Impact of OSHA’s Lab Standard on Undergraduate Safety Education

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Demonstrations Resulting in Methanol Flash Fires

- Methanol flash fires from demonstrations
- Common error: Opened, poured methanol from large bottle near ignition source
- Why?
  - Easy to just blame teacher
  - Ignorance of hazard and/or missing safety ethic – did not consider safety
  - Missing or weak safety education
OSHA’s Lab Standard

- Requirements for employers
  - Chemical Hygiene Plan; Chemical Hygiene Officer
  - Medical exams for exposures
  - Training/Information
    - Hazards in workplace, monitoring methods, signs/symptoms of exposure, lab standard, CHP, reference materials (SDSs, labels)

- Target audience – **employees** working in labs
Academic Response to Lab Standard

• Adopted LS as Safety Effort for ALL persons
  ▫ CHP, SDSs
  ▫ Experiments use less hazardous chemicals so students rarely handle hazardous chemicals

• Safety Training for
  ▫ Employees AND Students

• Safety Training Substituted for Safety Education
  ▫ Results – Students lack understanding (“why”) of safety and lack safety ethic
Safety Needs for Undergraduates

• Undergraduates (Baccalaureates) become
  ▫ School teachers
  ▫ Lab workers
  ▫ Graduate students conducting research/teaching
• Need *Professional Education* – including safety education to learn/develop
  ▫ Broad knowledge of lab hazards, risk assessment, methods to minimize exposures, emergency preparation
  ▫ Critical thinking about safety for future jobs
  ▫ Strong safety ethics
<table>
<thead>
<tr>
<th>Safety Education</th>
<th>Safety Training</th>
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<tbody>
<tr>
<td><strong>Focus:</strong> Mind-building</td>
<td><strong>Focus:</strong> Skill-building</td>
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<tr>
<td><strong>Target:</strong> Thought processes</td>
<td><strong>Target:</strong> Behavior and practices</td>
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<tr>
<td><strong>Emphasis:</strong> “Why” reasoning behind safety (non-specific)</td>
<td><strong>Emphasis:</strong> Specific application to specific workplace (“why”)</td>
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<tr>
<td>Long-term learning process</td>
<td>Short-term learning process</td>
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<tr>
<td>Teaches critical thinking, problem-solving in safety</td>
<td>Teaches specific information about hazards or practices</td>
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<tr>
<td>Teaches principles, theories, concepts with increasing complexity as education advances</td>
<td>Learning step-by-step, what and how to do something (insufficient to teach critical thinking)</td>
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<tr>
<td>Learning broad, in-depth</td>
<td>Learning limited and specific</td>
</tr>
<tr>
<td>Purpose: Develops knowledge base and safety ethic for future</td>
<td>Purpose: Provides employer with compliance documentation</td>
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Safety Education Develops: Safety Ethics

- **Safety education**
  - Provides knowledge, understanding of hazards, risks, hazard management, emergency preparation – This is the “Why” of safety
  - Builds Safety Ethic w/long-term, reasoned approach

- **Safety Ethic**
  - Values safety, Considers safety in work, Avoids at-risk behavior, Promotes safety, Accepts responsibility for safety
  - Dependent upon understanding the “Why” of safety

- **Rules, Compliance Requirements** – Do NOT build safety ethics; Employees want to know “WHY”
Can the Cycle that Undervalues Safety Be Broken?

Don’t teach safety education

Graduates become teachers – Don’t value safety

Students learn little/no safety

Students graduate without safety education/ethics

Students don’t develop safety ethic
Safety Education Basics - The Framework

- Four Organizing Principles of Safety
- Remember acronym – \textit{RAMP}\textsuperscript{\textdagger}
- \underline{Recognize} hazards
- \underline{Assess} the risks of hazards
- \underline{Minimize} the risks of hazards
- \underline{Prepare} for emergencies

\textsuperscript{\textdagger} R Hill, D Finster. \textit{Laboratory Safety for Chemistry Students}, John Wiley, Hoboken, NJ, 2010
Elements of Safety Education

• **Recognize Hazards:** Broad overview of lab hazards – “Why”
  ▫ Corrosives, flammables, explosives, pyrophorics, gases, incompatibles, toxicants/toxins, carcinogens, pressurized systems, cryogenics, peroxides, reactives, allergens, electrical, radiation, etc.

• **Assess Risks of Hazards:** Risk assessment process/methods
  ▫ What is it? Why? How do you do it? Rating systems

• **Minimize Risks of Hazards:** Methods to minimize exposures
  ▫ Hoods, PPE, procedures/practices

• **Prepare for Emergencies:** Emergency procedures, equipment
  ▫ What to do, How to do it, When to do it, Practice

• **Lessons learned**
  ▫ Students remember incident lessons; focus on addressing underlying issues; Does NOT focus on blame

• **Some safety training**
  ▫ Fire extinguishers, eye washes, showers, PPE donning-undonning, waste management, specific procedures for handling specific compounds
Lab Hazards - An Example

- Flammable liquids
  - Definitions, flash point, lower-upper explosive concentration limits
  - Combustion/reaction equations, exothermic chemical reaction profiles, bond energies, calculations of gas expansion during fire
  - What starts a fire, fire triangle/tetrahedron, types of fires, flash fires, bleves
  - Fire rating systems – GHS, NFPA
Why Safety Education?

- No one ever died from not fully understanding theories behind valence states of chromium or Diels-Alder reactions
- **BUT** many have been injured or died (and will continue to do so) because they did not have a safety education and a safety ethic

Throughout history, it has been the *inaction* of those who could have acted; the *indifference* of those who should have known better; that made it possible for evil to triumph.

Haile Selassie
Ethiopian Statesman
CDC Findings - Hazardous Substances Emergency Events Surveillance (HSEES)

- Surveyed 9 states from 1999-2008 [MMWR, 64 (SS#2), April 10, 2015]
- Top 5 Industries with Injuries from Acute Chemical Events
  - Chemical Manufacturing, Educational Services, Truck transportation, Food Manufacturing, Utilities
- 58K incidents, 4.6K incidents with 15.5K injuries
- Total injuries: CM (1753), ES (1562), TT (869)
- Of ES 1092/1562 Students [CM 407/1753]
- Trends: CM ↓, ES ↑
What Can We Do?

- Recognize need for safety education
- Promote safety education
- Convince academic colleagues of need for safety education – teach the “why” of safety
- Spread the “RAMP” concept
- Understand
  - Differences between safety education, safety training
  - Safety education develops strong safety ethics
  - Essential for strong safety culture
  - Need for critical thinking in safety
Famous Poster from Walt Kelly, Cartoonist, Earth Day, April 22, 1970