Safety in the UTK Department of Chemistry

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Departmental Safety Officer (DSO)/Chemical Hygiene Officer

Safety info available at: http://web.utk.edu/~bartmess/safety.pptx
Slides available at: https://chem.utk.edu/safety/
Why Are You Here? (Graduate/Undergraduate Research)

- Knowledge
- Skills

**In the Real World:**
- You will never be asked to perform your thesis/dissertation/research work again.
- You will earn your salary by being able to solve problems.
- You WILL deal with safety issues your entire career.
Why Are You Here? (Safety Lecture)

1. LEGAL – Because OSHA says we must.

*Occupational Exposures to Hazardous Chemicals in the Laboratory*  

A research lab is a facility where:

- Chemical manipulations are carried out on a “laboratory scale” (easily handled by one person)
- Multiple chemical procedures or chemicals are used
- The procedures involved are not part of a production process, nor do they in any way simulate a production process
- “Protective laboratory practices and equipment” are available and in common use to minimize the potential for worker exposure to hazardous chemicals.
Why Are You Here? (Safety Lecture)

2. Detailed Safety Information

3. Professional Reasons
   - Public image of chemistry
   - “Toxic-chemical” used as one word
   - We are all safety officers in the eyes of the public
What we need from you

**Safety should be:**
- Common sense
- Always applied (this is the hardest part!)
- Staying “Mindful” vs. “zoning out”
- Maintaining "Lab discipline" (also tough)

**Lab discipline:**
- Always *think things through* before you start something
- Constant awareness of the status of things; not just what’s there, but also what's missing or wrong
- Investigate problems!
- "Established practice" may be wrong. Just because you have gotten away with something 100 times doesn't mean the 101st time is safe.
- Murphy’s Law: “What can go wrong, will go wrong.”
What we need from you

How do we impose these characteristics on you?

We must develop “The Safety Culture”:
• Rationally (this lecture, emails, further training)
• By telling stories (stories as source of safety information)

We ask that you exemplify Competency, the ability to:
• Do the assigned job, without constant supervision
• Figure out how to self-train (with outside help, if needed)
• Figure out who to contact, to get help, if needed
• Communicate with administrators above
Is chemistry a dangerous profession?

Unfortunately:

Safety Rules are often written in Blood

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**Most Dangerous Jobs in 2016**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Occupation</th>
<th>Fatal Injuries per 100,000 workers</th>
<th>Total deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logging workers</td>
<td>135.9</td>
<td>91</td>
</tr>
<tr>
<td>2</td>
<td>Fishers and related fishing workers</td>
<td>86</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>Aircraft pilots and flight engineers</td>
<td>55.5</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Roofers</td>
<td>48.6</td>
<td>101</td>
</tr>
<tr>
<td>5</td>
<td>Trash and recycling collectors</td>
<td>34.1</td>
<td>31</td>
</tr>
<tr>
<td>6</td>
<td>Iron and steel workers</td>
<td>25.1</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>Truck and sales drivers</td>
<td>24.7</td>
<td>918</td>
</tr>
<tr>
<td>8</td>
<td>Farmers, ranchers, and other agricultural managers</td>
<td>23.1</td>
<td>260</td>
</tr>
<tr>
<td>9</td>
<td>First-line supervisors of construction trades and extraction workers</td>
<td>18</td>
<td>134</td>
</tr>
<tr>
<td>10</td>
<td>Grounds maintenance workers</td>
<td>17.4</td>
<td>217</td>
</tr>
</tbody>
</table>
Stories

Silver Nitrate Explosion/Burns

$t$-Butyl Lithium Fire

FROM THE JUNE 2015 ISSUE

Death in the Lab

A UCLA laboratory fire took Sheri Sangji’s life. Her boss and the university closed ranks. Will her family’s crusade for justice make researchers any safer?

By Eleni Laff Bamfer | Thursday, April 30, 2015

Sheri Sangji
How do we prevent accidents? (Legal)

- **Federal "Right to Know" Law** – The "Right to know", in the context of United States workplace and community environmental law, is the legal principle that the individual has the right to know the chemicals to which they may be exposed in their daily living.

- **Departmental Chemical Hygiene Plan (CHP)** – The purpose of a CHP is to protect laboratory workers from harm due to hazardous chemicals. The CHP is a written program stating the policies, procedures and responsibilities that protect workers from the health hazards associated with the hazardous chemicals used in that particular workplace.
  - A link to ours is accessible on the Dept. web page
How do we prevent accidents? (Educate Yourself)

Chemical Hazards:

Reactivity:
- Corrosives
- Redox reactions
- Flammables
- Compounds with reactive bonds (N-N, N-O, O-O, N-halo, O-halo, etc)

Toxicity:
- Acute poisons
- Chronic poisons ("it’s all toxic save distilled water")
- Carcinogens
- Tetratogens (HCONH₂)
- Mutagens
- Radioactivity

AE situations:
- Heat
- Cryogens
- Compressed gases
- Cryogens
- Gravity
- High energy compounds
- Mechanical

Information Sources:
- Material Safety Data Sheets (MSDS)
  BU 220 (dry ice room)
  Reading Room BU653
  Chemical Company Websites
  V. Sax, "Hazardous Properties of Industrial Materials"
- Labels
- Sigma-Aldrich catalog/website
- Merck Index
- Remember, MDs in the ER have no clue
How do we prevent accidents? (Educate Yourself)

Labels: National Fire Protection Association (NFPA)
How do we prevent accidents? (Educate Yourself)

Labels: Globally Harmonized System (GHS)

1. Signal word
2. Hazard statement
3. Precautionary statements & pictograms
4. Fill weight
5. Lot number
6. Gross weight
7. Fill date
8. Expiration date
9. Company name, street address, city, state, zip, country, phone number, emergency phone

GHS - Hazard Pictograms and Related Hazard Classes

- Exploding Bomb
  - Explosives
  - Self-reactives
  - Organic Peroxides

- Corrosion
  - Skin corrosion/burns
  - Eye damage
  - Corrosive to metals

- Flame Over Circle
  - Oxidizing gases
  - Oxidizing liquids
  - Oxidizing solids

- Gas Cylinder
  - Gases under pressure

- Environment
  - Aquatic toxicity

- Skull & Crossbones
  - Acute toxicity (fetal or toxic)

- Exclamation Mark
  - Irritant (eye & skin)
  - Skin sensitizer
  - Acute toxicity
  - Narcotic effects
  - Respiratory tract irritant
  - Hazardous to ozone layer (non-mandatory)

- Health Hazard
  - Carcinogen
  - Mutagenic
  - Reproductive toxicity
  - Respiratory sensitizer
  - Target organ toxicity
  - Aspiration toxicity

- Flame
  - Flammables
  - Pyrophorics
  - Self-heating
  - emitted flammable gas
  - Self-reactives
  - Organic peroxides
How do we prevent accidents? (Educate Yourself)

Always know the location of:
- All safety equipment (fire extinguisher, eye wash, safety shower, first aid kit, etc)
- The nearest phone (day, night) – may be a cell phone!
- The nearest fire pull station
  (calls both Campus Police and KFD)
- The nearest “blue phone” – Campus emergency phone

Be aware of Safety Door Placard:
- Responsible Person (PI)
- Departmental Safety Officer (Long)
- Occupants
- General hazards
How do we prevent accidents? (Expect the Unexpected)

Planning experiments, with safety in mind:
• What are the potential failure modes
• What if an interruption occurs:
  electrical power loss
  evacuation
  fume hood failure
  cooling water loss
• Did I plan for redundancy (“belt and suspenders”)

IF YOU EXPECT THE UNEXPECTED

DOESNT THAT MAKE THE UNEXPECTED THE EXPECTED

ALWAYS
EXPECT THE
UNEXPECTED
Protecting Ourselves – Personal Protective Equipment (PPE)

PPE:
- Eyewear (safety goggles/glasses)
- Clothing (lab coats/pants/etc)
- Gloves (remove outside of lab!)
- Shoes (no open toes)
- Hair (tie it back)
Protecting Ourselves – Facilities and Department-Specific Practices

**Departmental Safety supplies and equipment:**

Stored in the LN$_2$ room (BU 219)
- spill cleanup kit (vermiculite, bicarbonate)
- wet/dry vacuum

Stored in Individual labs
- 1st aid kits
- fire extinguishers
- eye washes
- safety showers
Protecting Ourselves – Engineered Controls

These are our primary methods of controlling chemical exposure!
Fume Hoods

Fume Hood Basics:
• Make some problems disappear
• Easily defeated by ignorance of how they work
• Hood Linear velocity: 60-100 feet/min
  (0.3-0.5 m/s, 0.7-1.1 mph)
• Faster: turbulence and loss of vapors to room
• Have flow sensors:
  • Electronic with alarm
  • Kimwipe taped to bottom of hood sash

When to use:
• When the MSDS/SDS says to
• When working with extremely volatile chemicals
• High probability of chemical vapors
Fume Hood Work Practices

- Know the toxic properties of the chemicals with which you work. (SDS)
- Be able to identify signs and symptoms of overexposure. (SDS)
- **Keep all chemicals and equipment six inches from the sash**
- Keep the sash completely lowered anytime "hands-on" experiments are not in progress or whenever the hood is unattended.
- Never utilize the hood unless there is some indication that the hood is operating.
- **The hood is not a substitute for personal protective equipment. Wear gloves, safety glasses, etc.**
- Visually inspect the baffles to be sure the slots are open and unobstructed.
- **Do not block baffles. If large equipment is in the hood, put it on blocks to raise it approximately two inches so that air may pass beneath it.**
- **Do not use the hood as a storage cabinet.**
- Keep the sash clean and clear.
- Clean all chemical residues from the hood chamber after each use.
- All electrical devices should be connected outside the hood to avoid sparks which may ignite a flammable or explosive chemical.
General Policy and Procedures – Transporting Chemicals

• Use a bottle carrier, cart or other secondary container when transporting chemicals in breakable containers through hallways or between buildings. Secondary containers are made of rubber, metal or plastic, with carrying handle(s), and are large enough to hold the entire contents of the chemical containers in the event of breakage.

• Transport of hazardous chemicals between buildings is strongly discouraged.

• When moving around the laboratory, anticipate sudden backing up or changes in direction by others. If you should stumble or fall while carrying glassware or chemicals, try to project them away from yourself and others.

• The individual transporting a chemical should be knowledgeable about the hazards of the chemical and how to handle a spill of the material. (SDS)

• When transporting compressed gas cylinders, the cylinder should always be strapped in a cylinder cart and the valve protected with a cover cap. Do not attempt to carry or roll cylinders from one area to another.

• Keep chemicals in their original packing when transporting, if possible.
General Policy and Procedures – Waste Handling

- Monthly pickups at SERF Loading Dock
- Segregate halogenated and non-halogenated organics
- Keep all containers closed except for the moment of adding waste
- Label it with waste tag and keep detailed records
- Leave headspace in container at final seal
- Date waste tag at final seal, not before

- When transporting waste, follow all of the regulations and procedures outlined on the previous page

- Transporting waste is one of the only times you are encouraged to wear PPE outside of the lab
General Policy and Procedures – Refrigerators and Freezers

General:
• NOT for storage of volatiles! Rather for chemicals that can decompose at RT
• Flammable storage: no ignition sources in these
• Red “no flammables” label
• Yellow “no Food” label

Vapors within can be a problem: seal containers well:
• Don’t breath these vapors
• Log chemicals in/out

Be aware of:
• Flash Point: temperature at which there’s enough vapor pressure to ignite from a spark/flame.
• Autoignition temperature: where compound ignites spontaneously
General Policy and Procedures – Mercury Spills

• Sulfur is only somewhat effective
• Best to use a pipette or eyedropper to suck up small spills
• Can create a “Hg vacuum” using a fish aquarium pump and tubing - $9 (BU 633)
General Policy and Procedures – Lab Security

Security:
• Keep lab doors locked when no one is present; check as you leave
• Be aware of suspicious people

Why?
• Drug precursors
• Simple $$$ theft (SERF 2016, Bu 2018)
• Irrational students, out for revenge for “ruining their life.”
• Just FYI, we are ~30 miles from a nuclear weapons complex
Please, JUST PREVENT IT !!!!

- Judge the situation; fight or run?
- Call 911, or send someone for help
- Pull the alarm
- 1 extinguisher = 1 liter burning solvent
General Policy and Procedures

It's time for quick safety items!
Quick Safety Items (most are common sense)

1. If it has a chemical in it, put a label on it

2. If it’s broken, fix it or clean it up, and reorder. (“it’s not the DSO’s problem”)

3. Your chemical spills are your problem (keep the door closed)

4. Treat chemicals as if they are all toxic; and all flammable

5. Plan safety into an experiment at the design stage, not just before you open the bottle

6. Clamp your hoses (main source of floods)

7. Take notes now, so others can figure out what went wrong after the accident

8. Back up your hard drive, memory stick, spectra, notebooks, etc

9. *Think Things Through* before you do anything
Quick Safety Items – Do not taste any chemical or pipette by mouth !!!

[Image of armadillo rolling over]

[Image of person with a red circle and line through the act of pipetting]
Quick Safety Items – Handle hot glassware with gloves or tongs.
Quick Safety Items – Heat test tubes at an angle and tie back loose hair

- Always point away from yourself
- Never heat closed vessel
- Dangling hair can catch fire or fall into chemicals
- P.S. Burning hair REALLY STINKS!
Quick Safety Items – Always ADD ACID to water; Wash hands before leaving lab
Quick Safety Items – Do not smell any chemicals directly!

“Wafting, wafting”
Quick Safety Items – Know the safety equipment and where it is in YOUR lab

- Eye wash fountain
- Safety shower
- Fire extinguisher
- Emergency exits
Quick Safety Items – Never work alone in the lab

• In case of a problem, you may need another person to prevent injury or even save your life!

• Always true for undergraduates

• As a PhD student, you should speak with your advisor about his/her policy
Quick Safety Items – Remember that the lab is a place for serious work!

Careless behavior (horseplay) may endanger yourself and others, and will therefore not be tolerated!
Quick Safety Items – When in doubt – ASK!!

Don’t perform a new or unfamiliar procedure until you have been fully trained & understand the precautions necessary for safe working

DON’T GUESS !!!
JUST ASK !!!
Quick Safety Items – Reporting is Mandatory

NOTICE
CHEMICAL SPILLS MUST BE REPORTED IMMEDIATELY

REPORT ACCIDENTS IMMEDIATELY

IN CASE OF EMERGENCY
Call 911
Quick Safety Items – Who to Contact

**Building Emergencies:**
Chuck Feigerle 4-3141, (C) 865-686-2811, (H) 865-692-8778
Shawn Campagna 4-3141, (C) 609-213-2192
David Jenkins 4-8591, (C) 626-394-1161
Brian Long 4-5664, (C) 512-653-1885
Johnny Jones 4-3145, (C) 423-215-5220, (H) 423-569-8008

**Using Campus Phones:**
- Dial 4-xxxx = outside 974-xxxx
- Dial “8” for outside line

**Environmental Health & Safety:** 4-5084

**UT Police:** 4-3111 (blue phone, 2 min)

**Facilities Services (One Call):** 6-7777