General Laboratory Safety and Hazardous Waste Management

Presented by
Human Resources
Occupational Health and Safety

www.uwo.ca/hr/

Objectives
- Understand the common hazards of laboratory work
- Understand the importance of:
  - Administrative controls
  - Elimination of hazards
  - Engineering controls
  - Personal Protective Equipment requirements
- Awareness of emergency procedures (fire, spills, medical)
- Understand Hazardous Waste Disposal Procedures
- Awareness of the criteria and guidelines for the segregation and storage of chemicals.

Occupational Health & Safety Services

OHS Act – Responsibilities

Supervisor
- Follow Procedures
- Training
- Adequate Facilities
- Filled/Documented
- Report Accidents and Hazards

Worker
- Training
- Wear PPE
- First Aid Program
- Accident Reporting
- Hazard Communication Form
Designated Substances

- Substances identified by the Ministry of Labour as materials that pose severe risk in the workplace.
- Laboratory supervisors are required to report any designated substances in their lab.
- Inventory of use to be maintained.
- Workers require specific training.

Designated Substances

- Acrylonitrile
- Arsenic
- Asbestos
- Benzene
- Coke Oven Emissions
- Ethylene Oxide
- Isocyanates
- Lead
- Mercury
- Silica
- Vinyl Chloride

For more information [Designated Substances Program](#)

Name Six Safety Violations?

Control of Hazards

Heirarchy of Controls

- Elimination
- Administrative
- Engineering
- Personal Protective Equipment
**Elimination**

- Elimination
- Removing hazard
- Substitution

**Before beginning......**

Communicate

- Discuss procedures with supervisor and knowledgeable colleagues *(UCLA)*

Prepare

- Determine potential hazards
- Take precautions

*Laboratory Health and Safety Manual for General Laboratory Practices*

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**Lab Safety Manual**

- General Principles
- Updated regularly
- Found on HR website
  - [http://www.uwo.ca/hr/form_doc/health_safety/lab_safety_manual.pdf](http://www.uwo.ca/hr/form_doc/health_safety/lab_safety_manual.pdf)

**General Principles – WHMIS**

- WHMIS
- Labelling
- MSDS
- Training
Safety Equipment

Do you know the location of?

- Safety shower
- Eyewash
- First aid kit
- Evacuation routes
- Fire extinguisher

When in the Lab......

- Use equipment for its designed purpose
- Ensure long hair and loose clothing are confined
- Avoid distracting others
- Ensure visitors are equipped appropriately

General Laboratory Safety and Hazardous Waste Management

……….. When in the lab

- Do not store or consume food and drink in the laboratory

Lunch found in chemical fridge!

General Laboratory Safety and Hazardous Waste Management

Administrative Controls

Timing of work
Policies/procedures
Training
Maintenance
Hygiene

General Laboratory Safety and Hazardous Waste Management
Warning Signs

- Posting of Signs
- Warning Sign Booklet
- OHS Supply
- Emergency Equipment


Basic Safety - Housekeeping

- Inspect
- Clean-up
- Don’t Hoard!
- Don’t Procrastinate

Emergency Equipment


Laboratory Equipment Maintenance

- Qualified Person
  - Inspect
  - Maintain
- Frequency
  - Degree of hazard
  - Follow Manual
- Records
  - Notes
  - Invoices
  - Certificates
- Hotplate Fire
- No "on the job" training
- No instruction manual
- No understanding of hazard
- Improper Maintenance

Electrical Equipment

- Must have certification mark
- No mark – field evaluation required
  http://www.electricalfieldevaluation.com/001.php
Electrical Equipment Around Water

- Use a GFCI (breaks circuit if there is a loss of more than 5 ma to ground)
  - Wet or damp areas
  - By sinks
  - Electrical equipment
    - Pumps
    - Water baths

Extension Cords and Power Bars

- CSA approved
- Plug into outlet
- Not pass through concealed spaces
- Not be “home made”
- *Extension cords are temporary use only

Glassware

Safe Handling
- Use gloves
- Be gentle
- Tape vacuum glassware or
- Use appropriate shielding
- Check for cracks especially on vacuum glassware

Disposal containers
- Plastic, metal, disposable
  - Broken glass
  - Pasteur pipettes
- REMEMBER someone could be hurt by broken glass in the wrong container
**Laboratory Health & Safety Manual - Health & Hygiene**

- Use a proper pipetting device
- No pipetting by mouth under any circumstances

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**Cryogenic Materials and Cold Traps**

- Hazards
  - Extreme cold
  - Asphyxiation
- Personal protective equipment
- Label containers
- Dewars
- Do not use a household vacuum flask
- Do not use liquid nitrogen or air as a trap for flammable and combustible materials

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**Compressed Gas Cylinders - Transporting**

- Transport gas cylinders using the proper hand cart for the task
- Ensure cylinder is secured to the cart using the chain/strap

What happens when the valve breaks?

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**Compressed Gas Cylinders - Securing**

- Properly secure all gas cylinders
- Always segregate flammables and oxidizers
- All "in-use" cylinders individually secured
  - Chain or strap
Compressed Gas Cylinders - Connecting

- Connect an appropriate regulator
- NEVER use
  - Adapters
  - Teflon tape
- Check for leaks
- Check tubing

Control of Hazards

Engineering Controls:
includes designs or modifications to lab, equipment, ventilation systems, and processes that reduce the source of exposure.

Personal Protective Equipment:
equipment worn by individuals to reduce exposure such as contact with chemicals or exposure to noise.

Shielding and Guarding

- Adequately guard moving parts and electrical components

  E.g.
  - Pump pulleys
  - Leaving cover panels off of equipment exposing live wiring

Fumehoods

MOST important safety feature in labs

- Proper use is crucial
- Allows work with hazardous materials
- Hazards are drawn away from the person
- The sash also acts as a shield
**Fume Hoods - Controls**

- Evaluate fume hood for air flow prior to each use
- If you think there is a problem inform your supervisor
- Always leave your fume hood running!

**Fume Hoods – Sash Position**

- Keep the sash fully closed when not using the fume hood
- While working in the fume hood, the sash should have an opening of no more than 45 cm

**Fume Hoods - Setup**

- Keep equipment at least 15 cm from the front of the fume hood
- Raise equipment a few centimeters to allow better air flow

**Fumehood Use**

- Do not use the fume hood for storage of equipment, hazardous materials or garbage.
Personal Protective Equipment (PPE)

PPE is Last Line of Defence

- Communicate and prepare
- Consider all the hazards, co-workers and visitors

PPE does not replace proper procedures and techniques

No Eye Protection

- Chemicals
- Foreign Body
- Impact
- Scratch
- Penetrating

- Which would you prefer?

PPE - Eye Protection

- Grad student working with ether in Erlenmeyer flask wearing safety glasses
- Organic peroxide formed
- Flask exploded
- Safety glasses impacted
- Eye uninjured

General Laboratory Safety and Hazardous Waste Management

Where do you get them?

- SSB 4190

Safety glasses
- All Employees

Splash Goggles
- All Employees

Prescription Safety Glasses
- FT Staff
- Faculty
- Grad Students

General Laboratory Safety and Hazardous Waste Management
Protective Clothing

Clothing worn should provide maximum protection

Consult your supervisor

When working with hazardous chemicals the minimum requirement is:
complete coverage from shoulder to toe including sturdy closed toed shoes

UCLA

Protective Clothing - Lab Coats

Buttom closed after work

Laundered separately

Remove and hang up before leaving

Protective Clothing - Gloves

MSDS

Hazard

Select Material

Check for Holes

Size

Always wear closed toed shoes – preferably leather

Foot splashed with chronic acid cleaning solution while the victim was wearing sandals

Can see outline of sandal

Protective Clothing - Chemical Contact

Consult glove selection charts [NIOSH/Chemical Protective Clothing Page](http://www.ansellpro.com/specware/ Ansell)
Protective Clothing - Chemical Contact

Graduate student wearing shorts poured nitric acid on his leg

Area covered by shorts had less damage than bare skin

Acids cause a very painful burn but they do not penetrate deep into the skin, bases are not so painful but penetrate deeply

Chemical Poisoning

Situation

Etching Aluminum:

- You are etching aluminum with a hydrofluoric acid solution you prepare yourself.
- What protective equipment is appropriate? What else should you be aware of when using hydrofluoric acid?

Protective measures

Ventilation System:
- A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.

Skin Protection:
- Wear protective clothing, including boots or safety shoes with polyvinyl chloride (PVC) or neoprene. Use chemical goggles and/or a full face shield. Wear coveralls with long sleeves, gloves and gloves of PVC or neoprene. A high degree of protection is obtained with an air-inflated suit with mask and safety belt. Use protection suitable for conditions.

Eye Protection:
- Use chemical safety goggles and/or full face shield where splashing is possible. Maintain eye wash fountain and quick drench facilities in work area.

MSDS

HYDROFLUORIC ACID

Ingredient CAS No Percent Hazardous
Hydrogen Fluoride 7664-39-3 48 - 52% Yes
Water 7732-18-5 48 - 52% No

Emergency Overview
- POISON! DANGER! CORROSIVE, EXTREMELY HAZARDOUS LIQUID AND VAPOR. CAUSES SEVERE BURNS WHICH MAY NOT BE IMMEDIATELY PAINFUL OR VISIBLE. MAY BE FATAL IF SWALLOWED OR INHALED. LIQUID AND VAPOR CAN BURN SKIN, EYES AND RESPIRATORY TRACT. CAUSES BONE DAMAGE. REACTION WITH CERTAIN METALS GENERATES FLAMMABLE AND POTENTIALLY EXPLOSIVE HYDROGEN GAS.
### Potential Health Effects

- **Exposure to hydrofluoric acid can produce harmful health effects that may not be immediately apparent.**
- **Inhalation:** Severely corrosive to the respiratory tract. May cause sore throat, coughing, labored breathing and lung congestion/inflammation.
- **Ingestion:** Corrosive. May cause sore throat, abdominal pain, diarrhea, vomiting, severe burns of the digestive tract, and kidney dysfunction.
- **Skin Contact:** Corrosive to the skin. Skin contact causes serious skin burns which may not be immediately apparent or painful. Symptoms may be delayed 8 hours or longer. The fluoride ion readily penetrates the skin causing destruction of deep tissue layers and even bone.

### Label: First Aid

**IN ALL CASES, CALL PHYSICIAN IMMEDIATELY.** First Aid procedures should be pre-planned for HF emergencies. A supply of 50:50 water/magnesium sulfate paste or 2 1/2% Calcium Gluconate paste should be available where first aid medications are administered. If ingested, DO NOT INDUCE VOMITING. If patient is conscious, give large quantities of milk or water and send to hospital. If inhaled and patient is unconscious, give artificial respiration or use inhalator and send to hospital. In case of eye contact, wash open eyes with large but gentle stream of water for 15 minutes. Place ice pack on eyes until reaching emergency room. In case of skin contact, remove contaminated clothing and wash burn area with plenty of water to remove acid. Cover burn area with a poultice of 50:50 water/magnesium sulfate paste or 2 1/2% calcium gluconate paste. Leave in place until medical help arrives or patient is transferred to hospital.
**Accident Case Study - Chemistry Fire & Fatality 1991**

What were the contributing factors?

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**Hazardous Waste Introduction**

- Chemical User
- Legislation
- Chemical Handling
- Legislation
- Laboratory Waste
- Legislation
- Disposal
- Legislation

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**Hazardous Waste**

**Goal**
- To help YOU comply
- Introduce service provided

**Outcome**
- YOU will be able to safely handle waste
- Understand waste procedures
- Be aware of regulations

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**Legislation We Need to Follow**

- Solid waste disposal
- Flammable & combustible liquids
- Recycling & composting
- Water
- Use & storage regs.
- Import/export
- NPRI reporting
- Contaminated soil guidelines
- Lakefilling guidelines
- TDGA
- Transport Canada
- OMAFRA
- Mun. Act by-laws
- Ont. Fire Code
- l.u. plumbing
- MOE
- EPA
- Contaminated Sites Guideline
- Lakefilling Guideline
- CEPA Environmental Canada

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**General Laboratory Safety and Hazardous Waste Management**
Chemical Management

- Inventory Control
- Condition of Facilities
- Shelf Life
- Chemical Management
- Compatibility
- Labelling

Inventory Control

- Amount Purchased
- Waste
- Amount Used
- Label with expiry date
- Dispose
- BUY ONLY WHAT YOU WILL USE WITHIN THE SHELF LIFE

Shelf Life

- Expiry Date
- MSDS
- Concentration change
- Stability
- User Responsibility
- WHMIS Legislation

Labelling

- Responsibility: User
- Legislation: WHMIS
- Requirements: Full chemical name(s), No short forms, Legible
Storage

- **Inventory**
  - User responsible for Tracking
  - Location of Chemical
  - Compatibility Classification

- **Shelves**
  - Secure
  - Resistant to chemicals
  - Lip at front or lean back
  - >500g - below 2m
  - Large Pails - close to floor

- **Containers**
  - Lip at front or lean back

- **Location**
  - Away from active work

**Compatability**

- Links to MSDS on OHS Webpage
- The Canadian Centre for Occupational Health and Safety CCOHS website

**Hazard Classes**

- **Mineral Acids**
  - Hydrochloric
  - Hydrofluoric
  - Perchloric*
  - Special fumehood required if used in greater than 10 ml quantities
  - Stored in acid cabinet on trays

- **Bases**
- **Flammable**
- **Inorganic Oxidizers**
- **Inorganic Corrosive Materials**
- **Cyanide Containing Materials**
- **Other materials require special storage consideration**

**Mineral Acids**

- *Hypochlorite*
- *Hypobromite*
- *Hypophosphite*
- *Nitroso*
- *Nitroamine*
- *Nitric*
- *Sulphuric*
- *Phosphoric*
- *Chlorosulphonic**
Bases

Stored in a cabinet dedicated for bases

- Sodium hydroxide
- Potassium hydroxide
- Organic amines
- Ammonium hydroxide

Working With Acids and Bases

- Will react with each other
- Serious burns
- Hazardous vapours
- Use in fumehood
- Wear PPE
- Know the hazards

Flammable and Combustable Liquids

Definitions

- Flammable
  - Flashpoint <37.8°C
- Combustible
  - Flashpoint 37.8°C to 93°C

In a fire separation

- Stored
  - Max 1500L Flammable
  - 1500L Combustible
- Immediate Use Quantity
  - Max 300L Flammable
  - 300L Combustible

UWO Policy 1.35 Storage and Dispensing of Flammable and Combustible Liquids in Laboratories
Storing Flammable Solvents

- **Flammables (eg)**
  - Acetone
  - Alcohol
  - Toluene
  - Formaldehyde

**Organic Acids**
- Acetic
- Formic

**Requirements**
- FM, UL, ULC approved
- Not modified
- Unvented
- All flammable solvents

**Flammable Solvents Cabinet**
- What is stored?
  - Waste
  - Immediate use
  - Quantities at end of use

**How much can we store?**
- 250L Flammable
- 250L Combustible
- Max Container 5L
- Note: Dispensing >5L restricted to certified facilities

Using Flammable Solvents

**Dispensing**
- Fume hood

**Control Static**
- Metal – Bonding
- Touch Plastic and Glass Together

**Hazards**
- Fire
- Possibly toxic

Inorganic Oxidizers

Aids in combustion
- Incompatible with combustible materials
- Stored separately
- Not stored with flammables
- Aids in combustion

- Inorganic Oxidizers
  - Chlorates
  - Perchlorates
  - Persuphates
- Stored separately from other oxidizers
Cyanide Containing Materials

- Contain the chemical group - CN
- Release HCN when acidified or in a fire

Special Storage Consideration

- Picric Acid
- Peroxide Formers
- Other Shock Sensitive Materials
- Organic Peroxides
- Water Reactives
- Air Reactive (Pyrophorics)

ALWAYS Refer to MSDS

Example of Specials Picric Acid

(2,4,6-trinitrophenol)

If found with dried out crust on cap:
- LEAVE IN PLACE
- Contact OHS to have it removed.
- Opening the container could cause it to explode.

Example of Specials – Peroxide Formers

If you find ether that has formed crystals:
- LEAVE IN PLACE
- Contact OHS to arrange disposal.
- It could explode if moved.
Example of Special - Organic Peroxides

Organic Peroxides
- Purchase in small quantities
- Keep refrigerated and date when opened
- Dispose of after 12 months
- Prevent solvent from evaporating

Examples:
- Benzoyl peroxide
- Peroacetic acid

Chemical Storage Fridges
- Use special refrigerators for chemical storage, especially flammable materials
- Do not store food with chemicals in a refrigerator
- Label Fridges
  - Food (no chemicals)
  - Flammable (no food)
  - Non-flammable (no food and no flammables)

Poor Segregation - Acids Cabinet
- Contains acetic acid, flammables and some containers in very poor condition

Poor Segregation – Flammable Cabinet
- Containers in very poor condition
- Bromine – very strong oxidizer
- Contains a mixture of unsegregated chemicals
Compatability

Why so much info?

CSI -1

- Ethanol
- Nitric Acid
- Waste Container

CSI -2

- Unlabelled chemical
- Incompatible chemicals mixed together
- Building damage
- Building closed 24 hours

UWO Hazardous Waste Management System
Hazardous Waste Disposal

Your Responsibilities

- Labelling
- Submitting
- Transportation
- Biological and Radioactive
- Unknowns
- Empty containers

Packaging

- Tight fitting lids
- Compatible containers
- Segregated
- Label on each box

Unknown Chemicals
“Unknown” (???) Chemicals

Unlabelled material
- Hazardous
- Dangerous
- Expensive

Who knows?
- Original researcher

What next?
- Investigate
- Type of work
- Storage location

Help needed?
- Call OHS
- RPR will identify

Help arrives?
- Keep unknown in lab
- Provide fume hood
- RPR will characterize for transportation and disposal
- Supervisor must be present

Different Waste Streams

Chemical

Radioactive

Biomedical

Radioactive Materials

All radioisotope users must
- Pass UWO Radiation Safety Training

Radioactive waste
- Must be handled as set out by the UWO Radiation Safety Manual

Acceptable waste
- Properly labelled
- Must be in pails
- Pails are “wipe tested”

Biomedical Waste

Biohazard Users
- Must pass Biosafety Training

Biohazardous waste
- Must be decontaminated prior to disposal
- Incineration
- Autoclave
- Disinfectant
General Laboratory Safety and Hazardous Waste Management

CLEAN Glassware and Empty Chemical Containers

- Glass Waste
  - Intact
    - Non-volatile
      - Empty
      - Rinse x3
      - Regular Recycle/Waste
    - Volatile
      - Empty
      - Regular Recycle/Waste
  - Broken
    - Submit for Disposal
      - Regular Recycle/Waste

Submitting Hazardous Waste
‘Preparation is the Key’

- Package
  - Regular
  - Send to Chemistry Lab
  - In transit
  - Delivered

Thursday Pick up

‘Thursday Pick up’

- Be on time
- Waste must not be left unattended
- Send waste with knowledgable person
- RPR may have questions

Thursday Pick up Schedule

- Siebens Drake Res. Institute (loading dock) 9:00 am
- Robarts Research Institute (loading dock) 9:15 am
- BGS Building (loading dock) 9:30 am
- North Campus Building (loading dock) 9:45 am
- Medical Sciences Building (outside M003) 10:00 am
- Chemistry Building (loading dock) 10:30 am
- Spencer Engineering Bldg (loading dock) 11:00 am

- All other buildings please contact Occupational Health & Safety to make special pickup arrangements.
Emergencies

- Fire
- Flood
- Chemical Spill
- Police
- Ambulance

First Aid - Skin Exposure

Skin Exposure
- Remove all clothing
- Continue showering for 15-20 minutes
- Do not use soap or detergent unless stated on MSDS
- Always seek medical attention
- Take along MSDS

First Aid - Eye Exposure

Eye Exposure
- Continue flushing for 15-20 minutes
- Always seek medical attention
- Take along MSDS

Emergencies - Chemical Spills

Is the area safe?
- Assess the spill
- If safe administer first aid where needed
- Keep the area to keep others away

Consult the MSDS and your supervisor
- Clean up spill if comfortable to do so
- Put on required protective equipment
- Dispose of residue

Spills beyond your capability contact CCPS @ 911
- Close windows and doors
- Turn fume hood to maximum
- Be available to answer questions

Complete an accident incident investigation report form
In the event of a fire:
- Activate the fire alarm using the pull station
- Close the doors and windows where possible
- Evacuate using the stairs, walk don't run

If the fire is small you may use an extinguisher:
- Never enter a room to put a fire out
- Activate the fire alarm first

Get out and stay out:
- Meet the fire department and explain the situation
Small Western Lab Fire

- Overnight experiment
- Rubber hose touching hotplate
- Cooling stopped
- Experiment broke
- Smouldering fire
- Found next day
**Equipment Fires**

- Western Blot
- Stirrer required
- Hotplate turned on
- Discovered late in evening

**Equipment Fires**

- Solvent in oven
- Oven door blown off
- Fire inside
- Glass everywhere
- Missed all 5 lab occupants

**OWL Quiz**

We have looked at:
- Basic safety
- Equipment
- Glassware
- Electrical
- Compressed Gases
- Flammable Liquids
- Fume Hoods
- Personal Protective Equipment
- Emergencies
- Chemical Segregation
- Waste procedures

**Personal Action Plan**

**Emergency Procedures**

Know evacuation route(s)

Know location and use of
- first aid kit
- fire extinguisher
- safety eyewash
- deluge shower
- spill kit

General Laboratory Safety and Hazardous Waste Management
Don’t forget OWL test
e-mail will be sent when set up

Questions?
Comments