against your eye, so they must be removed in the event of a chemical splash.

Prescription Eyewear
Some safety glasses and goggles will fit over them. Ordinary eye glasses DO NOT provide adequate eye protection for impact or chemical hazards. They MUST be rated Z87, have clip-on side shields, and provide adequate (large area) coverage to the eyes.
Chemical splash safety goggles offer the best impact protection and seal around the eyes for splashes, which is why they are required for use with liquid chemicals. Make sure they have a good fit and seal to your face.

However, in the real world, if this had been an actual experiment where such a facial spray could actually occur... (next slide)

Where splashes to the face are likely, and cannot be engineered out, a splash shield is the proper defense for the face, with safety glasses or goggles underneath.

It is ultimately up to you to decide what is the best possible protection to minimize your exposure to hazards in the laboratory or the workplace.

Always avoid direct contact with any chemical by correctly choosing and wearing PPE.
Gloves
Natural rubber, butyl rubber, Viton®, PVC, nitrile—all these materials, as well as others, are possible options for laboratory gloves. They all come in different colors. Nitrile gloves are shown, and provide resistance against the widest variety of chemicals used in our labs.

Breakthrough
Is the movement of a chemical through a protective material, such as nitrile gloves. This gradual permeation or chemical degradation of the glove/material, can be slowed or prevented by checking for the best material compatibility for the chemical being used, lowering concentrations and chemical contact time, or obtaining thicker gloves. Gloves that are contaminated, damaged, or worn must be replaced.

Reference your chemicals SDS in Section 8 – Exposure Control/Personal Protection and the chemical resistance guide from your glove manufacturer for chemical compatibility.

Lab Coat, Clothing, etc.

**Lab Coat**
*MUST* cover torso, upper leg, whole arms, and not too loose as to get caught on items in the lab. These are available in the UHCL bookstore.

**Personal Clothing**
Leg covering *MUST* be long (e.g., pants) and of a durable material, like denim. NO shorts or skirts allowed. Your legs are *NOT* to be exposed.

**Foot Covering**
*MUST* wear closed toe shoes of non-porous material like leather or polymeric substitute (e.g., vinyl) that completely cover your feet. NO open-toe sandals are allowed.

**Hair Restraint (Ties)**
Long hair *MUST* be properly secured and away from face and work space to prevent contamination and accidents.
Ultimately, your shoe is a barrier, offering protection from a chemical spill coming in contact with the skin.

Choose solid footwear covering the whole foot, not porous or perforated. Solid, one-piece top shoes made of vinyl like this medical safety shoe are ideal.

Correctly choosing and wearing your PPE may save you from injury.

Always put on your PPE before you enter the lab.

Anyone not properly dressed for the laboratory will not be allowed to work in the lab.
Proper Laboratory Practice

Put large articles like backpacks inside designated drawers or designated shelves near the front room entrances of STEM labs.

Read, understand procedures and (M)SDS
- Don’t use a chemical you don’t know the hazards of
- Use chemicals only as directed and for their intended purpose

Organize Workspace
- Wash your benchtop, keep clean during and after experiment
  - Clean up any spills promptly
- Take out only what you need for the experiment
- Prevent slips and trips by making sure your floor is clean, dry and clutter free

Practice proper hand hygiene, wash hands frequently, after:
- Handling chemicals (with gloves and other PPE on)
- After removing gloves
- Before you leave the lab

When carrying large containers use lab cart or a bottle carrier
- Always support bottles from the bottom as well as side or top when carrying

Return chemicals to storage when not in use.

Turn off all equipment and disconnect electrical cords after use.
Other rules to remember are:

- Never work alone in the lab.
- Never eat or drink in the lab. This includes drinking water from the lab sinks or faucets. Do not bring food or drinks into the lab.
- Never apply any cosmetics while in the lab.
- Never inhale or taste laboratory chemicals.
- Never engage in inappropriate behavior or horseplay in the lab.
- Never even partially block the pathway to an exit or safety equipment, like a safety shower or fire extinguisher, not even temporarily.
- Never store chemicals on the floor.
- Never use unlabeled chemicals.
- Never leave a running experiment or heat source, like a Bunsen burner, rotovap or hot plate unattended.
- Never remove chemicals from the lab without instructor authorization.
- Always keep aisles clear of obstacles such as boxes, chemical containers, and other storage items.
- Always keep work area clean and uncluttered.
- Always keep chemicals and equipment stowed away when not in use.
- Always keep drawers and cabinet doors closed.
- Always keep all potential trips hazards, including electrical cords off the floor.

Some accidents can be prevent by simply inspecting glassware prior to use.

Any combination of heating, cooling, pressurizing and vacuuming of glassware will cause imperfections to break the glassware.

Look for any imperfections or discoloration. If you come across glassware that appears damaged, Never use it.

Carefully rinse and clean off any hazardous chemicals from it, and put in the broken glass container.

After using your good glassware always properly clean it and safely put away for future use.
Before inserting any glass tubing, thermometers, or thistle tubes into a stopper, always lubricate it using vacuum grease or something similar.

Carefully use a gentle slow rotating motion while inserting.

Never force any type of glassware into stoppers, pipette bulb, pumps or similar as they may break and cause injury.

Never mouth pipette chemicals.
Use a pipette bulb or pump.

Use a Laboratory Hood When
Using volatile materials, solvents, alcohols, toxic materials, or where there is a possibility of poisonous or corrosive or irritating vapors emitted from the materials used or reaction taking place.

18” Sash Opening
Lower the fume hood sash while experiments are running to protect you and other users in the lab. The sash is designed to be operated with an 18 inch opening (about halfway up). This allows you to see through the glass, while your face and upper body are still protected.

Sample Placement
Place your sample containing the chemical as far back as possible, at least 6 inches from opening.
Laboratory Hood, Cont’d

- **Fume Hood and Large Equipment**
  Position large, bulky equipment as far back as possible, and place on top of stilts to allow the best possible circulation both around and underneath the equipment.

  ![Placement of equipment](image1)

  ![Placement of equipment using stilts](image2)

Always very that a Fume Hood is working properly. Do not use a hood without verifying these first.

- **Velocity Flow Monitor**
  There is a constant face velocity measuring device on every fume hood, equipped with visual lights and audible alarms to indicate proper or inadequate air flow. Most flow monitoring devices display face velocity, which should be 80-100 linear feet per minute.

- **Hood Testing Certification Sticker**
  Every hood should have one of these affixed to the front of the glass sash. It contains information about hood performance, and the most recent inspection. Hoods not inspected within the past year should be immediately reported to the EHS Department.

- **Maintain proper airflow:**
  Keep hoods free of clutter and extra debris, and do not block vents (baffles) at the back of hood. Do not block front of hood opening. One person per 2.5 feet of hood width. Do not walk fast in front of hoods or open lab doors quickly, as this can disturb flow and cause backdrafts.
Unexpected reactions may occur when dealing with cross-contaminated chemicals.

- **Never** put unused chemicals back into stock reagent bottles. Returning any unused sample into the original container may jeopardize the quality and purity of that stock reagent.

- **Never** place lids directly on benchtops.
  Place container lids on a clean non-permeable surface, like a watch glass, piece of parafilm, or held between fingers.

- **Always** take out only the amount you need.
  Dispose of unused material in the chemical waste container.

First things you should do when entering a laboratory is:

- Identify all the **EXITs** and **stairwells**; always have and **EXIT** strategy
- Identify the location of the **fire alarm pull station** (may be outside lab)
- Identify the location of the **eye wash stations**
- Identify the location of the **safety shower**
- Identify the location of the **first aid kit**
- Identify the location of the **spill kit**
- Identify the location of the **(M)SDS**
- Identify the location of the laboratory **telephone** and **emergency numbers**

**NOTE:** UHCL Campus Police can see where you’re calling from when you use a UHCL Campus landline.

In the Event of an Emergency

- **Dial 911** and Contact the UHCL Campus Police
  (Dial from any UHCL Campus phone)
- **2222**
- Or Direct at **281-283-2222**

Remember, the way you came in isn’t always the safest way out. **KNOW YOUR EXITS.**
Be aware of the following in order to prevent a fire from happening:

- Many solvents used in the laboratory are flammable.
- **Never** use Bunsen burners to heat flammable liquids (*acetone, Methanol, Isopropanol, Toluene etc.*)
  - Use hotplates instead provided by your instructor or TA.
- Vapors from flammable solvents can also ignite with electrical sources.
- Keep containers closed and work in a fume hood with flammable materials.
- Keep water away from electrical outlets and electrical equipment.
- Keep in mind Plexi-glass and other plastics are combustible and can burn easily.

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  2222  
  Or  
  Direct at **281-283-2222**

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**Fire Safety, Cont’d**

**Rules for Fighting Fires**

1ST  
**Remember the A’s:**
- **Alert & Activate**  
  Yell “Fire” to alert room  
  Activate the building alarm systém
- **Assist**  
  Any persons in immediate danger without risk to yourself
- **Attempt**  
  Only attempt to extinguish a fire only after the first two A’s are completed

2ND  
**Fight a fire only IF:**
- Only IF it is small fire.  
  (It is small and contained)
- Only IF you are comfortable doing so.  
  (Your instincts tell you it’s OK)
- Only IF you can do it safely and quickly.  
  (You are safe from toxic smoke)
- Only IF you have a clear pathway to an EXIT.  (You must be able to escape)

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Elements of a Fire

This is the Fire Triangle. Actually, it's a tetrahedron, because there are four elements that must be present for a fire to exist. There must be Oxygen to sustain combustion, Heat to raise the material to its ignition temperature, Fuel to support the combustion and a Chemical Reaction between the other three elements.

Remove any one of the four elements to extinguish the fire.

The concept of Fire Prevention is based upon keeping these four elements separate.

Fires and Extinguisher Types

- Not all fires are the same.
- Different fuels create different fires and require different types of fire extinguishing agents.
- Some fire extinguishing agents can be used on more than one class (type) of fire.
- Others have warnings where it is dangerous to use that extinguisher agent on certain types of fire.

Class A
- Fires in ordinary combustibles such as wood, paper, cloth, trash, and plastics.

Class B
- Fires in flammable liquids such as gasoline, petroleum oil and paint.
- Class B fires also include flammable gases such as propane and butane. Class B fires do not include fires involving cooking oils and grease.

Class C
- Fires involving energized electrical equipment such as motors, transformers, and appliances. Remove the power and the Class C fire becomes one of the other classes of fire.

Class D
- Fires in combustible metals such as potassium, sodium, aluminum and magnesium.

Class K
- Fires in cooking oils and greases such as animal fats and vegetable fats.
Remember the Acronym **P.A.S.S.**

- **P**ull the pin.
- **A**im the nozzle or hose at the base of the fire from the recommended safe distance.
- **S**queeze the operating lever to discharge the fire extinguishing agent.
- Starting at the recommended distance, **Sweep** the nozzle or hose from side to side until the fire is out. Move forward or around the fire area as the fire diminishes. Watch the area in case of re-ignition.

**Fire Extinguisher Use**

Remember the rules for fighting fires:

- Only if it is small fire.
- Only if you are comfortable doing so.
- Only if you can do it safely and quickly.
- Only if you have a clear pathway to a close exit (no fire between you and exit). Smoke can fill a room fast and overcome you quickly.
- Fire extinguishers are instrumental to have on hand quickly to prevent a small fire from growing into something unmanageable, but property is never more important than ensuring your own safety and life.

If you don’t sweep side to side at the base of the fire, you may not cover the whole flame and may not be able to extinguish the fire.

In the Event of an **Emergency**

Dial **911** and Contact the UHCL Campus Police

(Dial from any UHCL Campus phone)

2222

Or

Direct at **281-283-2222**
Accident / Incident Reporting

All accidents, incidents, & near misses must be reported to your instructor immediately.

A Student/Visitor Incident Report must be submitted by you or your instructor to the Environmental Health & Safety Department (ehs@uhcl.edu) within 24 hours.

If you witness the incident, complete and submit the Witness Statement Form to ehs@uhcl.edu

Major Incidents:
1. Call 911, and 2222 (UHCL Police) from any campus phone, or 281-283-2222
2. Locate and perform first-aid treatment until emergency personnel arrive

Minor Incidents:
1. Locate first-aid supplies for treatment and assist as needed
2. Feel free to go to the Health Service Center, or your primary care physician.
3. Urgent care clinics can provide after hours care

* Students must carry health insurance, and are expected to get medical attention after an accident, or will be taken for medical attention in the event of an emergency; and you are responsible for these costs.
Submit the Incident Report or Witness Statement to the Environmental Health & Safety Department at ehs@uhcl.edu within 24 hours. All Incidents are investigated by EHS for any appropriate corrective follow up measures.

In the event of an accident, follow-up with a professional medical evaluation. Ensure those injured are under observation for a minimum of 24hrs.

**First Aid**

**Corrosives /Chemical Burns**
- Wash under cold running water for at least 15 MINUTES.

**Flame Burns**
- Extinguish the fire. Use fire blanket if necessary, but remove immediately.
  - NOTE: The blanket traps heat in, causing internal damage if left on a burn victim.
- Wash under cold running water for at least 15 MINUTES.
- Apply burn gel if necessary for minor burns only

**Accidental Ingestion**
- Consult (M)SDS and call the local poison control center for advice: 800-222-1222
- Do not drink anything unless instructed.

**Accidental Inhalation**
- Move to fresh air.

In the Event of an Emergency
Dial 911 and Contact the UHCL Campus Police
(Dial from any UHCL Campus phone)
2222
Or
Direct at 281-283-2222
First Aid, Cont’d

In the event of an accident follow-up with a professional medical evaluation.
Ensure those injured are under observation for a period of 24hrs.

Lacerations (Cuts)
- Wash under running water with soap, allowing to bleed out slightly to cleanse the wound.
- Then compress and bandage. Encourage self-care (see Bloodborne Pathogens following)
- Seek medical attention.

Needle punctures (Injection)
- Wash under running water, allowing to bleed out slightly to cleanse the wound.
- Consult (M)SDS and call the local poison control center for advice: 800-222-1222

Eye Accidental Chemical Splashes
- For the Eye Wash pictured.
  - **FIRST Step** - you must turn the water on.
  - **SECOND Step** - pull the plug on the front of eyewash towards you.
- Leave goggles on initially under the water
  - To prevent contaminated goggles from dripping into eyes when removed.
- Hold eyelids open with fingers and thumb.
- Have someone keep you in the water.
- Wash for at least 15 MINUTES.
- Remove contact lens if present and wash again.

In the Event of an **Emergency**
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( Dial from any UHCL Campus phone)
  2222
  Or
Direct at **281-283-2222** 65
First Aid, Cont’d

In the event of an accident follow-up with a professional medical evaluation. Ensure those injured are under observation for a period of 24hrs.

**BODY** Accidental Chemical Splashes / Flame & Chemical Burns

- Get under Safety Shower.
- Pull metal handle off wall clip, or dangling from ceiling straight down.
- Remove affected clothing and any clothing below affected area.
- Stand under shower for at least 15 MINUTES.
- Push up to stop if not on a timer.
- Call EHS at ext. 2106 to notify of use.

In the Event of an **Emergency**
Dial 911 and Contact the UHCL Campus Police
(Desk from any UHCL Campus phone)
2222
Or
Direct at 281-283-2222

First Aid, Cont’d

In the event of an accident follow-up with a professional medical evaluation. Ensure those injured are under observation for a period of 24hrs.

**Eye** Accidental Chemical Splashes

- For the Eye Wash pictured.
- Pull the yellow metal handle straight down, an alarm will sound.
- Leave goggles on initially under the water.
  - To prevent contaminated goggles from dripping into eyes when removed.
- Hold eyelids open with fingers and thumb.
- Have someone keep you in the water.
- Wash for at least 15 MINUTES.
- Remove contact lens if present and wash again.
- Do Not pull Eyewash handle except in an emergency.

In the Event of an **Emergency**
Dial 911 and Contact the UHCL Campus Police
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2222
Or
Direct at 281-283-2222
First Aid, Cont’d

In the event of an accident follow-up with a professional medical evaluation.
Ensure those injured are under observation for a period of 24hrs.

Body Accidental Chemical Splashes / Flame & Chemical Burns
- Get under Safety Shower.
- Pull the yellow metal handle straight down, an alarm will sound.
- Remove affected clothing and any clothing below affected area.
- Stand under shower for at least 15 MINUTES.
- NOTE: Do Not pull Safety Shower handle except in an emergency.

In the Event of an Emergency
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First Aid & Bloodborne Pathogens Awareness

- **Bloodborne Pathogen (BBP)**
  Any pathogenic microorganism that is present in human blood, or other potentially infectious materials (OPIM) that can cause disease in humans. An infected person may not know about it for years, therefore all blood is considered to be potentially contaminated, so handled and treated with precaution.

Some examples include:
- Hepatitis B Virus (HBV)
- Hepatitis C Virus (HCV)
- HIV / AIDS
- Treponema pallidum (syphilis)
- Herpes Virus
- HTLV-I
- *Mycobacterium tuberculosis*
Hepatitis B Virus (HBV)
- Attacks the liver
- Initial symptoms are much like a mild flu
- The virus can go undetected for 10, 20, even 40 years
- Survives in dried blood for up to 1 week at room temperature

Hepatitis C Virus (HCV)
- Also Attacks and Inflames the Liver
- Similar symptoms to Hepatitis B, most common symptom is extreme fatigue
- No effective vaccine exists

Human Immunodeficiency Virus & Acquired Immune Deficiency Syndrome (HIV/AIDS)
- **Acute HIV** – This is the initial acute infection phase. During this phase, flu-like symptoms develop within 2-4 weeks after infection, sometimes 3 months later, often described as “the worst flu ever.”
- **Asymptomatic HIV** – This the chronic infection period, approximately 8-12 years. Toward the middle and end of this period you may begin to have symptoms such as weight loss, fever, chills, night sweats, abdominal issues, fatigue and muscle weakness.
- **Acquired immunodeficiency syndrome (AIDS)** – Is defined in terms of either a CD4+ T cell count below 200 cells per μL or the occurrence of specific diseases in association with an HIV infection.

Bloodborne Pathogens may be transmitted by:
- Puncture wounds caused by sharp objects
  - Example: Broken glass, misuse of or accidental puncture by needle
  - NOTE: Needle sticks account for about 50% of injuries!
- Contact with open wound or broken skin
- Risk increases with prolonged contact or larger areas of broken/damaged skin
- Splash into the eyes
- Sprayed or aerosolized and into nose or mouth
- If you have been exposed to human body fluids, human cell lines, human blood, etc. report it immediately to your PI in charge and to EHS for assistance.
Governing Laws and Regulations

Occupational Safety and Health Administration (OSHA)
- Needlestick Reduction Act modified it in 2001
- Education of and selection of sharps injury reduction devices (like self-sheathing needles)
- Keeping a (contaminated) sharps injury log

Texas Department of State Health Services (TDSHS):
- Bloodborne Pathogen Control 25 TAC 96
- Exposure Control Plan required to minimize government agency employee's exposure to BBP

Minimizing or Eliminating Biohazards

An Exposure Control Plan identifies all the following information:
- Engineering Controls
- Safe Work Practices & Universal Precautions
  - Treat all human blood and body fluids as if they are infectious.
- Signs and Labels
- Personal Protective Equipment
- Proper Hygiene
- Proper Waste Disposal Procedures
- Proper Spill cleanup
  - Decontaminate work surfaces frequently for preventive maintenance and after spills, using a disinfectant/sterilization solution like 10% bleach (sodium hypochlorite), 70% alcohol (isopropanol) solution or commercial solution like Lysol (phenols).
**Engineering Controls**

**Engineering Controls** – Devices that isolate or remove the BBP from the workplace.

They can include:

- Handwashing facilities
- Leak-proof containers for storage and transportation
- Sharps Injury Reduction Devices such as retractable syringes and self-sheathing needles
- Biosafety cabinet (BSC) with HEPA filter and directional air flow.
  - Follow “clean to dirty” procedure when working with biohazards:

  ![Workflow Diagram]

  A typical layout for working “clean to dirty” within a Biosafety Cabinet (BSC).

  Clean cultures (left) can be inoculated (center), contaminated pipettes can be discarded in the shallow pan and other contaminated materials go into the biohazard bag container (right).

**Engineered Sharps Devices**

Here are three examples of syringes engineered for injury reduction:

- Hypodermic syringes with "Retractable" technology
- Two types of Hypodermic syringes with "Self-Sheathing" feature
**Sharps Injury Prevention**

- Eliminate the use of sharps when possible
- If elimination is not possible, use engineered sharps devices that reduce injury
- **ALWAYS** use a puncture resistant tray to transport sharps

**Use Safe Sharps Practices at all times:**
- **Never** recap a used needle!
- **Never** bend or manipulate sharps
- **Never** pass sharps by hand between people
  - Place on bench, allow other to pick up instead
- **Never** attempt to catch falling sharps if dropped
- **Never** fill container more than ¾ full

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**PPE for BBP**

- All previously mentioned PPE applies in order to protect from contact with blood or OPIM and is required by the Bloodborne Pathogens Standard and UHCL.

- In the possibility of an event that would generate sprays or splashes of blood or OPIM:

  A **face shield** must be used in conjunction with your PPE to protect mucous membranes, such as the nose, mouth and eyes from contact with any blood or OPIM during sample manipulation.

  A **healthcare respirator mask** is also used to protect the nose and mouth.
How to Remove Gloves

1. With both hands gloved, grasp the outside of one glove at the top of your wrist, being careful not to touch your bare skin.
2. Peel off the first glove, peeling away from your body and from wrist to fingertips, turning the glove inside out.
3. Hold the glove you just removed in your gloved hand.
4. With your ungloved hand, peel off the second glove by inserting your fingers inside the glove at the top of your wrist.
5. Turn the second glove inside out while lifting it away from your body, leaving the first glove inside the second.
6. Dispose of the gloves safely. Do not reuse the gloves.

Clean your hands immediately after removing gloves and before touching any objects or surfaces.

(next slide…)

Hand Hygiene

Frequent / effective hand washing is essential in reducing BBP and possible bacteria transmission such as: Methicillin Resistant Staphylococcus Aureus (MRSA) and Vancomycin Resistant Enterococcus (VRE)…

BUT unfortunately, these areas are frequently missed:

Follow the hand hygiene techniques provided, washing for a **minimum of 20 SECONDS**.

(next slide…)

University of Houston Clear Lake
Follow the 3 Step Process:

1. **Wash**
   - Wet the hands
   - Take an adequate amount of liquid soap
   - Rub hands to lather
   - Rub each thumb against the opposite palm
   - Rub the palms together
   - Rinse the wrists
   - Repeat until dry

2. **Sanitize**
   - Rub palm with index finger interlaced
   - Rub the palm together
   - Rub fingertips in the opposite palm
   - Rub the back of each hand with the opposite palm
   - Rinse the wrists
   - Repeat until dry

3. **Dry**
   - Take a paper towel
   - Dry hands thoroughly

**Hand Hygiene, Cont’d**

NOTE:
When dealing with BBP or OPIM, sanitizing solution alone does NOT completely clean your skin.
Follow the 3 Step Process.

**Biohazardous Waste Containers**

- Must be Rigid, Leak-proof containers
- Sealed and impervious to moisture
- Closed container for aerosols
- With Proper Labeling
- Biohazard Symbol Labels on Containers
- Orange heat withstanding bags for Autoclave
- Moisture in bag when autoclaved
- Absorbent to capture free liquids when shipped offsite
Biohazardous Waste

All Biohazard Waste is Regulated Waste

The following are considered Biohazardous Regulated Waste:

- Blood or Other Potentially Infections Material (OPIM) such as human bodily fluids, whether liquid, semi-liquid, or dried
- Contaminated items that would release blood or OPIM if handled or compressed
- Contaminated sharps
- Pathological or microbiological waste with blood or OPIM or medical drugs for treatment or research
- Medical waste, biological teaching and research waste

All Regulated Waste MUST be rendered non-infectious prior to disposal.

It should be placed in properly labeled biohazard containers and then treated by

- Autoclave (Steam Sterilization),
- Disinfection, or
- Sent off-site for Incineration.

Waste Handling & Disposal

- Methods of Biological Waste Treatment

**Autoclaving (Steam Sterilization)**

Similar to a pressure cooker, and autoclave relies on high temperature, pressure and steam, in an enclosed pressure chamber to kill or remove all forms of life on an object's surface such as bacteria, fungi, viruses, and spores.

You may see Orange heat resistant bags, and rigid leak proof containers that don't morph or melt used in this process.

**Disinfection / Sterilization (Chemical)**

Involves completely immersing surfaces, equipment and disposable equipment with chemicals designed to kill virtually every organism for a minimum period of 10 minutes. Some examples of solutions used are: 70-100% alcohol, 1:10 Bleach solution, iodine, phenols/Lysol, Iodine, and quaternary ammonium salts.

**Incineration**

Biological waste that cannot be autoclaved or sterilized are properly packaged and professionally incinerated off-site.

Properly labeled plastic sharps containers are placed in special biohazard cardboard box or tub for off-site disposal.

Red bags are used in certain locations on campus for off-site disposal. When ready, they are tied in a knot and placed in biohazard box or tub, all labeled with the biohazard symbol.
Spill Clean-Up

If you spill blood or OPIM:

- Inform your instructor.
- Place paper towel(s) or other absorbent material on top.
- Wet the paper toweled area with disinfectant and let it soak for 15 MINUTES.
- Pick up broken glass pieces with tongs or a dustpan. **Never** pick up broken glass with your hands, even if you're wearing gloves.
- Contaminated broken glass should go in a sharps container (Biohazard).
- Disinfected broken glass goes in the broken glass container (Hazardous Waste).
- Wipe up spill from outward to inward to avoid spreading it any further.

Sharps Injury Log

- An injury log must be maintained by EHS.
- Injuries are reported by supervisor to EHS Department **within 24 hours**. Incidents are investigated for any appropriate corrective follow up measures.
- Some incidents are reportable to outside agencies, like TDSHS.
- At a minimum, the log must contain, for each incident:
  - Type and brand of device involved
  - Original intended use of sharp
  - Department or area of incident
  - Description of incident
This concludes the General Laboratory and Chemical Safety Training

Thank you!