Laboratory Safety Training

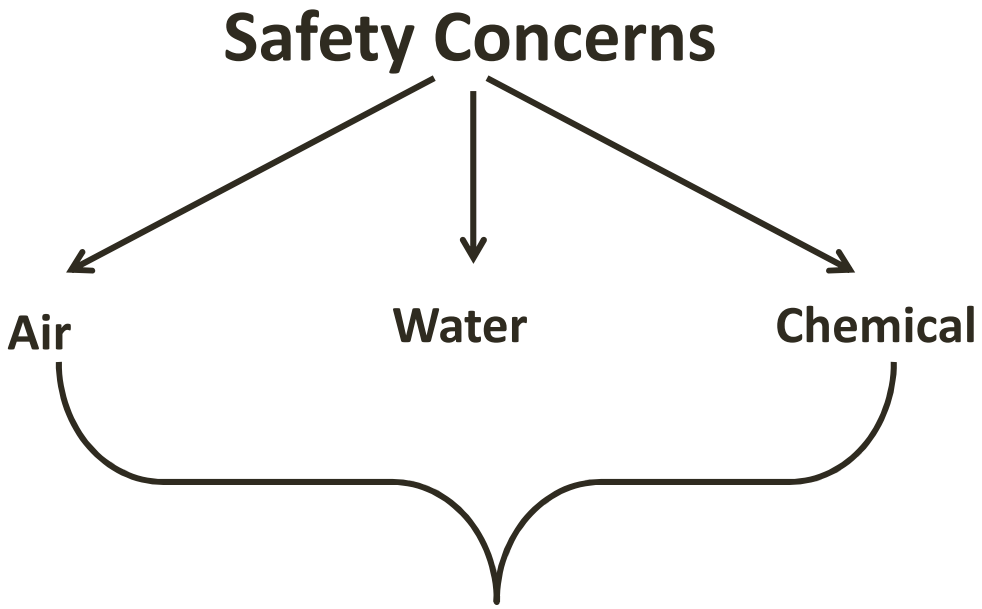
Advanced Materials Research Center
Dr. Sumit Sinha Ray
School of Engineering

Your practice makes you and others safe

Why are we here today?

What is EHSO?

EHSO is Environmental Health and Safety Organization



Your Practice!!!

Some accidents

A researcher was involved in a chemical explosion in the UCSB Chemistry building. He inappropriately mixed a strong oxidizing acid (nitric acid) with organic solvents inside a waste container within a fume hood.

The young man was splashed with a strongly corrosive liquid, probably a strong acid. Fortunately, he was wearing his safety glasses at the time

Professor Robert S. Coleman's lab at Ohio State University's (OSU) got completely burnt from hexane

Felony charges filed against UC and a UCLA chemistry professor after fatal laboratory fire

A research assistant was fatally burned when chemicals burst into flame. Her death three years ago has focused attention on safety issues.

December 28, 2011 | By Kim Christensen, Los Angeles Times

And there are many more……..

Criminal Defense UCLA Professor

L.A. NOW

SOUTHERN CALIFORNIA THIS JUST IN

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UCLA professor arraigned on charges in fatal 2008 lab fire

A Los Angeles County Superior Court judge entered a not guilty plea Wednesday on behalf of a UCLA chemistry professor arraigned on felony charges in a 2008 laboratory fire that killed a staff research assistant.

Judge Kelly Tornwella also set a preliminary hearing on UCLA professor Patrick Harran, who is charged with three counts of willfully violating state occupational health and safety standards.

Professor Patrick Harren's Trial

Investigator: "When Sheri arrived, do you know if she received any general lab safety training from the university?"

Harran: "I don't believe she received generalized safety training. I believe my assistant was told that it was not offered for her category per se."

They determined that Sheri Sangji had not been taught how to work safely with the dangerous chemical.

Investigator: "Did you ever discuss the characteristics of t-buty-lithium with Sheri?"

Harran: "No, not of t-butyl-lithium specifically, no."

Investigator: "Did you have any fire-resistant clothing available for employees to use when handling t-butyl-lithium?"

Harran: "Not fire-resistant clothing, no."

Detail of AMRC accidents:

2014: RB burst and Pankaj Gaur (PhD Student) got injured.

2015: Chemical hood's door burst, no one affected.

2017: a. One autoclave burst, no one affected.

b. Ceiling of NMR fell down, due to water leakage from one condenser in 1st floor.

c. One reaction set up inside chemical hood caught fire. No one affected.

2018: 2.5 lit concentrated HNO3 bottle broke. No one injured.

Rules and regulations governing health and safety

"Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials. (According to OSHA regulations)

- **Purpose:** The purpose of this regulation is to assure that laboratory employees' exposure to any regulated substance does not exceed OSHA permissible exposure limits (PELs)
- **Chemical Hygiene Plan:** Laboratory supervisors and practitioners must carry out the provisions of a Chemical Hygiene Plan
- **Hazard Identification:** Chemicals are hazardous and they should be identified based on their hazards.
- **Responsibilities:** Practitioners and supervisors are responsible to monitor, report and review
- **Recordkeeping:** Documentation of procurement, usage, dumping and safety data sheet is a must

Operational information

Appropriate design and flow of the laboratory facility is critical in assuring a safe work environment for laboratory employees.

Lighting: **Adequate, glare-free lighting is necessary throughout the laboratory facility.**

Egress: **In standard laboratory practice even exits have certain norms-**

- **Passageways should not be obstructed in any fashion like storage, equipment etc.**
- **Are you aware of your normal and emergency exits??**
- **Are you aware of your floor plan?**

Hallways:

- **No storage or laboratory work**
- **No eating, drinking**

Operational information

Appropriate design and flow of the laboratory facility is critical in assuring a safe work environment for laboratory employees.

Electrical:

- All electrical equipment must be properly grounded
- Do not route cords over metal objects

General health and safety concerns

Slips, Trips, and Falls: **Remember, even tripping is considered as hazard.**

- Electrical cords or other lines should not be suspended across rooms or passageways.
- All wet areas due to leaks or spills of any type should be cleaned and dried immediately
- No running, jumping in the laboratory areas are permitted

Housekeeping: **Good housekeeping practices indicate common sense activities**

- The area must be kept as clean as the work allows
- Reagents, equipment, and samples should be returned to their proper places
- Benchtops and fume hoods should not be used for chemical storage
- Stored items or equipment must not block access to the fire extinguisher

General health and safety concerns

Basic Laboratory Safety Rules: **The following protocol must be adhered to when working with biohazardous, hazardous materials.**

- Store and label all biohazardous, hazardous, and radioactive materials properly. Use flammable and acid storage cabinets and explosion-proof refrigerators when required
- Do not store food or drinks in refrigerators, freezers, or containers designated for chemical, biohazardous, or radioactive storage
- Compressed gas cylinders must be secured at all times
- Do not work alone in a laboratory if the procedures being conducted are deemed hazardous
- Never dispose of a hazardous, biohazardous, or radioactive substance down the drain or in the trash
- Accurate records of receipt, use, transfer, and disposal of highly toxic, carcinogenic, suspect carcinogenic, and radioactive materials must occur.

General health and safety concerns

Basic Laboratory Safety Rules: **The following protocol must be adhered to when working in lab.**

- Wear laboratory coat, appropriate gloves while dealing with chemicals. Some chemicals/practice require you to wear goggles and helmets.
- Laboratory coats worn in the laboratory area are not to be worn outside the laboratory
- No sandals, open-toed, or open-heeled shoes are to be worn by laboratory personnel
- Do not pipette by mouth!!!!!
- Clean after you are done
- Any accidental exposure (inhalation, ingestion, skin contact, or injection), injury, or spills must be reported to the supervisor immediately.

Chemical hazards

Hazardous situations can arise if employees are not educated in general chemical, safety, and toxicological information, as well as information on the specific chemicals they are using

https://www.ehso.uic.edu/research_safety/laboratory_safety/labsafety_training

Chemical hazards

Your practice makes you and others safe

Chemical hazards

- Health Hazard (i.e.- benzene, chloroform)
  - Can be any chemicals that are carcinogens, mutagens, teratogens, have target organ toxicity, or severe toxins.

- Acute Toxics (i.e.- ethidium bromide, mercury)
  - Severe health hazards which can result from a short exposure.

- Corrosives (i.e.- sulfuric acid, sodium hydroxide)
  - a substance that causes visible destruction or irreversible alteration of living tissue or metals.

- Irritant (i.e.- ammonia, sodium hydroxide)
  - A substance that causes reversible inflammatory effect on living tissue.
- Sensitizer (i.e.- latex, formaldehyde)
  - A substance that causes an allergic reaction to the skin or respiratory system

Chemical hazards

- Flammable Liquid (i.e.- acetaldehyde, ethanol)
  - Present exposure hazard because of volatility.
  - Ignite easily because flash point below 100 ^{o}F.
  - Must be stored in Flammable Cabinet.

- Flammable Solid (i.e.- magnesium, sulfur)
  - A solid that can ignite through friction, absorption of moisture, or when ignited burns vigorously
  - Require chemical-specific fire extinguisher – Class D

- Combustible (i.e.- acetic acid, phenol)
  - Flash point above 100 ^{o}F and below 200 ^{o}F

Chemical hazards

- Water Reactive (i.e.- sodium, potassium)
  - a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

- Oxidizer (i.e.- nitric acid, permanganate)
  - a chemical that promotes the combustion of other materials by releasing oxygen when heated.

- Explosive (i.e.- TNT, potential explosive – picric acid)
  - a chemical that causes sudden release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Chemical hazards

- The “Big Five” Hazard Classes
  - **GHS and DOT Symbols for the Hazard classes**
    - **Corrosives, oxidizers, flammables, toxins, carcinogens**

Chemical hazards

Appendix A: Incompatible Chemicals

Use as a guide; specific incompatibilities are in MSDSs. Consult *Bretherick's Handbook of Reactive Chemical Hazards* (Urben, P.G.; sixth Ed; Butterworth-Heinemann: London, 2000; book or CD-ROM) for an extensive listing and thorough discussion of incompatibilities.

Chemical	Keep Out of Contact With
Acetic acid	Oxidizing agents, e.g., chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Nitric acid, sulfuric acid, other oxidizing agents
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals	Water, carbon tetrachloride or other chlorinated hydrocarbon compounds, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (e.g., in manometers), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, other oxidizing agents
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Chromium trioxide (chromic acid)	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids

More to be found in the sent out details

Mix these and a flaming acid will be the result.

Chemical hazards

- Why is secondary containment necessary?
  - Limited storage space does not always allow hazard classes to be stored in separate cabinets or on separate shelves.
  - Secondary containment can be used to separate incompatible chemicals in the same hazard class.
  - Helps contain spills.

Dangerous chemicals: Organic Peroxides, Strong Acids, and Carcinogens

- **Organic Peroxides are unstable compounds by design and must be handled in a correct manner.**

Most common peroxide formers:

Isopropyl ether, Ethyl Ether,

1,4- Dioxane, and Tetrahydrofuran

- **Ether has a shelf life of roughly 120 days when opened. Organic peroxides may then form after opening, thus creating a violent explosive hazard.**
- **Have you checked its expiry date?????**

- **Brief exposure (5 min) of HF of about 50 ppm can be fatal to humans. Spills of 70% on an area the size of your hand are fatal.**

Calcium Gluconate **gel must be on hand in all labs that use HF.**

Personal protective equipment

Personal Protective Equipment

- Gloves
- Safety goggles
- Coat
- Mask

Details of gloves compatibility are in sent out details

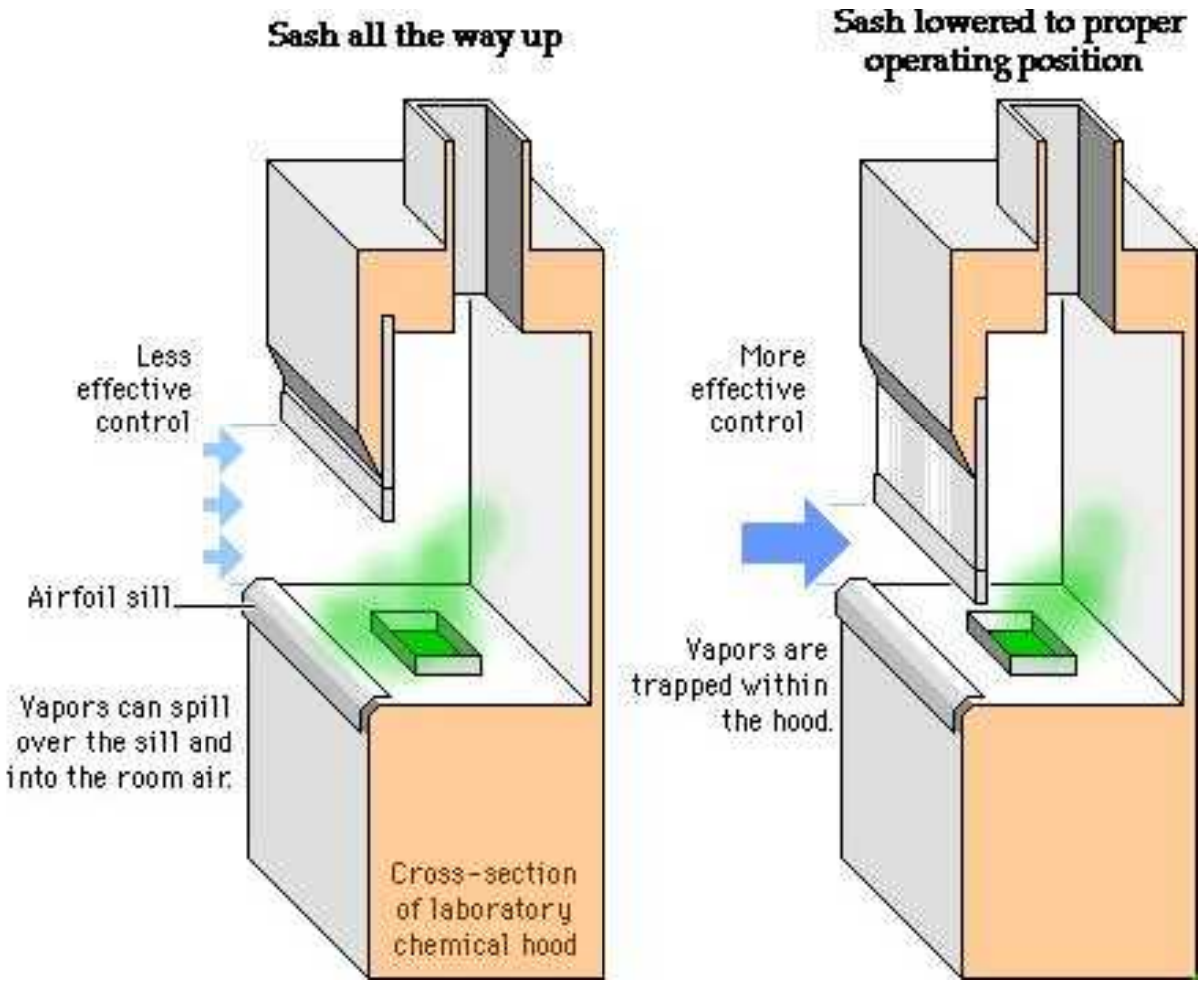
Personal protective equipment

Three important properties determine the type of chemical-resistant gloves worn:

1. **Chemical degradation** –The breakdown of the physical properties of a glove because of contact with a chemical.
2. **Permeation rate** – The amount of time a glove will provide effective permeation resistance, when totally immersed in the test chemical.
3. **Breakthrough time** - The amount of time required for a given chemical to penetrate through a glove.

	Glove Materials					
Chemical (Organic Acids)	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton
Acetic acid	2	3	4	2	1	4
Formic acid	2	3	4	3	2	2
Lactic Acid	4	4	4	3	4	4
Maleic acid	3	3	2	3	3	4
Oxalic acid	4	4	4	4	4	4

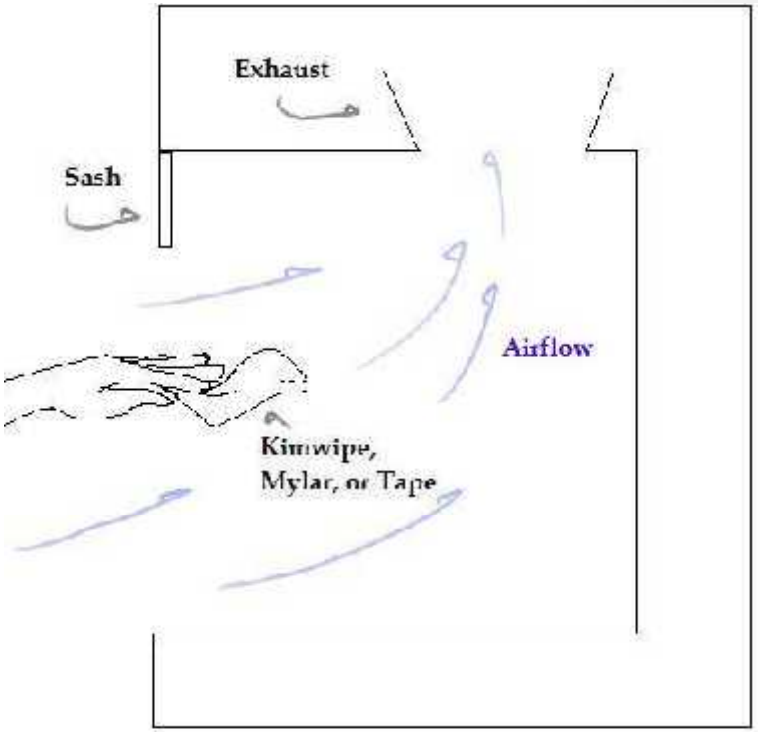
Fume hood safety



Fume hood safety: Qualitative inspection

- The material used should be pulled into the hood
  - **45º angle- works well**
  - **90º angle- not good**

- Test multiple areas where the hood is open.



Side View of a Laboratory Fume Hood

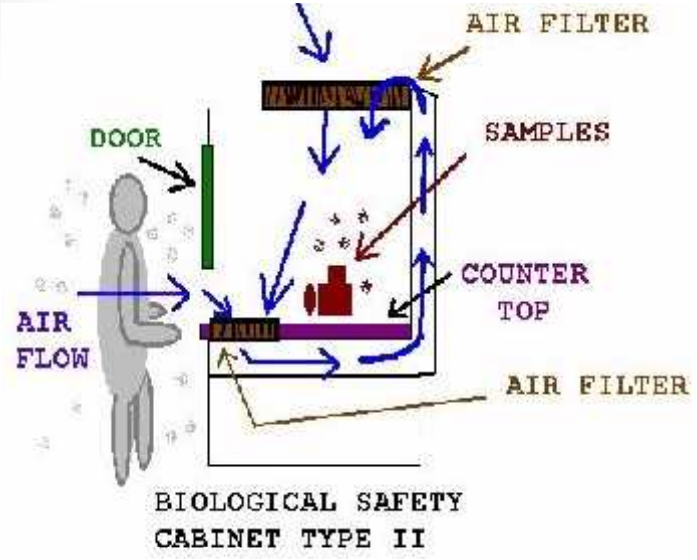
Safe Height

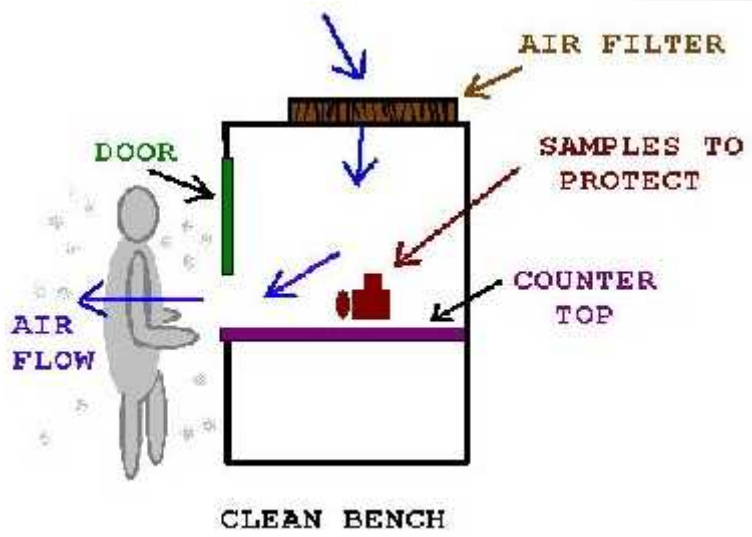
Fume hood concern in campus

- **Fume hoods are not designed to be storage cabinets.**

- **Fume hoods only work correctly when the back sash is clear from obstruction so the ventilation can work.**

Biosafety cabinets





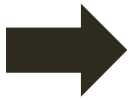
Biosafety cabinets protect humans from the research samples, while clean bench protect the samples from their researcher.

General Information

- Hands and arms should be washed well with germicidal soap before and after work in the BSC.
- Wear long sleeve gowns with knit cuffs and gloves.
- Organize the material so that dirty “contaminated” items are not passed over clean items.
- Minimize room activity which can create disruptive air currents.
- The BSC should not be overloaded.

Safety data sheets: What you should do?

- Become familiar with changes to the Material Safety Data Sheet (MSDS) / Safety Data Sheet (SDS) format.
- Understand the new chemical labels and where information is found.
- Know what Personal Protective Equipment (PPE) is needed for safe chemical use.



- **Keep MSDS record of your chemicals.**
- **Print the safety data sheet and put them in folders.**
- **Label chemical storage according to hazards, keep a check on expiries and write necessary information.**
- **Discard if expired !!!!!!**

Waste handling

Waste: Material that no longer has an intended value-any material which is discarded.

Before dumping waste, check:

- ❑ **Ignitable (oxidizers and flammable together?)**
- ❑ **Corrosive (pH)**
- ❑ **Reactive (like peroxide formers and water)**
- ❑ **Toxic(like lead, mercury)**

CAN NOT JUST SIMPLY DRAIN THROUGH YOUR SINK!!!!!

Label what waste bottle contains

- **Unwanted Chemicals must be stored in proper containers in good condition that are compatible to contents, proportionally sized, with screw-top lids.**
- **Do not use metal cans for your waste!!!**
- **If reusing a chemical bottle for hazardous waste, the original label must be completely defaced.**

Spill control : Kit and process

- Absorbents
- Neutralization Materials
  - Citric Acid for Bases and Sodium Carbonate for Acids
- Dust Pan
- Plastic Bags
- Labels
- Gloves and Goggles

What to do after splash/cut

- **<u>Wash the exposed area</u> with soap and water as soon as possible after removing gloves or other PPE. For a mucous membrane exposure, thoroughly flush the area with running water for about 15 minutes**
- **<u>Remove remaining PPE</u> before leaving the work area**
- **<u>Notify your supervisor</u>**
- **If the exposure occurs during regular hours, <u>go to Institute Health Services</u>**

Don’t

Don't

No food/ drinks in Lab

Don’t

Don’t

- **Appropriate Lab Attire**

- **Inappropriate Lab Attire**

Thank you for your attention

Be Safe, Keep Safe