Columbia University
Laboratory Safety Training
Welcome to Columbia University's Laboratory Safety & Hazardous Waste Management training course. Please use the navigation bar to move backward and forward through the course.

There is a mandatory test of your knowledge at the end of the course so good luck! Minimum score of 70% is a passing grade. Please review the course materials until you achieve a passing score.
Training Options

- Employees who have attended live initial training may satisfy the annual retraining requirement by reviewing the material in their module and passing the online quiz at the end.

- EH&S provides this training in a classroom setting. ALL NEW EMPLOYEES MUST TAKE THEIR INITIAL SAFETY TRAINING IN THE CLASSROOM SETTING. Those needing refresher training have the option of attending a classroom session or completing this module. The classroom training schedules and other information can be found at http://www.ehs.columbia.edu/Training.html.
Please become familiar with your building or department's Research Safety Specialist.
Please contact them with any laboratory safety related questions or concerns.

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Why Training?

- Crucial for a safe work place
- Policy/Procedures may vary
- Required by OSHA
- Specific and hands-on training by PI in lab
- To Understand your rights & responsibilities
- Participate in safety programs and take appropriate action
Agenda

- Laboratory Safety
  - Basic Concepts about safety (including roles and responsibilities)
  - Regulations
  - Hazard (identification)
  - Exposure Management
    - Engineering Controls
    - Administrative Controls
    - Personal Protective
- Fire Safety
- Emergency Procedures
- Hazardous Waste Management
Responsibilities

CU
- Identify Hazards
- Provide Personal Protective Equipment (PPE)
- Provide Information
- Provide Training

YOU
- Ensure your own safety
- Report hazards
- Use PPE provided
- Follow procedures
- Get Trained
- Promote a safe, healthy & environmentally sound workplace
Regulatory Introduction

Columbia University laboratories must comply with government regulations. Common regulators by campus are not limited to, but include:

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Regulatory Introduction

- The **FDNY (RCNY 10) & NFPA** sets most of the regulations that have a day-to-day impact on lab operations and safety.
- The **NYCDEP** regulates the inventory management and storage of chemicals/hazardous.
- **NYSDEC and EPA** govern the way that hazardous waste is handled, and exist to ensure a positive relationship between the University and the surrounding environment and neighborhoods.
- **OSHA** governs general workplace safety, which applies to laboratories and the special hazards that they present as well.
- The **DOT & IATA** regulate the transportation and shipping of hazardous materials.
- The Drug Enforcement Agency (**USDEA**) regulates the purchase and use of controlled substances in CU labs.
- The **CDC**, Center for Disease Control & Prevention, regulate the use of infectious agents in labs.
Regulatory Introduction- FDNY & NFPA

- Every NYC lab is inspected annually at a minimum by FDNY

- Common inspection focus are:
  - Storage and dating of peroxide forming chemicals
  - Compressed gas cylinder management
  - Material storage and labeling
  - Flammable chemical storage
  - Certificate of Fitness holder present in every lab while during lab operations
Must be dated immediately upon opening

Discard any unused chemicals within a year of opening date or by manufacturer’s expiration date

Check for expiration dates of chemicals including, but not limited to:

- Dioxane, Ethers, Furans (e.g. tetrahydrofuran a.k.a. THF), Picric Acid, Perchloric Acid, and Sodium Amide

Regulatory Introduction- FDNY & NFPA: Peroxide Formers and Unstable Chemicals
Compressed gas cylinders must be stored upright and be restrained at all times.

Oxygen cylinders should be kept at a minimum of 25 feet away from flammable gas cylinders.

Cylinders must be capped when not in use.

A compressed gas cylinder can become a deadly missile if mistreated.

Oxygen cylinders should be kept at a minimum of 25 feet away from flammable gas cylinders. (i.e. hydrogen)
Chemical containers must be clearly labeled to indicate their contents at all times, along with any special storage requirements (such as refrigeration). Light-sensitive items that must be covered in foil must be labeled on the exterior of the foil.

This includes even benign items such as counterweights to centrifuges that may only contain water, and small sample containers.

Unlabeled containers are the most common violation cited by the FDNY lab inspectors.
Regulatory Introduction - FDNY & NFPA: Glass Chemical Bottles Floor Storage

- Must be in Secondary containment
- Not in aisles
- Can hinder emergency response personnel
Regulatory Introduction- FDNY & NFPA: Explosion Proof Refrigerator Used for Cold Flammable Storage

No flammables stored in a refrigerator, cooler, or cold room, that is not lab safe
Flammables in Refrigerators

- Flammable liquids requiring refrigeration must be stored in a “Flammable Material Storage” or “Explosion Proof” refrigerator.
- Domestic refrigerators located in labs are labeled: “Store No Flammables Flashing below 100 F”.
- Use dry ice or an ice bath to temporarily cool flammable liquids.
Certificate of Fitness Program

- At least one C of F holder is required per lab while the laboratory is in operation (includes nights & weekends).
  - Certificate (C-14) indicates that holder knows emergency procedures in the event of a fire in the lab.
  - Labs with large amounts of compressed gases or cryogenics may require additional Certificates.
  - Information on obtaining a C of F can be found at the following site.

http://www.ehs.columbia.edu/COFFlyer.html
Regulatory Introduction
US Environmental Protection Agency

- Agency may perform audits or unannounced inspections; authorities impose fines.
- EPA works with NYSDEC to ensure compliance.
- Resource Conservation and Recovery Act (RCRA) specifies authority of EPA to enforce Hazardous waste Regulations
Regulatory Introduction
OSHA

- The Occupational Safety and Health Administration is the federal regulatory agency governing workplace health and safety.

- OSHA Laboratory Standard (29 CFR 1910.1450) is the specific regulation that applies to laboratory environments:
  - Information on hazard identification and protection
  - Information on chemical exposure, detection, and management
  - Emergency procedures
  - Employers’ and employees’ rights and responsibilities
The HazCom Standard requires that personnel be provided access to information about hazardous chemicals in their workplace and the hazards they may pose, and ensures that personnel have easily understandable information about protection from exposure to these hazards.

Personnel are required to receive training on the classification of chemical hazards and safety information.

HCS mandates the maintenance of:
- Chemical Labeling
- SDS
- Written Hazard Communication Program (HCP).

Please visit www.ehs.columbia.edu/HazardCommunicationPolicy.html for detailed information on Columbia University’s HCP.
The United States recently adopted the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

The Globally Harmonized System (GHS) is a system for standardizing the classification and labeling of chemicals on an international level. It is a logical and comprehensive approach to: Defining health, physical and environmental hazards of chemicals.
Major Changes in HazCom Due to GHS

- All **chemical labels** must comply with the new GHS format. Manufacturers and labs who ship chemicals must ensure that all internal containers have GHS labels attached.

- **SDS**: MSDS will now be referred to as SDS and must be organized in a standard 16-section format.

- All personnel must be **trained** on Hazcom updates on or before *December 1, 2013*. 
OSHA has updated the requirements for labeling of hazardous chemicals. Many companies are already using the new label and as of June 1, 2015, all vendor labels will be required to have:

- Pictograms
- Signal Word
- Hazard Statement
- Precautionary Statements
- Product Identifier
- Supplier Identification.
Manufacturer Chemical Labels

Sections

Updated sections are required to contain specific information, as seen below:

- **Hazard Pictograms** – pictograms visually convey health, physical, and environmental hazard information.
- **Signal Words** - convey the level of hazard. For example:
  - “Warning” being the lowest level of hazard
  - “Danger” referring to the highest level
- **Hazard Statements** - phrases that describe the hazard as determined by classification. For example:
  - “Fatal if swallowed”
  - “Flammable liquid and vapor”
  - “Causes serious eye damage”
Manufacturer Chemical Labels Sections Cont.

- **Precautionary Statements** - briefly provide measures to be taken to minimize or prevent adverse effects
  - **Prevention**
    - For example: “Keep away from heat/sparks/open flames/hot surfaces”
  - **Response**
    - For example: “IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing”
  - **Storage**
    - For example: “Store in a dry place”

- **Product Identifier** – chemical name
- **Supplier Identification** – manufacturer name & address
- **Supplemental Information** – miscellaneous information
Pictograms & Hazards Review

Pictograms are graphic symbols used to communicate specific information about the health, physical, & environmental hazards.

- 5 of the 9 pictograms are used to represent physical hazard classes.
- 4 of the 9 pictograms are used to represent health hazards.
- 1 of the 9 pictograms is used to represent environmental hazards.
Hazardous chemicals present several types of hazards: physical hazards, health hazards, asphyxiant, pyrophoric, combustible dust, and others that are not classified. A physical hazard occurs when a chemical exhibits one of the following properties:

- Explosive
- Self-reactive
- Oxidizer
- Corrosive to Metal
- Gas under pressure
- Flammable
- Emits flammable gas when contacts water
- Self-heating
- Pyrophoric liquid or solid
- Organic Peroxides
Health hazards can cause illness or other health problems, which can include short-term effects, such as headaches, dizziness, or skin irritation, or long-term effects, such as organ damage or cancer. A health hazard occurs when a chemical exhibits one of the following properties:

- Acute toxicity
- Skin corrosion or irritation
- Serious skin & eye damage or irritation
- Respiratory or skin sensitization
- Germ cell mutagenicity
- Carcinogenicity
- Reproductive toxicity
- Specific target organ toxicity
- Aspiration hazard
Out with the Old
In with the New
Safety Data Sheets GHS Updates

- SDS’s provide workers and emergency personnel with comprehensive information on chemical management, proper handling procedures & safety precautions.

- Manufactures are required to supply safety data sheets with every chemical shipment.

- Chemical labels and Safety Data Sheets for a particular substance are linked containing identical precautionary information.

- Please note: Section 8 “Exposure Controls” will always contain information on chemical exposure limits, engineering controls and ways to protect yourself, including personal protective equipment.
Safety Data Sheets Format List

MSDS will now be referred to as SDS and must comply with a 16-section format.

1. Identification
2. Hazard Identification
3. Composition
4. First Aid Measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling & Storage
8. Exposure Controls
9. Physical & Chemical Properties
10. Stability & Reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

The highlighted sections are of particular importance in a laboratory setting.
How to Access SDS

- Columbia’s online source for safety data sheets: ChemWatch
- Available from any computer on the CU network.
- We encourage all labs to maintain hard or printed copies of SDS.

Access Location for SDS’s below: http://www.ehs.columbia.edu/sds.html
Inconsistent
HazCom Application in Labs

The HazCom standard GHS updates apply in laboratories as follows:

- Lab Staff must not remove or deface labels on incoming containers of hazardous chemicals.

- Labels on secondary containers of hazardous chemicals, (e.g., spray bottles and transfer bottles) must include identifying information (i.e., chemical name) and words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals and appropriate hazard warnings, (e.g., “flammable” or “corrosive”).

- SDS for all chemicals in lab or lab support area must be readily accessible during each work-shifts.
HazCom Application in Labs

- Personnel are encouraged to review SDS for all chemicals before use and when new chemicals are introduced into the lab.

- If a lab is shipping hazardous chemicals under the HazCom Standard it is considered to be either a chemical manufacturer or a distributor. Thus the lab must ensure that:
  - Any containers of hazardous chemicals leaving the laboratory are labeled in accordance with the new GHS format.
  - SDS must also be provided and sent with each shipment.
Responsibilities: Laboratory Workers

Every laboratory worker is responsible for:

- Following oral and written safety rules, regulations and standard operating procedures required
- Consult with PI/Laboratory Supervisor before using highly hazardous materials or conducting higher risk experimental procedures; obtain prior approval, if required
- Report all emergencies, injuries, near misses or safety concerns to the PI/Laboratory Supervisor
- In the event of an emergency, call Public Safety and your PI
- Keep work area safe and uncluttered
- Avoid working alone in the laboratory whenever possible
- Absolutely no food, drink, or smoking is permitted in the laboratory at any time
Evaluating Hazards and Assessing Risks in the lab

Nearly all laboratory chemicals inherently possess some degree of hazard that usually cannot be changed.

Toxic effects, and the real risk to the user, can be reduced or eliminated by keeping exposure to a minimum.

REMEMBER:

- Plan ahead
- Identify potentially hazardous substances
  - Particularly Hazardous Substances
    - Select Carcinogens
    - Reproductive toxins
    - Acutely toxic substances
- Minimize exposure to chemicals
- Do not underestimate hazards or risks
- Be prepared for accidents
OSHA-Hazard Communication
Evaluating Hazards

Acceptable limits of exposure have been established for certain chemicals; see SDS (formerly MSDS), OSHA website, or contact EH&S for more information.

Benzene:
- OSHA PEL: 1 ppm
- STEL: 5 ppm

Xylene:
- OSHA PEL: 100 ppm
- STEL: 150 ppm

Methylene Chloride:
- OSHA PEL: 25 ppm
- STEL: 125 ppm
Evaluating Hazards & Assessing Risks

Chemical Hygiene Plan

OSHA requires employers to develop and carry out the provisions of a Chemical Hygiene Plan. This plan must be readily available to employees.

- **University Chemical Hygiene Plan** – managed by the Director of Occupational Health & Safety.
- **Lab Specific Chemical Hygiene Plan (LATCH)** – managed and maintained by the lab and includes chemical inventory and lab staff training.
Hazard Recognition

“The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.”

29CFR1910.1450

Safety and hazard information is available from multiple sources.

- Hazard Communication
  - Signs & Labels
- Chemical Inventories
- SDS (formerly MSDS)
- Training
- EH&S
Hazard Recognition

- Chemicals are often marked with the NFPA Diamond or similar hazardous communication markings to denote their hazards.
- Note the hazards as listed on chemical containers in your lab prior to using them.
Hazard Recognition – Physical Hazards

- Elements of the laboratory work environment, including chemicals and equipment, hold the potential to cause physical harm.
- For each type of hazard, awareness and simple protective measures will ensure safety.

- Burns
- Asphyxiation
- Slips, Trips, Falls
- Electrocution
- Blunt Force Trauma, Lacerations
- Compressed Gas and Cryogenic Hazards
Hazard Recognition - Physical Hazards

Cryogenic Materials

Pose the threat of:

- Burns or frostbite: extremely low temperatures can cause rapid tissue damage. Use adequate hand, eye, and face protection when handling.

- Asphyxiation - off gassing can displace oxygen. Use cryogenic materials only in areas with adequate ventilation; never in a cold room.
Hazard Recognition - Physical Hazards
Cryogenic Safety Oxygen Alarms

- Oxygen alarms are used where large amounts of cryogenics or inert gases are stored, which can potentially cause asphyxiation by displacing oxygen.
- DO NOT ENTER any area where an oxygen alarm is going off.

- Asphyxiation can be rapid and sudden, with no warning signs.
- Rescues must be performed by someone with a supplied air respirator.
- If it is possible to open doors/windows to ventilate area without entering, do so.
Hazard Recognition - Chemical Hazards

- Many substances commonly encountered in the laboratory environment pose chemical hazards.
- For each type of hazard, awareness and other protective measures will ensure safety.
- USDOT Diamonds, NFPA Diamonds, manufacturer’s labels, and MSDS will alert you to a chemical’s specific hazards. Review all hazard information before beginning work, and never work with an unfamiliar chemical.

- Flammability
- Corrosivity
- Toxicity
- Reactivity
Chemical Exposure – Health Effects

- **Acute effects** – sudden, traumatic effects
  - Headaches, dizziness, burns from corrosive chemicals

- **Chronic effects** – slow, gradual effects not rapidly perceived; poor or no warnings of exposure
  - Cancer, mutation, reproductive effects

Some exposures to chemicals like HCl can produce acute effects (burns), while some materials, such as benzene, produce both acute effects (irritation) and chronic risks (carcinogen). Not all chemical exposures will show immediate effects!
Chemical Exposure
Chemical Routes of Entry

- Inhalation
- Absorption
- Injection
- Ingestion
Chemical Exposure
Chemical Routes of Entry-Inhalation

Be aware of aerosol-producing procedures such as:

- Accidental spills
- Pipetting
- Weighing
- Injections using syringes and needles
- Removing caps and stoppers
- Clean-up procedures, dry sweeping
- Centrifugation
Hazard Recognition: Absorption

- Skin is the largest organ in the human body and offers an important protective cover.
- Your skin is the major route of entry for hazardous substances in the workplace.
- To avoid dermal contact:
  - Follow protocols
  - Use safe work practices
  - Wear proper personal protective equipment (PPE)
Chemical Exposure

Chemical Routes of Entry - Injection

- Sharps, including needles, razor blades, and glass, pose the physical hazard of cuts, lacerations, and punctures. In addition, broken skin increased the risks from chemical or biologically hazardous materials.
- All needles, syringes, pipettes, pipette tips, and blades must be discarded in rigid sharps containers regardless of the status of biological contamination.
- Limit use, do not recap needles
- Do not remove needles from syringes
- Do not bend, break, or manipulate syringes
- Dispose in sharps containers
Chemical Exposure
Chemical Routes of Entry - Ingestion

A common route of chemical exposure is INGESTION due to contaminated food or hands. Food and drink (including coffee cups and water bottles), applying cosmetics and changing contact lens are strictly prohibited in Columbia University labs.

NO EATING OR DRINKING IN THE LAB
Exposure Management

- Toxic effects can be minimized by keeping exposures to a minimum.
- Acceptable limits of exposure have been established for certain chemicals for example Formaldehyde.
- Hierarchy of control measures to minimize risk.
- Reduce time or amount of exposure, or alter nature of exposure.
  - Engineering controls
  - Administrative controls
    • Chemical Management
    • Safe Work Practices
  - Personal protective equipment (PPE)
Exposure Management

Exposure Monitoring

- Regular monitoring performed for those working closely with regulated chemicals (ie. formaldehyde)
- Area monitoring where fume hoods are not available
- Low potential for exposure if not working directly with chemicals
Exposure Management

Engineering Controls

Engineering controls are measures designed to prevent exposure to a harmful substance or hazard. The most common engineering controls are:

- Chemical Fume Hoods
- Biosafety Cabinets (BSC)
Engineering Controls
Chemical Fume hoods

Reduce exposure to airborne hazards.
Ensure that your fume hood is:

- Free of clutter
- No permanent storage
- 80-120 linear feet/minute
- ‘Kim-wipe test’
- Not open more than 12”
- Work 6” inside

Fume hoods also act as a Physical Barrier in the event of a explosion

- Not the same as BSC
*Engineering Controls
Chemical Fume hoods
Exposure Management
Chemical fume hoods
Exposure Management
Administrative Controls

Alter work practices:
- Chemical substitution
- Proper storage and segregation of hazardous materials
- Proper housekeeping practice
- Prudent inventory and purchase order management
- Appropriate training and Right to Know information (such as MSDS)
Administrative Controls
Chemical Substitution

Less hazardous alternatives
- Citrosolv v. xylene
- Enzymatic detergents v. chromic/sulfuric acid-based glass cleaners
- SYBR Safe v. Ethidium bromide
- Mercury-free Thermometers
Administrative Controls
Chemical Storage

Consider the following:

- **Compatibility**
  - Like-hazard classes stored together in secondary containment
  - Acids and Bases stored separately
  - Oxidizers and Flammables stored separately
  - Water reactive and Aqueous chemicals stored separately
  - Cyanides and Acids stored separately
  - Particularly Hazardous Substances (PHS)
    - Highly toxic chemicals, select mutagens, teratogens, carcinogens

- **Location**
  - Near incompatible materials, heat, or open flame
  - Not above eye level
  - **Not in cold rooms**
  - Not in sinks

- For more information please visit:
Administrative Controls
Chemical Storage

Chemicals Stored in Approved, Compatible Cabinets

- Acid cabinet OR regular cabinet with **secondary containment**
- Corrosives below eye level and not on bare metal shelves
- **Nitric Acid** physically separated from all other acids,
  - plastic tub,
  - separate cabinet
  - separate part of the acids cabinet
Administrative Controls
Chemical Containers in Good Condition

- Regularly inspect your inventory for safe storage
- Unacceptable conditions include:
  - rusty containers, including cylinders
  - bulging containers
  - leaking containers
  - broken caps
Hazardous Materials Cannot be stored in the Walk-In Cold Rooms/ Refrigerators

- Flammable
- Volatile
  - Mercury
  - Formalin
- Dry Ice
- Gas cylinders
DEA Controlled Substances Policy

Use and Management of Controlled Substances

The acquisition, use and disposal of controlled substances in New York State are strictly regulated by the New York State Department of Health (NYS DOH) Bureau of Narcotic Enforcement and the United States Department of Justice Drug Enforcement Administration (US DEA). These regulations are aimed at preventing diversion of controlled substances through a variety of administrative and physical controls. To assist researchers in understanding and meeting their individual obligations under these regulations, Columbia University has established a Policy for the Acquisition, Use and Disposal of Controlled Substances in Research.

In addition to the Policy, several Appendices, Resources and Reference Documents have been prepared to assist researchers in navigating the requirements for controlled substances.
DEA Controlled Substances

For more information please visit:
http://www.ehs.columbia.edu/ControlledSubstances.html
Allowable Limit of Flammable Chemicals
Morningside & Medical Center Only

- Determined by construction materials and presence of sprinklers.
  - 4 Lab types: I, II, III, IV
  - Flammable limits of 30, 25, 20, 15 gallons, respectively
  - Flammable waste materials count toward these limits
Administrative Controls
Good Housekeeping

- Poor housekeeping contributes to accidents and can hinder emergency response activities.
  - Work area clean and uncluttered
  - Chemicals properly labeled and stored
  - Clean up after operation and end of day
  - Keep exits, aisles, doorways free of obstruction
Electrical Cords In Good Condition

- Insulation not worn, split, or frayed
- Plug not separated from the cord
- Cord not pinched in a door or in any other way
- **Extension cord not used for permanent use**
Administrative Controls
Inventory Management

- Purchase order management
  - Smallest quantity sufficient for your work
  - Utilize ‘just in time’ delivery
  - Excess chemicals become Hazardous Waste
- Updated chemical inventory
- Dispose of all outdated or unused chemicals properly and promptly.
Transporting chemicals safely

YES  YES  NO
Freight Elevator

Please remove gloves before leaving the laboratory.

Hazardous materials must be transported via the freight elevator and must not be transported using the passenger elevator. Secondary containment must be utilized for transport and gloves must be removed before leaving the laboratory.

*Hazardous Chemicals*

*Open Containers*

*Animals and Animal Bedding*

*Biological Materials*

*Radioactive Materials*

*Compressed Gas Cylinders and Cryogenic Liquids*

*Laboratory Items/Equipment Requiring a Cart or Hand Truck*

Please contact Environmental Health & Safety at 212-305-6780 if you have any questions or refer to the Laboratory Safety and Chemical Hygiene Policy at http://www.ehs.columbia.edu/lscp1.html
Exposure Management: Focus on PPE

MUST BE WORN AT ALL TIMES IN THE LAB:

- Closed Toe Shoes
- Long Pants/Scrubs
- Lab coats/Aprons
- Safety glasses / goggles
- Protective gloves

DO YOU KNOW WHEN AND WHERE TO WEAR PPE?
Columbia University’s Personal Protective Equipment Policy addresses the use of PPE in all University laboratories & support areas. The Policy is designed to ensure that the University’s research & teaching community understand proper PPE selection, PPE use and maintenance, and meet established safety standards.

Please visit the PPE website for details & guidance on the policy!

http://www.ehs.columbia.edu/ppe.html
Exposure Management:
New PPE Web Page

Personal Protective Equipment

Columbia University's Personal Protective Equipment Policy addresses the use of PPE in all University laboratories & support areas. The Policy is designed to ensure that the University's research & teaching community understand proper PPE selection, PPE use and maintenance, and meet established safety standards.

PPE Policy

The appropriate use of PPE is critical in reducing exposure to laboratory hazards and represents the last line of defense against potential exposure. PPE is provided at no cost to affected personnel and used whenever the potential for occupational exposure exists. In most instances, the minimum level of PPE for laboratory personnel consists of a lab coat, gloves, and eye protection.

Please visit the links below for detailed information regarding PPE:

- PPE Hazard Assessment Tool
- Laboratory Coats
- Other Clothing Considerations
- Hand Protection
- Respiratory Protection
- Eye & Face Protection

In addition to understanding the appropriate uses of various types of PPE, it is equally important to realize that all PPE items have limitations that should be considered in making a selection. Please note, PPE should never be used as a substitute for proper engineering and administrative controls or prudent work practices, but only as an additional measure of protection once all other reasonable precautions have been taken.
Exposure Management: Acceptable Lab Attire
Exposure Management
Laboratory Coats

- Provide partial protection to the torso, and are designed to limit the impact of contact with a hazardous material.

- Should extend to the knees, be fully buttoned, and sleeves not rolled up.

- To be worn in laboratory spaces, but removed before entering common areas.
Exposure Management
Laboratory Coats

Limitations

- Are typically permeable, and do not provide a complete barrier against hazardous materials.
- Fabric must be compatible with the hazard potential.

Care & Disposal

- Should be laundered on a regular basis, but not at home.
- Replaced if damaged.
- Disposed of as a hazardous waste if soiled with a hazardous material.
Exposure Management
Eye Protection

- Protects the eyes from splash, projectile, and other hazards.

- Worn over the eyes, not on the forehead or around the neck.

- Must provide peripheral, in addition to direct, protection.
Exposure Management
Eye Protection

Limitations

- Safety glasses protect well against projectiles and minor splash hazards, but are not suitable when a major splash risk exists.

Care & Disposal

- Clean the lenses and frames on a regular basis to maintain lens clarity.

- Soap and water, or a household glass cleaner are suitable. Avoid alcohol.

- Replace if damaged.
Exposure Management
Hand Protection

- Protective gloves provide a barrier between a hazardous material and the skin.

- In general, disposable nitrile gloves are preferred for most laboratory applications.

- In some cases, specific glove material must be used to provide the best protection.
Exposure Management
Hand Protection

- Formaldehyde/Sodium Iodine permeates latex
- Acetone permeates nitrile
PPE - Hand Protection
Personal Protective Equipment
HOW TO REMOVE GLOVES

- Grasp the exterior of one glove with your other gloved hand.
- Carefully pull the glove off your hand, turning it inside-out.
- Ball the glove up and hold in your other gloved hand.
- Slide your ungloved finger into the opening of the other glove.
- Carefully pull the glove off your hand, turning it inside out again.
- Discard appropriately.

Always avoid touching the exterior.
Standard Precautions for Laboratory Glove Removal

- Remove gloves before leaving the laboratory and entering common use spaces such as elevators or corridors outside your laboratory.
- Remove gloves before using the telephone or touching other common use surfaces in your laboratory.
- Use an appropriate secondary container when transporting materials through common use areas.

Always wash your hands with soap and water after removing gloves and before leaving the laboratory.
Respiratory Protection

- The use of a respirator is not typically necessary in the laboratory environment.

- Cannot be safely utilized without detailed risk assessment, medical surveillance, and training.
Proper PPE
Emergency Equipment

Keep Clear of Obstruction

- Showers, eyewashes, spill supplies, and fire extinguishers need to be unobstructed
- Don't wait for an Emergency
  - Test eyewashes weekly
Safety Equipment-Eyewash Operation

- With the assistance of someone in the laboratory, go to the nearest eyewash.

- Hold eyes open with fingers and allow for stream of tepid water to irrigate eyes for at least 15 minutes.
Fire Safety Staff

- John LaPerche – JL2709
  Director of Fire Safety
- Jerry Meehan- JM2143
  Sr. Fire Safety Officer
- Harry Oster- HJO2104
  Fire Safety Officer
Certificate of Fitness Program

- At least one C of F holder must be in lab while in operation (includes nights & weekends).
  - Knows emergency procedures in the event of a fire in the lab.
  - Compressed gases or cryogenics may require additional Certificates.
  - Information on obtaining a C of F can be found at the following site.
    - [http://www.ehs.columbia.edu/COFFlyer.html](http://www.ehs.columbia.edu/COFFlyer.html)
Fire Safety

- In Case of Fire:
  - RACE & PASS
  - Rescue
  - Alarm
  - Confine
  - Extinguish

To use Fire Extinguisher:
- Pull Pin
- Aim Hose
- Squeeze Handle
- Sweep From Side to Side
RACE

RESCUE

- Not just yourself!
- People with special needs
- People in immediate area

ALARM

- Alarm (Manual Station)
  - Located by exits
- Call Public Safety
- Notify occupants as you leave
- Give all information to security/FDNY
- When to sound a fire alarm:
  - Any fire or smoke condition.
  - Dangerous situation – crime in progress, etc.
  - For emergency building evacuation.
RACE

CONFINE

- Close all doors/windows as you leave.
- Turn off source of ignition if possible
- Keep fire in room of origin

EXTINGUISH

- Use extinguisher if:
  - You are properly trained.
  - Fire is very small.
- Report the fire before attempting to extinguish.
- Maintain a clear path between you and the exit.
ABC Fire Extinguisher

- **Class ‘A’** = Combustibles fires involving solids such as wood, paper, plastic
- **Class ‘B’** = Flammable liquids such as alcohol, paint, oil.
- **Class ‘C’** = Electrical equipment, Computers, Copiers.

*Extinguisher Ratings*

Fire extinguishers are rated by the type of fire they can put out.
Fire Extinguisher Use

- Stand 6 to 8 feet from the fire, keeping your back to the door.
- Using the proper extinguisher, remember PASS.
  - P – Pull the pin.
  - A – Aim the nozzle at the base of the fire.
  - S – Squeeze the handle.
  - S – Sweep nozzle across base of fire.
Fire Extinguisher Use - PASS

P - Pull The Pin

A - Aim The Nozzle At Base Of Fire
Fire Extinguisher Use - PASS

S-Squeeze Handle

S-Sweep Nozzle Across Base Of Fire
Fire Extinguisher Use

- Use extinguisher if:
  - You are properly trained.
  - Fire is very small.
- Report the fire before attempting to extinguish.
- Maintain a clear path between you and the exit.
- The 30 Second Rule:
- If you can’t extinguish the fire in **30 seconds** or with one extinguisher,

  GET OUT!
What to do in the Event of a Real Fire

*Fight or Flight? –*

**If you stay:**
- Feel door. If HOT, don’t open.
- If smoke or heat is present:
  - Remain in room.
  - Close door and seal cracks.
- If possible, phone Public Safety and give your location.
- Stand at window to signal Public Safety or the FDNY.
- If possible, open top and bottom window to allow fresh air in.

**If you go:**
- If smoke and heat permit, stay low and crawl to safety.
- Close doors.
- Take keys with you to return if necessary.
- Knock on doors and yell “FIRE” if you can.
- Report location of heat and fire to Public Safety of the Fire Department.
Laboratory Evacuation Procedures

- Turn off all equipment within reach that can be safely turned off.
- Close fume hood sash.
- Close open chemical containers.
- Look for exit sign.
- Know the location of fire exit.
- Count the number of doors.
- Use the nearest stairwell.
- Know location of fire exits.
- Use nearest stair.
- Move horizontally into an adjoining building.
Laboratory Evacuation Procedures

Know Your Location

DO NOT USE ELEVATORS
If you catch on fire!

- **DO NOT RUN!**
- Immediately call out for help
- **Use**
  - Emergency shower
  - Deluge hose
  - ABC Extinguisher
  - Fire Blanket
- Know location of these items
- If Co-worker, may have to knock to ground
What to do in the Event of a Real Fire

Stop-Drop-and-Roll

If you catch fire,
Spills and Emergency Response

What would you do in the event of a spill?
Emergency Response: Reporting Laboratory Emergencies

Provide:
- Name
- Location (Building, Room)
- Phone Number
- Incident Details
- Any Personal Injury

### Reporting Fire, Smoke Conditions or Personal Injury

<table>
<thead>
<tr>
<th>Campus</th>
<th>Public Safety from a Campus Phone</th>
<th>Public Safety from a Personal Phone</th>
<th>Environmental Health &amp; Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUMC</td>
<td>305-7979</td>
<td>(212) 305-8100</td>
<td>(212)305-6780</td>
</tr>
<tr>
<td>LDEO</td>
<td>911 and then X555</td>
<td>(845) 359-2900</td>
<td>(212) 854-8749</td>
</tr>
<tr>
<td>Morningside</td>
<td>x99</td>
<td>(212) 854-5555</td>
<td>(212) 854-8749</td>
</tr>
<tr>
<td>Nevis</td>
<td>911 and then (914) 591-92</td>
<td>(914) 591-2870</td>
<td>(212) 854-8749</td>
</tr>
</tbody>
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### Reporting a Chemical or Hazardous Materials Spill

<table>
<thead>
<tr>
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<tr>
<td>LDEO</td>
<td>x555</td>
<td>(845) 359-8822</td>
<td>(212) 854-8749</td>
</tr>
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<td>Morningside</td>
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Emergency Response
Chemical Spill

Laboratory personnel must know what to do in case of an emergency and conduct a risk assessment of the incident.

- Personal Injury / Health Emergency
- Chemical Release
  - Unmanageable: Must only be handled by trained professionals.
  - Manageable: Can be handled by laboratory personnel using in-lab spill kit.
Spills and Emergency Response
Unmanageable Spills

- STOP the experiment you are conducting
- ALERT everyone in the lab
- CONTAIN (if possible)
- EVACUATE everyone in the lab
- NOTIFY
  - Public Safety
  - PI
  - EH&S
- SDS
- MEDICAL ATTENTION if necessary
Spills and Emergency Response
Personal Contamination

- Remove contaminated clothing.
- Flush exposed area with tepid water for 15 minutes.
- If there are no visible burns, wash gently with soap and warm water.
- Obtain SDS.
- Obtain medical attention, if necessary.
- Report the incident to your supervisor. File appropriate accident reports and notify EH&S.
Medical Surveillance

- Employees who work with hazardous chemicals shall be provided the opportunity to receive medical attention:
  - Post-exposure
  - Post-monitoring (if exposure indicated)
  - Post-event (if exposure deemed likely)
# Spills and Emergency Response

Where to go for Injuries and Health Emergencies

<table>
<thead>
<tr>
<th>Campus</th>
<th>Hours</th>
<th>Faculty / Staff</th>
<th>Students</th>
<th>Public Safety Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUMC</td>
<td>Business-Hours</td>
<td>Workforce Health &amp; Safety- Harkness Pavilion First Floor (212) 305-7580</td>
<td>Student Health Services - 60 Haven Avenue (212) 305-3400</td>
<td>x5-7979</td>
</tr>
<tr>
<td></td>
<td>After-Hours</td>
<td>NYPH Emergency Department - First Floor of the Vanderbilt Clinic (VC)</td>
<td>NYPH Emergency Department - First Floor of the Vanderbilt Clinic (VC)</td>
<td></td>
</tr>
<tr>
<td>LDEO</td>
<td>Business-Hours</td>
<td>Nyack Hospital: 160 North Midland Avenue Nyack, NY 10960 (845) 348-2000</td>
<td>Student Health Services - John Jay Hall, 3rd and 4th Floors (212) 854-2284</td>
<td>(845) 359-2900 or x555</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morningside</td>
<td>Business-Hours</td>
<td>St. Luke's Hospital 1111 Amsterdam Avenue at 114th St, New York</td>
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<td>x5-7979</td>
</tr>
<tr>
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<td>After-Hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nevis</td>
<td>Business-Hours</td>
<td>St. John's Riverside Hospital Dobbs Ferry Pavilion 128 Ashford Avenue Dobbs Ferry, NY 10522 (914) 693-0700</td>
<td></td>
<td>(914) 591-2870</td>
</tr>
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<td></td>
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</tbody>
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Labs are required to purchase and maintain spill kits. They should contain the following:

- **PPE**
- **Absorbent material**
- Pads or powders
- Activated carbon for organic solvents
- Vermiculate or kitty litter
- **Neutralizing agents**
- Acid – Sodium bicarbonate
- Base - Citric acid

**Hazard-specific spill kits are needed for:**

- Formaldehyde
- Mercury
- Radiation
- Hydrofluoric Acid
Spills and Emergency Response – Manageable Spills
Wall Guide

The EH&S Wall Guide is a useful source of information and we encourage you to locate the one in your lab and become familiar with it's contents which includes:

- Emergency Contact Information
- Emergency Response Procedures
- Health & Safety Reminders
Chemical/Hazardous Waste Management

- Environmental Management Systems
- **No Drain Disposal Policy**
- Waste identification/classification
- Waste management (5 L’s)
- Additional Types of Waste
- Campus Specific Disposal Guides
Policies

Environmental Management Systems (EMS)
Columbia University’s Environmental Management System (EMS) provides a framework for environmental management and the implementation of the University’s environmental policies at all campuses.

The EMS ensures a healthy and safe place for its students, faculty, employees and visitors, while at the same time minimizing its impacts on the environment and maintaining compliance with environmental regulations. This is accomplished through a rigorous system of checks and balances, evident in programs such as the Hazardous Materials Program.

No Drain Disposal Policy
Requires ALL waste to be collected for safe and proper disposal through EH&S. This includes trace amounts ethanol and acetone used for slide washing and dilute solutions containing a hazardous waste such as hydrochloric acid must be collected.
Hazardous Waste: Managed at the State & Federal Level
4 Characteristic Hazardous Wastes

Ignitable
- Flashpoint <140°F
- Examples
  - Liquids: methanol, ethanol, isopropanol
  - Solids: paraformaldehyde, nitrates

Corrosive
- Acids: pH ≤ 2
- Examples
  - Organic Acids: acetic acid, formaldehyde
  - Inorganic Acids: hydrochloric, sulfuric, and hydrofluoric acids
  - Bases: pH ≥ 12.5
  - Examples
    - hydroxide solutions, sodium hypochlorite, amines
4 Characteristic Hazardous Wastes (con’t)

Reactive
- Materials which may react violently with water or air, or generate toxic gases, vapors or fumes.
  
  Examples: sodium/potassium metal, dry picric acid, organometallics

Toxic
- Capable of causing death or injury via physicochemical reaction.
  - Heavy Metals and their Compounds:
    - arsenic, barium, cadmium, chromium, mercury, lead
  - Organic Liquids:
    - 1,4-dichlorobenzene, methyl ethyl ketone, chloroform, phenol, acrylamide, trypan blue stain
  - Acutely Toxic (P-listed):
    - The chemical and the empty &/or residue containers must be managed as a hazardous waste. Examples include: epinephrine, sodium azide, cyanides, osmium tetroxide, and arsenic compounds.
5 Rules of Hazardous Waste Management

The Five Ls are a quick reference to assist in managing Hazardous Waste:

- **Collect**
- **Label**
- **Lid**
- **Locate**
- **Leaks**

*Note: Evaporation, Neutralization, Dilution and Treatment are NOT acceptable Hazardous Waste management practices.*
Collect
All Hazardous Waste must be collected. Even small amounts (i.e. a few mL) must be collected. Containers must be compatible with the waste being collected.

Unacceptable

Chemically contaminated sharps must be collected in chemical waste containers rather than the RMW containers. Drain disposal of solvents, including dyes, is prohibited.
Labels

All waste must be labeled with an orange hazardous waste label containing the chemical constituents and percentages. Abbreviations, chemical formulas and structures, or generic names like “organic”, “halogenated”, or “solvent” are not acceptable.
Containers must be closed at all times. If the container were to be knocked over, no waste should be spilled. Parafilm, Foil, Funnels or Loose Tubing are not acceptable lids. Specialty caps are available for wastes which may generate pressure or require special openings, for example HPLC machines.
Hazardous Waste, unlike other types of waste, must be stored “At or near” the point of generation. a.k.a In the same room it is produced. Waste **cannot be moved** to a collection area in another room or building.
Leaks

Visually inspect waste containers on a regular basis to check for leaks. Leaking hazardous waste containers must be immediately cleaned up using the lab’s spill kit. For assistance with leaks or spills immediately contact EH&S.
NEVER Combine Waste!

- Each waste stream must be collected and managed in individual containers.
  - For Example: All “organic” or “inorganic” or “solvent” waste must never be mixed or comingled.
- Mixing wastes may lead to unintended, potentially dangerous reactions.
- Chemical wastes may never be mixed unless prior approval has been granted from EH&S.
Requesting a Waste Pickup

Requests for hazardous chemical waste pick ups, containers, lids, and/or labels may be placed by:

Morningside, Medical Center, Nevis and Lasker*:

Fill out an online request form at http://vesta.cumc.columbia.edu/ehs/wastepickup/

Lamont:

E-mailing the Safety Department at hazwaste@admin.ldeo.columbia.edu.
Other Waste Types

- Gases
- Buffers
- Inherently Waste-like Chemicals
- “Unknowns”
- Universal Waste, including Used Batteries
- Silver Recovery
- Used Oil
- Mixed Waste (Chemical & Radioactive)
- Select Agent or Toxin Waste
- DEA Controlled Substances
- Regulated Medical Waste (RMW)
Other Waste: “Buffers”

The constituents of many “buffers” make them a hazardous waste.

- Western Blot, Coomassie Stain, Running & Transfer Buffers
  - May contain methanol &/or acetic acid
- Extraction Kit Buffers
  - May contain methanol, ethanol, guanidine thiocyanate, sodium hydroxide, acetic acid and other hazardous chemicals
- Other Buffers
  - May containing heavy metal salts or flammable liquids
- Electrophoresis stock and used solutions
  - May contain low concentrations of dyes unsuitable for drain disposal without prior treatment/filtration.
Other Waste

- **Inherently Waste-like chemicals:** Have expired shelf-life, no foreseeable use, contaminated or unusable chemicals, significant deterioration of label and/or container.

- **“Unknown” Chemicals**
  Prevent “unknowns” from occurring by labeling all chemical containers. Before submitting a waste pickup request, containers must be labeled as “hazardous waste pending analysis”.
Other Waste

- **Gases**
  Must be collected as Hazardous Waste even if empty, including: lecture bottles, butane/propane canisters and aerosol cans.

- **Universal Wastes**
  Universal Waste includes a variety of common items that contain RCRA Hazardous Wastes, which also must be managed to prevent environmental contamination.
Universal Waste: Used Batteries

- Should be collected in the designated white battery containers.
- “Wet Chemistry” batteries, including lead acid batteries must be managed as hazardous waste.

Battery can locations may be found at: http://www.ehs.columbia.edu/RecycleBattery.html

- With the exception of alkaline batteries, all battery terminals must be covered with non-conductive, clear tape or individually bagged and disposed.
Other Waste

- **Silver Recovery Units:**
  Must be affixed to every photo processing unit per NYCDEP. Units are available from and maintained by EH&S.

- **Silver Films:**
  Used, unused and expired must be collected for recycling.

- **Used Oil:**
  Oil must be collected in a closed container and labeled as “Used Oil”. Oil contaminated with PCBs, heavy metals, chlorinated solvents or other hazardous material must be managed as a hazardous waste.
Other Waste: Mixed Waste

Mixed Waste = Chemical Waste + Radionuclide

- Mixed Waste is any waste that includes a RCRA Hazardous Waste and a radioactive isotope.
- Waste collection must meet both Hazardous Waste and Radioactive Waste Requirements for collection and labeling.

Examples:
- Phenol-chloroform mixtures with extractions of radiolabelled nucleic acids
- Electrophoresis gel liquid waste containing methanol or acetic acid and radionuclides.
Other Waste

- **Toxin or Select Agent Waste**
  Waste generated from the use of toxins or select agents. Examples: Tetrodotoxin, Diptheria, Spider or Snake Venom.
  [http://www.ehs.columbia.edu/select.html](http://www.ehs.columbia.edu/select.html)

- **DEA Controlled Substances**
  Waste generated from the use of Controlled Substances. Examples: Testosterone, Barbital and compounds, Ketamine, Ketaset, Nembutal, etc.
  [http://www.ehs.columbia.edu/ControlledSubstances.html](http://www.ehs.columbia.edu/ControlledSubstances.html)

Toxins, Select Agents and DEA Controlled Substances are specially regulated. Please consult the online guidance documents or contact EH&S for disposal requirements.
Regulated Medical Waste (RMW)

- All “soft” material, including gloves, bench pads, small tubes and petri dishes may be collected in the red waste bags.
- All sharps, including syringes, razor blades, scalpels must be placed into a ridged red sharps collection container.
Regulated Medical Waste (RMW) Services

**Morningside:**
- All departments EXCEPT Chemistry are serviced by the RMW vendor Tuesdays and Fridays. The online chemical waste pickup request form may be used to request additional supplies or to report missed pick ups.
- The Chemistry department’s RMW is picked up by request via the online chemical waste pickup request form.

**Medical Center:**
- All RMW Services are provided through Facilities by dialing 5-HELP extension 3.

**Lamont:**
- All RMW Services are provided through the Safety Department by request at hazwaste@admin.ldeo.columbia.edu.

**Nevis:**
- RMW waste requests are placed directly with the vendor.

**Lasker Companies:**
- Must make independent arrangements directly with a vendor.
Morningside - Solvent Recycling

- EH&S recycles solvents onsite, free of charge, for reuse in laboratories.
- Ethanol, Methanol and Acetone are recycled in 1-gallon and 5-gallon quantities.
- To join the recycling program, contact EH&S at hazmat@columbia.edu.
**Remember:** Bottles with a pink p-list sticker must be managed as a hazardous waste and may not be placed into the yellow bins.

Barcodes from these bottles must be removed, placed on a sheet of paper and left with yellow bins to be scanned out.
Disposal Guide - Morningside

Morningside Campus
Disposal of Empty Laboratory Chemical Containers and Glassware


Please contact EH&RS with any questions @ 854-8749 or ehrs@columbia.edu

June 2006
Disposal Guide - Medical Center

**Laboratory Disposal Guide**

**SHARPS**
- Place all sharp objects such as syringes, pipette tips, serological pipettes, razor blades, etc. in sharps container. When 75% full, place outside the lab door for replacement with empty containers. No clean tip holders or lab debris.

**NON-SHARPS**
- Dispose of all other potentially biohazardous non-sharp waste from the laboratory in red bags. When finished place closed red bag in gray bin or box. Put room number on tape used to close the red bag.

**LAB TRASH/RECYCLABLES**
- Lab refuse free of contamination and presenting no other hazard should be recycled where applicable or disposed of with regular garbage clear bags. *Not in Red Bags or Sharps Containers*.

**EMPTY GLASSWARE**
- All clean empty glass bottles should be defaced then placed into an empty cardboard box for facilities to recycle.

**EMPTY CHEMICAL BOTTLES**
- Empty chemical bottles should be defaced then placed into an empty cardboard box for removal by facilities. *Empty acutely toxic (EPA P-list) material containers must be picked up as hazardous waste by EH&S.*

**LAB EQUIPMENT**
- All lab equipment for relocation and/or disposal needs to be disinfected with either 10% bleach or 70% Ethyl Alcohol. Then contact EH&S to obtain clearance at 212-305-6780.

**UNWANTED CHEMICALS OR CHEMICAL-HAZARDOUS WASTES**
- Unwanted chemicals must be collected, kept closed at near the point of generation, properly labeled, and checked for leaks. For removal, fill out form at: [http://vesta.cump.columbia.edu/ehe/wastepicksp/](http://vesta.cump.columbia.edu/ehe/wastepicksp/)

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Environmental Health & Safety - (212) 305-6780

Printed on recycled paper
Questions?

Please contact EH&S with any questions or concerns.
Additional Training

Please be advised that depending on the nature of your laboratory work you maybe required to take additional training.

- Formaldehyde/Xylene Safety
- Blood borne Pathogen and Biological Safety
- Radiation Safety
- Hydrofluoric Acid Safety
- Workshop Safety
- Laser Safety

http://www.ehs.columbia.edu/Training.html
Thank you.