What is Environmental Health and Safety?

• Four priorities:
  – The safety and health of the campus community
  – Complying with government regulations
  – Laboratory productivity
  – Laboratory safety education
What Kinds of Hazards are there in Cornell Laboratories?

HASP Laboratories Distribution
Total Labs: 3083 rooms

- Chemical Labs: 2398 (78%)
  - report chemical use

- Biological Labs: 1214 (39%)
  - report biohazards use

- Radiation Labs: 862 (28%)
  - report radiation use

- 39% report chemicals only
- 12% report bio only
- 5% rad only
- 5% only
Who Tracks These Hazards?

- OSHA tracks chemical hazards to lab employees
- EPA tracks chemical hazards to the environment
- NIH (and others) track biological hazards
- NRC tracks radiation hazards

39% report chemicals only
12% report bio only
5% report radiation only
The Cornell Laboratory Safety System

To organize the partnership between safety efforts in specific labs and the campus wide EHS program, we have developed the Cornell Lab Safety System. There are 6 key elements in this System:

1. EHS Awareness
2. Hazard Identification
3. Hazard Assessment
4. Hazard Management
5. Emergency Preparedness
6. Laboratory Sustainability
Laboratory Hazards: Chemicals

From a regulatory point of view, "chemicals" are materials that retain their value when they change their shape – gases, liquids, dusts or powders.

If we don’t know what a chemical is, we have to try it as the most hazardous chemical possible.
The Radium Story:

• Pierre and Marie Curie jointly discovered radium in 1898 and shared the 1903 Nobel Prize for this achievement.

• After winning a second Nobel, Marie died in 1934 of aplastic anemia from radiation exposures in her lab.

• Marie’s notebooks are still too radioactive to handle safely without Personal Protective Equipment.
The Radium Girls of New Jersey

- The **Radium Girls** were female workers who contracted radiation poisoning from painting watch dials at the United States Radium factory in Orange, New Jersey around 1917.

- The women, who had been told the paint was harmless, ingested **radium** by licking their paintbrushes to sharpen them; some also painted their fingernails and teeth with the glowing substance.

- As a result, many suffered from anemia, and bone fractures of the jaw, a condition also known as ”radium jaw”.

The Plutonium Story: Glenn Seaborg

• Grew up in California and went to UC Berkley in the 1930’s, where he heard of the radium girls
• Discovered plutonium and received the 1951 Nobel Prize for this work
• He was responsible for running the lab group that purified plutonium for the Manhattan Project in Chicago
Wednesday, January 5, 1944

“As I was making the rounds of the laboratory rooms this morning, I was suddenly struck by a disturbing vision. I pictured in my mind the expanding scale of work with solutions containing plutonium that will soon result ... plutonium handling will no longer be confined to microquantities manipulated by specially trained experts.

“Recalling the health problems incurred by workers in the radium dial painting industry, I realized clearly that similar hazards face those of us working with alpha-particle-emitting plutonium-239.”

*With this mind, Dr. Seaborg developed the set of laboratory safety practices that are the basis for what we do today.*
Dr. Seaborg's guidelines for handling plutonium

Dr. Seaborg proposed seven laboratory safety practices:
• Put linoleum on all floors.
• Paint or varnish walls and ceilings.
• Remove steam coils from windows and seal all windows.
• Provide a cleaning crew to mop every laboratory and wipe down every laboratory bench twice a day.
• No laboratory unit should have more than four workers.
• Every effort should be made to develop adequate methods for monitoring the air.
• Such dangerous practices as eating in the labs must be stopped.

This list is the origin of many of today’s lab safety practices.
The Result

In the 1990’s a retrospective health study of the Manhattan Project workers showed that those who worked in the plutonium labs lived slightly longer and healthier lives than the peers in the Project.

Dr. Seaborg’s awareness of Environmental Health and Safety concerns was a primary reason for this.
Karen Wetterhahn (1948 – 1997) was a professor of chemistry at Dartmouth College, who specialized in toxic metal research. She made national headlines when mercury poisoning claimed her life due to accidental exposure to the organic mercury compound *dimethylmercury*. The latex gloves she used were insufficient to stop the mercury compound she was working with from penetrating to her skin when a few drops of the chemical made contact with the gloves.
The Other Side of Lab Safety History 2: The 2008 fatal UCLA Chemical Fire

Chemical Fire at UCLA
2. Recognizing the Hazards: Labeling

Laboratory Labels are Our System of Communication

Remember that the audience for chemical labels includes both people working inside and outside the lab

Unknown chemicals are potentially dangerous to everyone who has to handle them
The U.N.’s Globally Harmonized System

Hazard Classification Criteria
- Definitions for “toxic”, “flammable”, “corrosive” and other important chemical words

Hazard Communication
- Labels
- Safety Data Sheets
- 2 signal words: Danger and Warning
- Pictograms
Hazard Definition

• The GHS established specific international definitions of the hazards. One example is flammability

<table>
<thead>
<tr>
<th>Classification Criteria</th>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash point less than 23°C (73°F) and boiling point less than 35°C (95°F)</td>
<td>Flash point less than 23°C and boiling point greater than 35</td>
<td>Flashpoint between 23°C (73°F) and 60°C (140°F)</td>
<td>Flashpoint between 60°C (140°F) and 93°C (200°F) degrees</td>
<td></td>
</tr>
<tr>
<td>Symbol</td>
<td>Flame</td>
<td>Flame</td>
<td>Flame</td>
<td>No symbol</td>
</tr>
<tr>
<td>Signal word</td>
<td>Danger</td>
<td>Danger</td>
<td>Warning</td>
<td>Warning</td>
</tr>
<tr>
<td>Hazard statement</td>
<td>Extremely flammable liquid and vapor</td>
<td>Highly flammable liquid and vapor</td>
<td>Flammable liquid and vapor</td>
<td>Combustible liquid</td>
</tr>
</tbody>
</table>

Note: Increasing hazard to left
Hazard Communication

The GHS system also lays out a specific format for chemical labels and *Safety Data Sheets*

![Image of GHS Pictograms and Hazard Classes]

<table>
<thead>
<tr>
<th>GHS Pictograms and Hazard Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Oxidizers" /></td>
</tr>
<tr>
<td>Oxidizers</td>
</tr>
<tr>
<td>- Oxidizers</td>
</tr>
<tr>
<td>- Self Reactives</td>
</tr>
<tr>
<td>- Pyrophorics</td>
</tr>
<tr>
<td>- Self-Heating</td>
</tr>
<tr>
<td>- Emits Flammable Gas</td>
</tr>
<tr>
<td>- Organic Peroxides</td>
</tr>
<tr>
<td><img src="image4" alt="Acute toxicity (severe)" /></td>
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<tr>
<td>Acute toxicity (severe)</td>
</tr>
<tr>
<td><img src="image7" alt="Carcinogen" /></td>
</tr>
<tr>
<td>Carcinogen</td>
</tr>
<tr>
<td>- Respiratory Sensitizer</td>
</tr>
<tr>
<td>- Reproductive Toxicity</td>
</tr>
<tr>
<td>- Target Organ Toxicity</td>
</tr>
<tr>
<td>- Mutagenicity</td>
</tr>
<tr>
<td>- Aspiration Toxicity</td>
</tr>
</tbody>
</table>
The Importance of Chemical Storage

• Flammable liquids need to be protected from the possibility of a fire in the lab to avoid boil overs
• Cooling flammable chemicals requires a special refrigerator.

This refrigerator was used to store a flammable liquid; the cooling compartment filled with vapors from the loosely capped bottle. The fumes exploded when the refrigerator switch caused a spark.
Nitric Acid Events

★ Hazmat situation at high school
ROCKY HILL, Conn. (WTNH) – Police, fire, and DEEP personnel responded to a hazmat situation at Rocky Hill High School Tuesday morning.

Department of Energy & Environmental Protection (DEEP) officials said there was a minor acid spill that occurred when an acid cabinet was being moved. Nitric acid spilled from a beaker.

Officials said janitorial staff initially attempted to clean the spill, until the acid reacted with the water in the mop.

The building was evacuated as a result of the ... [more]

us_CT laboratory release response nitric_acid
6 days ago by dchas   edit  delete

★ Corrosive chemical overheats, spills from Dallas truck
DALLAS — Dallas Fire-Rescue dispatched a hazardous materials team to check on a truck that was leaking a fluid and emitting a brownish-orange smoke early Tuesday evening.

The situation was reported shortly after 5:30 at the Penske Truck Rental facility in the 10800 block of Goodnight Lane, just west of Interstate 35E in Northwest Dallas.

The ChemStation truck also bore markings indicating it has a carload of corrosive liquid. According to its website, ChemStation specializes in ... [more]

us_TX transportation release response cleaners nitric_acid
4 weeks ago by dchas   edit  delete

★ UK Alert issued over chemical leak
LEXINGTON, Ky. (WKYT) - The University of Kentucky issued an alert for the Veterans Drive area Saturday morning.

The Lexington Fire department and several crews including Hazmat were on the scene at 1096 Veterans drive for a chemical spill.

The Lexington Fire department tells WKYT that the UK Police Department placed a call shortly before 11am involving a spill in one of their research labs.

When fire crews arrived they found two gallons of diluted nitric acid had been spilled. They ... [more]

us_KY education release response nitric_acid
5 weeks ago by dchas   edit  delete
A laboratory technician had been exposed to vapors containing phenol and had often spilled phenol on his trousers. The spills resulted in skin irritation; symptoms related to these exposures included loss of appetite, darkened urine, and muscle pain in the legs and arms.

He stayed away from his job for several months during which time his health gradually improved. He returned to the lab and in a period of 45 minutes had an immediate recurrence of muscle pain and subsequent darkened urine.
Specific Target Organ Toxicity

The **Specific Target Organ Toxicity** is a reminder that certain chemicals can have effects on specific organs. Consult the SDS on which organ the chemicals you use can affect in order to understand the symptoms associated with such exposures.
Labeling Experimental Samples

Within the lab, groups of samples can be stored together in a secondary container if the individual materials are compatible with each other. The secondary container must be labeled with:

- The name of the person to contact for information about the materials
- Chemical identification, including an approximate concentration of the chemical
- Hazards associated with the chemicals
- Date the material was made

If you need to use abbreviations to efficiently label chemicals or samples, post a key prominently in the lab so visitors to the lab will know what they mean.
Information Beyond the Label: Safety Data Sheets

• The **Safety Data Sheet** for a chemical to identifies unusual hazards associated with that chemical (for example, forming peroxides in storage).

• Remember that all of this information applies to that **specific chemical** and not to reactions and chemicals that may form as your chemical process proceeds.
Labeling Laboratories

• **HASP: the Hazard Assessment and Signage Program**
  
  • HASP signs identify lab wide hazards and the associated risk level in each lab room to help visitors and emergency responders understand safety concerns in the lab.
  
  • They also have room contact information; identify required personal protective equipment (PPE) and special safety rules.
3. Assessing the Hazards

• Assessment involves reviewing the hazards associated with the chemicals you work with and determining how much of a risk they pose.

• Risk = Hazard * Exposure

• Risk assessments include use conditions as well as chemical hazard information.

• Risks also can vary from one worker to another.
Assessing the Risk of Working with Phenol

Laboratory Chemical Safety Summary:
Phenol is a corrosive and moderately toxic substance that affects the central nervous system and can cause damage to the liver and kidneys.

*Phenol is irritating to the skin but has a local anesthetic effect, so that no pain may be felt on initial contact.*
A whitening of the area of contact generally occurs, and later severe burns may develop. Phenol is rapidly absorbed through the skin. *As little as 1 gram of absorbed phenol can be fatal to humans.*
The Impact of Concentration on Hazard

- **At home:** Chloraseptic: Phenol 0.5%
- **In the lab:** Animal preservative solutions (around 2%)
- **At home:** Paint strippers – 20% phenol
- **In the lab:** Phenol – chloroform solution (50/50)
4. Managing the Hazards:

Because every laboratory works with a different set of chemicals, specific Standard Operating Procedures and training will be provided by your laboratory supervisor.

Some of the questions you should be able to answer by reading the SOP are:

- Which chemical processes should be done in a fume hood?
- When and where must Personal Protective Equipment (PPE) such as gloves, lab coats and eye protection be worn?
- Who should I report an accident to?
- Who should I ask for help?
The Importance of Housekeeping

The level of risk associated with laboratory hazards depends on the context of the hazard. Laboratory housekeeping is an important part of that context. To keep your lab safe:

1. Keep your work area uncluttered.
2. Store chemicals in secondary containment.
3. Clean up drips and spills as they happen.
4. Wipe down your work area at the end of the day.
5. Being Ready for Emergencies

- Google reported 148 emergency responses to laboratory accidents in the US in 2011 (3 per week):
  - 45% were in research labs, 25% in high school labs, 20% in industry and 10% in teaching labs
  - 25% were explosions, 20% were fires, 45% were releases and 10% were discoveries of unexpected hazards
  - 36% of the time, someone was hurt, 1 person died immediately
The Importance of Lab Emergency Response

Although there was a safety shower in the lab, Sangji did not use it. Instead, a postdoctoral researcher in the group who was cleaning up one of the lab’s benches, wrapped a lab coat around Sangji to try to put out the fire.

“She was screaming and was moving around and I was attempting to wrap her tightly,” he told Cal/OSHA. He abandoned the lab coat when it started burning. He then started pouring water on Sangji from a nearby sink, while she sat on the floor.

Sangji suffered burns over 40% of her body and died three weeks later.
Key Steps in Emergency Response

1. Be prepared: Know the hazards
2. Recognize the emergency
3. Protect yourself and others
4. Assess the situation
5. Arrange to fix the problem
6. Develop “Lessons Learned” and plan recovery.
Step 4: Assess the Situation: Is this an emergency? What kind?

- What is an emergency?
  - Fire or immediate threat of fire
  - Personal injury or illness
  - Major chemical spill
  - Unexplained situations

http://emergency.cornell.edu
Responding to a Fire

Fire, Smoke & Explosion

In the event of fire, smoke, or an explosion:

- Alert those around you to the hazard
- Evacuate the room, closing doors behind you as you leave
- Manually activate the fire alarm system as you exit the building
- Exit and move away from the building – DO NOT USE ELEVATORS
  - If you encounter smoke, stay low and if necessary use your secondary escape route
- Call 911 from a safe location. Tell the dispatcher:
  - Name of the building
  - Location of the fire
  - Description of the fire
- ALL fire must be reported to Cornell Police, including those that have been extinguished
Responding to a Medical Situation

Medical or Mental Health Emergency

A medical emergency may exist for many reasons including trauma, alcohol or other drug overdose, serious mental health issues, or medical conditions like diabetes or cardiac arrest.

- Call 911
- Do not move the person unless they are in immediate danger
- Provide first aid if you are trained to do so
- Reassure the person that help is on the way
Responding to a Chemical Spill

Hazardous Materials

For spills or incidents requiring training, procedures, or personal protective equipment beyond the abilities of the personnel present, take the following actions:

- Alert others in the immediate area and evacuate the room.
  - If building evacuation is needed then manually activate the building fire alarm.
- Close doors as you leave the room.
- Call 911 from a safe location and provide the following information:
  - Your name, telephone number, and location
  - Location of the spill
  - Name and quantity of material spilled (if known)
  - Any injuries or personal contamination
- Use eyewash or safety showers as needed to wash spilled chemicals off your body.
  - Flush the affected areas with copious amounts of water for at least 15 minutes.
- Call 911 to report hazardous materials spills and personal contamination.
- If you are contaminated do not spread the material or contaminate others. Tell responders you have the material on you.
Managing an Unexplained Situation

1. Ask people around you in your lab

2. Check with your building coordinator or Departmental Safety Representative. Your building coordinator can be found on the Cornell facilities web site

3. Contact us through AskEHS@cornell.edu
• Is this a fire hazard?
• Is this a medical emergency?
• Is this a hazmat spill, or can you clean it up yourself?
• What do you do to respond to each?

The flashpoint of acetic acid is 104 F
The PEL is 10 ppm for acetic acid;
the odor threshold is 2 ppm
Vapor Density 2.07
What if another chemical is involved? (for example, nitric acid)

From the *Laboratory Chemical Safety Summary* from the National Research Council:

**Reactivity and Incompatibility**

Nitric acid is a powerful oxidizing agent and ignites on contact or reacts explosively with a variety of organic substances including acetic anhydride, acetone, acetonitrile, many alcohols, thiols, and amines, dichloromethane, DMSO, and certain aromatic compounds including benzene.
What if someone has acetic acid splashed on them? Will they feel it?

- Mineral acids, such as HCl, H$_2$SO$_4$, etc. on the skin cause pain.
- Base spills on the skin cause a slippery feeling, but not immediate pain.
- Some organic acids, such as phenol, are anesthetics.

Bottom line: Know the warning properties of the chemicals you work with.
What if someone is wearing sandals in this scenario and the glass cuts their foot?

Blood borne Pathogens are spread through contact with blood or other body fluids

- Hepatitis C (HCV) ..................4 million
- Hepatitis B (HBV) ...................1.25 million
- Human Immunodeficiency Virus (HIV) ... 1 million

Remember:

- There’s no way of telling if a person or a blood sample it is infectious.
- The consequences of infection could be life-threatening.
- So it’s best to avoid contact; if contact occurs get medical attention.
Fitting PPE to the Person and the Event
The Cornell Climate Action Plan commits the University to becoming carbon neutral by 2050. Laboratories use about 50% of the University’s energy, so this will require careful consideration of energy conservation opportunities in labs.
Energy Conservation in Labs

• Ventilation is the largest user of energy in labs
  – One fume hood is the equivalent of 3 households
  – Lowering your fume hood sash is both safer and conserves energy

• Cold storage of samples is the second largest use of energy
Laboratory Waste

- Chemical
- Biological
- Sharps
- Radioactive
- Trash
- Recycling
- Mixes and Contaminated
A Lab Safety Reminder

You always look both ways before you cross the street, even if you’ve crossed the same street safely 100 times before; take the same approach with your lab experiments.

– Timothy C. Gallagher, chair of the chemistry department, University of Bristol, UK quoted in the ACS Safety Zone blog http://cenblog.org/the-safety-zone/2010/11/a-safe-lab-culture-should-enhance-what-you-do/
Questions?

If you have any questions, check with your supervisor or contract us via AskEHS@cornell.edu

In case of an emergency, call 911 from a campus phone or (607)255-1111 from a cell phone