CHEM 799
Introduction to Laboratory Safety

Room and Time: Chapman 201; F 2 - 3 pm
Instructor: David S. Lawrence

This introductory course in laboratory chemical safety is required for all entering chemistry graduate students. Topics to be covered include laboratory emergencies, chemical hazards, lab inspections and compliance, managing and working with chemicals, waste handling, case studies of university accidents, laboratory equipment, biosafety, radiation, and animals, and microfabrication and nanomaterials.

Prerequisite: First Year Graduate Student Status

August 23: Introduction to laboratory safety

I. Introduction
   1. The Texas Tech Incident
   2. Lessons to be learned: Shared Responsibilities

II. Risks in a Research Laboratory
   1. Health Effects Due to "Hazardous" Chemical Exposure
   2. How Does One Determine the Hazards Associated with Specific Chemicals?
   3. Exposure Routes
   4. Summary: Toxicity Risk Assessment

III. Personal Protective Equipment (PPE)
   1. Proper Attire
   2. Eye/Face Protection
   3. Lab Coats
   4. Gloves
   5. Respirators
   6. Disposal/Removal of PPE

IV. Emergency Equipment
   1. Safety Showers/Eye Washes
   2. Emergency Equipment Operation - Showers
3. Emergency Equipment Operation - Eye Washes

V. Key Campus and Department Chemical Safety Contacts
   1. Environmental Health and Safety (EHS)
   2. Department of Chemistry

VI. Case Study
   1. Dartmouth: Chemical Poisoning
   2. Key Lessons

**August 30: Laboratory emergencies: spills and fires**

I. General Preparation for Emergencies
II. Handling the Accidental Release of Hazardous Materials
III. Notifications
IV. Spill Containment and Clean-up
   1. Complicated Spills
   2. Simple Spills
V. Leaking Gas Cylinders
VI. Fires
   1. Classification
   2. Fire Extinguishers - how they work
   3. Fire Extinguishers - types
   4. Risk Assessment
VII. Case Study
   1. Sodium Fire
   2. Lessons Learned

**September 6: Chemical Hazards**

I. Chemical Hygiene Plan
II. The New Safety Data Sheets (SDS) versus the Old Material Safety Data Sheets (MSDS)
III. Assessment of Chemical Toxicity
IV. Toxic Hazards
   1. Dose
   2. Risk Assessment
   3. Types of Toxins
V. Flammable Hazards
   1. Flammability Characteristics
2. Flammability Classes
3. Causes of Ignition

VI. Reactive Hazards
VII. Explosives
VIII. Case Study
   1. University of Wisconsin - LiAlH₄ Explosion
   2. Lessons Learned

**September 13: Lab inspections, compliance, and inventory**

I. Ordering and Receiving Chemicals
II. Regulatory Compliance - History of Occupational Safety and Environmental Laws
III. Current Research Regulations
IV. Regulatory Inspections that Occur at UNC
   1. EPA
   2. OSHA
   3. CDC/NIH
   4. NRC
   5. FAA
   6. DEA
V. Environmental Health & Safety Department - Roles, Responsibilities, Organization
VI. Inspections
   1. EHS
   2. Self-Inspections
VII. Case Study

**September 20: Managing and working with Chemicals. I**

I. Storage
   1. General Considerations
   2. Chemical Segregation
II. Transfer and Transport
III. Chemical Fume Hoods
   1. Safety Features
   2. Chemical Hood Parts
   3. Chemical Fume Hood Types
4. Hood Operation
5. Hood Safety
6. Other Types of Ventilation
7. Ventilation: Key Points

IV. Working with Highly Toxic Compounds
   1. General Considerations
   2. Planning
   3. Precautions for Minimizing Exposure - Handling
   4. In the Event of a Spill

V. Case Study
   1. DuPont Facility - Phosgene Release
   2. Lesson Learned

September 27: Managing and working with Chemicals. II

I. Working with Flammable Substances
II. Working with Highly Reactive or Explosive Substances
III. Working with Compressed Gases
IV. Cryogenic Hazards
V. Case Study

October 4: Waste handling

I. Characterization of Waste
II. Collection and Storage
III. Consequences of Mixing Incompatibles
IV. Treatment and Disposal
V. Records and Record Keeping
VI. Mixtures
VII. Solid Wastes
VIII. Case Study
October 11: A case study: the “UCLA incident”

October 18: No class/Fall Break

October 25: Laboratory equipment. I
   I. Working with water cooled equipment
   II. Working with vacuum pumps, refrigerators and freezers, stirring and mixing devices, heating devices, stills, ultrasonicators and centrifuges
   III. Working with high or low pressures and temperatures
   IV. Case Study

November 1: Laboratory Equipment. II
   I. Laser classifications
   II. Effects of lasers on skin and eyes
   III. Protective eyewear
   IV. Enclosing laser beams
   V. Examples of common mistakes and ways to avoid them
   VI. Non-beam hazards
   VII. Risk Assessment: when is it okay to violate specific safety rules? The importance of understanding how things work

November 8: Biosafety, Radiation, and Animals
   I. Radiation
   II. Chemicals such as acrylamide & ethidium bromide
   III. Pathogens
   IV. Biological waste handling
   V. Recombinant DNA
   VI. Mammalian cell culture
   VII. Case Study

November 15: Microfabrication and Nanomaterials
   I. Hazards of nanoparticles
II. Preventative Measures
III. Disposal
IV. Microfabrication
V. Chemical hazards associated with microfabrication
VI. Instrument hazards associated with microfabrication

November 22: Last day of class – exam