Laboratory Safety – Making Safety a Priority!

Lab Safety Team
Department of Environmental Health and Safety
Florida International University
(305) 348-2621

“An ounce of prevention is worth far more than a pound of cure”
Overall Goal

- As a member of the FIU research and teaching community, it is your responsibility to ensure a safe and healthy environment when conducting your experiments.

- Provide guidelines that enable:
  - Safe handling, containment, and disposal of hazardous materials
  - Prevention of accidents (exposures, injuries, spills, etc)
  - Protection of public health and the environment

*Overall, to ensure a safe work environment through safety awareness training and adherence to safety procedures*
FIU campuses have over 300 research, teaching and core lab facilities

Each of these areas may contain various types and quantities of hazardous materials such as:

- Chemicals
- Biological agents
- Radioactive materials and equipment
Lab Facility Signage

- All lab areas must post the following information for emergency response purposes:
  - Appropriate hazard signage and symbols
    - EH&S can assist in providing the required signage and labels
  - Principle Investigator/Lab supervisor name
  - Alternate contact name and phone number
  - Additional hazards (flammables, radiation, UV exposure, etc)
  - Required PPE and entry instructions
Safety training is required by Federal, State, and Local Regulations
- Occupational Safety & Health Administration (OSHA), Dept. of Environmental Protection (EPA), Dept. of Health (DOH)

Safety training modules are available through the FIU EH&S “Online Anytime” Safety Training Program
- Classroom versions are also available depending on the type of training needed
Requisite Knowledge & Awareness

- The protection of lab workers, other persons associated with the lab, and the public depends on the lab workers themselves

- Lab workers are required to complete a series of EH&S online safety training courses PRIOR to working in the lab area
  - Lab Safety, Hazard Communication, Fire Safety are the core online courses for anyone working in a lab/core facility
  - Additional courses are dependent on job tasks and potential exposures

- It is the responsibility of the PI/Department lab manager to ensure that lab workers have been trained in the use of lab practices and safety equipment required for the safe handling of the material(s)

- All lab workers must also be trained on:
  - Recognizing the signs and symptoms of accidental exposures
  - Understanding the need to report all potential exposures and accidents
  - Understanding how work-related exposures occur
Requisite Knowledge & Awareness

Task-Specific Courses:

- **Work with Chemical Hazards**
  - Chemical Handling and/or Disposal
    - Safe Use of Chemical Fume Hoods (every 3 years)
    - PPE (every 3 years)
    - EPA Hazardous Waste Awareness and Handling (every year)
    - Environmental Awareness Part II (every year)
    - Small Spills and Leaks (every year)

- **Work with Biological Hazards**
  - Human cell lines, tissue, fluids and/or Infectious Agents
    - Bloodborne Pathogen Exposure Control (every year)
    - Safe Use of Biosafety Cabinets (every 3 years)
    - Safe Management of Biomedical Waste (every year)
  - Research Animals
    - Animal Care Safety (every 3 years)
Requisite Knowledge & Awareness

Task-Specific Courses (cont’d):

- Work with Radiological/Laser Hazards
  - Radioactive materials
    - Radiation Safety (every 3 years)
    - Safe Use of Chemical Fume Hoods (every 2 years)
    - PPE (every 2 years)
  - Lasers
    - Laser Safety (every 2 years)
    - PPE (every 2 years)

- PIs and lab supervisors are responsible for ensuring all lab personnel complete the required safety training
  - Maintain completion certificates in a readily accessible area
  - Complete refresher courses as required

- A detailed matrix of required trainings according to profession is also available on the FIU EH&S Website (http://www2.fiu.edu/~ehs/)
Recent lab accidents at several universities over the past couple of years have played a key role in reiterating the importance of safety awareness, training, and enforcement of safe work practices.
May 2011 – Graduate student injured in beaker chemical explosion
  - Student was heating a combination of hydrochloric acid, tetrachloride, titanium and water in a 30 mL beaker

Jan. 2012 – Student injured in lab chemical explosion
  - Chemical type and quantity have not been definitively determined
  - Due to the nature and toxicity of potential chemicals, building was evacuated and remains closed until clean-up is completed
Dec. 2008 – Research assistant dies from massive burns after chemical she was handling caught fire

- Assistant was working alone using a material and procedure she was not familiar with
- PPE consisted of nitrile gloves, safety glasses, and synthetic sweater with no lab coat
- The gloves and sweater were ignited
Texas A&M University

- May 2010 - Two students were injured when glass tubing in a science lab over-pressurized and exploded
  - The contents in the beaker were described as “some sort of solution” that exploded
  - They were working with dry ice near a fume hood
Yale University

- April 2011 – A Yale student died in a chemistry lab machine shop
  - Her long hair became caught in a fast spinning lathe (see example of lathe below)
University of Wisconsin

- Feb. 2010 - Graduate student suffered burns to his hand after a fire in a lab where he was conducting an experiment
  - Fire started when chemicals being used dripped onto a chair and ignited the upholstery
  - Hand was injured when he pushed the burning chair down the hallway to the stair well

- Jan. 2012 – Employee injured in chemistry lab explosion
  - The cause is still under investigation
2009 – Researcher dies after infection with weakened strain of *Yersenia pestis* bacterium
- CDC reports that a genetic predisposition increased susceptibility to bacterial agents
- Reports that glove use was inconsistent
- Most likely became infected through dermal exposure

August 2011 – Researcher hospitalized with a skin infection caused by a common bacterium being studied in her lab
- Likely exposed through an unprotected open wound
Why this is important? - Summary

- Lab accidents can be prevented by:
  - Understanding the occupational risks and consequences of the material
  - Ensuring personnel have the proper training on handling the material
    - Equipment safety and PPE
    - Review the MSDS where applicable
  - Making sure written safety procedures are made available and understood
  - Being aware of what’s going on in the lab
    - Know who has access, what is in the lab, what leaves the lab, and what research activities are occurring
  - Enforcing safety policies – No excuses!!!
Risk Assessments

References:
- FIU Biosafety Manual
- FIU Lab Safety Manual
- FIU Radiation Safety Manual
Risk Assessment

- Risk assessments are an important responsibility shared by the Principal Investigator, EH&S, and associated university compliance committees.

- Risk assessments are used to identify:
  - Hazardous characteristics of an agent or material
  - Activities that can result in exposure or release
  - Possibility that the exposure will cause an illness
  - Probable consequences of such an illness or release
Risk Assessment

- Primary factors to consider when conducting a risk assessment:
  - Material hazards (chemical, biological, radiation)
  - Lab procedure hazards
  - Work practice and safety equipment hazards
  - Capabilities of the lab staff (including health status)

- Careful judgment must also be used
  - Underestimating the risks could result in adverse consequences
  - Over-estimating the risks could result in additional expenses and burden on the lab
Risk Assessment

- Material Hazards will be specific to the type of material. Some general hazards will include:
  - Capability to cause illness in humans or animals
  - Availability of preventative measure and treatment
  - Probable routes of entry
  - Lethal or Infectious dose
  - Stability in the environment

- Chemical, Biological and Radiological are the common types of material hazards to consider when conducting a lab risk assessment
Risk Assessment

- **Common Lab Material Hazards**
  - Exposure to fire dangers
    - Open flames from bunsen burners
    - Flammable, volatile, or explosive solvents
  - Procedures that may generate volatile reactions/explosions
    - Chemicals heated in closed or open containers
  - Chemical and thermal burns
    - Hot plates and corrosives (acids or bases)
  - Exposure via inhalation, ingestion, or absorption
    - Skin contact by touching face or eyes with glove
    - Contamination of food from dirty hands
    - Toxic fumes from a solvent
  - Cuts
    - Broken glass from improper manipulation of glass tubes and thermometers
Risk Assessment

- Lab Procedure Hazards:
  - Investigations of lab exposures have identified five principal routes of lab transmission:
    - Inoculations with contaminated sharps
    - Spills and splashes onto skin and other mucous membranes
    - Ingestion through mouth pipetting
    - Animal bites and scratches
    - Inhalation of infectious aerosols and fumes*

- *Aerosols and fumes are a serious hazard because they are usually undetected and place the lab worker and other persons in the lab at risk of exposure
Risk Assessment

- **Work Practice Hazards**
  - Risk assessments identify any potential deficiencies in the practices of the lab workers
    - Carelessness can compromise any safeguards
    - Lack of proper training or experience with the material, knowledge of the material and handling hazards
    - Inadequate training on use and storage of personal protective equipment (PPE)

- **Safety Equipment Hazards**
  - Equipment that is not working properly is hazardous, especially when the user is unaware of the malfunction
    - For example, poor location, room air currents, decreased airflow, leaking filters, raised sashes, crowded work surfaces, and poor user technique compromise the containment capability of a biosafety cabinet
A proper risk assessment includes:

- Identifying materials and performing an initial assessment of risk
  - Consider the hazardous characteristics of the material(s)

- Identifying lab procedure hazards
  - Material concentration, volume, generation of aerosols/fumes and airborne particles, and use of sharps

- Determination of additional precautions
  - Requires a comprehensive understanding of the practices, safety equipment, and facility safeguards
A proper risk assessment includes:

- Evaluation of staff regarding safe practices and integrity of safety equipment
  - Evaluate training, experience in handling the material, proficiency in the use of safe techniques and primary barriers (BSCs, chemical fume hoods, glove boxes, etc), ability to respond in emergency situations, and willingness for accountability

- Review the assessment with the FIU Compliance Committees (IBC, IACUC) and EH&S
  - Required by regulatory or funding agencies, as the case with the NIH Guidelines
  - Always beneficial and will promote the use of safe practices in work with hazardous agents
Principles and Procedures

Safety Principles and Occupational Health & Safety

References:
- FIU Biosafety Cabinet Manual
- FIU Lab Safety Manual
Lab Practices and Techniques

- Persons must be aware of potential hazards and trained and proficient in the practices and techniques required for handling the material safely.

- Each lab should develop Standard Operating Procedures (SOPs) with the following details:
  - The intended scope
  - Potential hazards associated with the activity/process (material, physical hazards, electrical hazards, equipment items)
  - Potential exposures using the four “routes of exposure” as a foundation (inhalation, ingestion, injection, absorption)
  - Engineering control and PPE requirements
  - Storage and handling requirements
  - Decontamination and waste management
  - Emergency procedures
Lab Practices and Techniques

- **Material Safety Data Sheets (MSDS)**
  - Required by OSHA Hazard Communication Standard
    - The PI or lab supervisor is responsible for maintaining MSDSs in their area(s)
  - Use the MSDS to help develop SOPs
    - Provides detailed material information such as handling, storage, and disposal, engineering controls, PPE and emergency response
  - Must be readily accessible to personnel
    - Personnel should review and understand the MSDS prior to working with the material
  - Available online
    - Chemical manufacturers and distributors (e.g. Sigma, Fisher)
    - Safety Data sheets are also available for Pathogens (PSDS)
      - Public Health Agency of Canada
Lab Practices and Techniques

- **Safety Audits**
  - Self-audits provide a measure for compliance achievement
  
  - Regular unannounced safety audits are carried out by FIU EH&S safety professionals
    - Inspections are conducted once, twice, or four times a year depending on the hazard
    - Be prepared – have all training documents, MSDS, SOPs and updated chemical inventories readily accessible
    - Ask questions - EH&S is available to provide guidance for compliance concerns

- **Safety audits are an important part of improving employee safety as well as individual and university compliance with federal, state, and local requirements**
Safety Equipment

- Safety equipment is designed to remove or minimize exposures to hazardous materials. Examples include Biosafety cabinets, Chemical Fume Hoods, and items for personal protection.
Safety Equipment

- **Primary Barriers**
  - **Biosafety Cabinets (BSCs)**
    - Provide personnel, environmental and product protection when appropriate practices and procedures are followed
    - Used during manipulations of infectious microorganisms, such as cell culture procedures
    - Must be routinely inspected to verify that it is working properly (referred to as annual certification)
    - Personnel should complete online AND receive on-site training from the PI or lab supervisor
Safety Equipment

- **Primary Barriers**
  - **Chemical Fume Hoods**
    - Keeps toxic or irritating vapors and fumes away from the user and out of the general lab circulation
    - Used during manipulations involving toxic, volatile, odiferous or harmful hazardous materials
    - Must be routinely inspected to verify that it is working properly (referred to as annual certification)
    - Do not block the vents in the back of the hood with materials or equipment
    - Do not use the hood for chemical storage
    - Personnel should complete online AND receive on-site training from the PI or lab supervisor
Safety Equipment

- **Personal Protective Equipment (PPE)**
  - Used in combination with primary barriers and other devices that contain the materials being handled
  - Includes gloves, lab coats, shoe covers, respirators, face shields, safety goggles/glasses
  - Contact EH&S for assistance with selection of suitable PPE

- **Gloves**
  - Required when contact with a hazardous material (infectious, chemical, radiation) is anticipated
  - Style and type of material is based on the following:
    - Type of chemical or substance handled
    - Quantities to be used
    - Potential for contact
    - Permeation of material through glove
    - Degradation of glove material
Safety Equipment

- Gloves (cont’d)
  - Inspect for tears or pinholes prior to each use
  - Remove or replace contaminated gloves prior to leaving the work area

- Lab Coats
  - Protects the skin and clothing from spatters and spills
  - Fire-resistant and worn properly
    - Fully buttoned with sleeves rolled down
  - Remove before leaving the work area
Safety Goggles/Glasses

- Required in locations where hazardous materials are stored, handled or used, or the potential for an eye injury exists
- Should be appropriate for the type of hazard anticipated (ANSI Z.87.1)
  - Glasses protect from the possibility of objects striking the eye (shards, particles, glass)
  - Goggles protect from objects AND chemical splashes
Safety Equipment

- Proper Safety Attire (example)
Safety Equipment

- **Respirators**
  - Used to prevent inhalation of air contaminants such as dusts, fumes, mists, vapors, and gases that may be hazardous
  - Anyone required to wear a respirator must complete a fitness test and medical evaluation
    - OSHA Respiratory Protection Standard 29 CFR 1910.139
  - FIU Respirator Use Program
    - Provides fit testing and medical evaluation services
    - Training for respirator use and maintenance
  - Training and medical monitoring must be renewed annually

- **Hearing Protection**
  - Required when occupational noises exceed permissible levels
  - FIU Hearing Protection Program
    - Conducts workplace noise monitoring
    - Assists in selecting appropriate hearing protection equipment
Overall Summary

Responsibility and Accountability – Making safety a priority!

- Conduct risk assessments to determine how to safely work with hazardous materials
  - Consult with the MSDS (chemical and some biological hazards)
  - Use the information to develop standard operating procedures for each material

- Complete the required online safety training PRIOR to working in the lab or with the material
  - Training documents should be kept in the lab for review by FIU, state, and federal inspectors
  - Successfully complete refresher training as required

- P.I.s, lab managers, and supervisors are responsible for providing task and lab area-specific training
  - Ensure personnel understand how to use lab equipment and PPE, handle, store, and dispose of the material, emergency response kits and equipment (e.g. fire extinguishers and spill kits)
  - Documentation should include date, time, name of attendees, subject matter, and the name of the person providing the training with their qualifications
  - Assure that all laboratory workers also have ready access to other safety manuals applicable to the work performed in the lab
Overall Summary

Responsibility and Accountability – Making safety a priority!

- Conduct safety self-audits to help determine compliance deficiencies
  - Discuss the findings during scheduled lab meetings and encourage personnel to come up with solutions
  - P.I.s/Lab managers may schedule unannounced visits to the lab area to see what’s going on

- Consult with EH&S
  - Safety professionals are always available to assist with compliance concerns

- Embrace a “culture of safety”
  - Lab personnel are more likely to follow by example when a P.I./lab manager demonstrates that safety is a priority in their lab area
EH&S Compliance Services

- **Biosafety Cabinets and Fume Hood Certifications**
  - Biosafety cabinets certification services are provided by the Biosafety Office. Cabinets are certified once a year or after relocation.
  - Fume Hoods are certified every 6 months and services are provided by the Environmental Compliance Office.

- **Waste Disposal Services**
  - Provided by EH&S
    - Hazardous
    - Biomedical/Biohazardous
    - Radioactive
    - 348-7835/348-8355
    - 348-3387
    - 348-0489

- **Facility Evaluations**
  - EH&S conducts evaluations to determine if the designated facility and equipment are adequate for the type of research
  - Recommendations are made based on the evaluation findings
    - Chemical
    - Radiation/Laser/Nanoparticle
    - Biohazardous
    - 348-7835
    - 348-0489
    - 348-3387
Where to get more information...

Surendra Dua
Radiation, Laser & Controlled Substances Safety Officer
348-0489, Duas@fiu.edu

Tamece Knowles
Biosafety Officer
348-3387, Knowles@fiu.edu

Bill Youngblut
Certified Industrial Hygienist & Environmental Compliance
348-7835, William.Youngblut@fiu.edu

2/1/2012