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

Safety Education versus Safety Training

Safety Education

- Focus: Mind-building
- Target: Thought processes
- Emphasis: "Why" reasoning behind safety (non-specific)
- Long-term learning process
- Teaches critical thinking, problem-solving in safety
- Teaches principles, theories, concepts with increasing complexity as education advances
- Learning broad, in-depth
- Purpose: Develops knowledge base and safety ethic for future

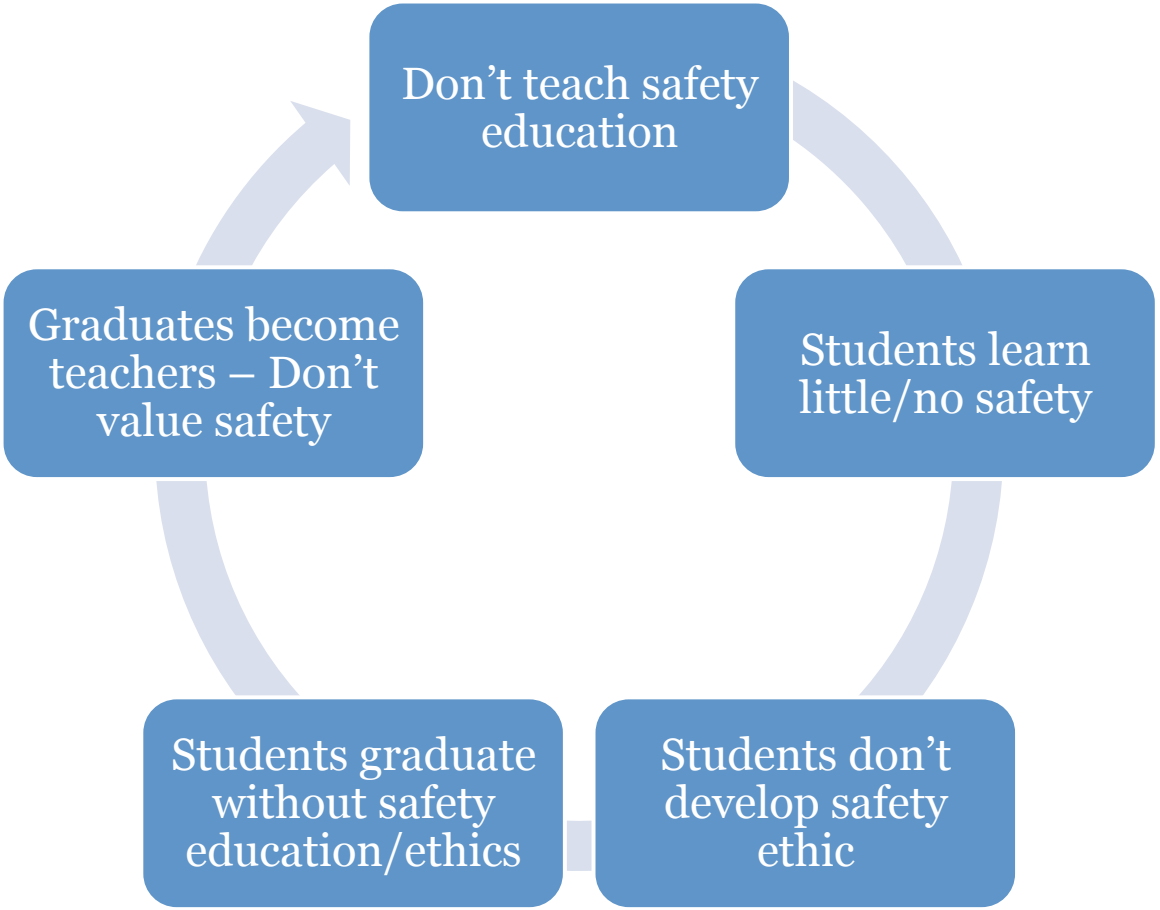
Safety Training

- Focus: Skill-building
- Target: Behavior and practices
- Emphasis: Specific application to specific workplace ("~~why~~")
- Short-term learning process
- Teaches specific information about hazards or practices
- Learning step-by-step, what and how to do something (insufficient to teach critical thinking)
- Learning limited and specific
- Purpose: Provides employer with compliance documentation

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?



Safety Education Basics – The Framework

- Four Organizing Principles of Safety
- Remember acronym – ***RAMP*** [1]
- **Recognize** hazards
- **Assess** the risks of hazards
- **Minimize** the risks of hazards
- **Prepare** for emergencies

[1] R Hill, D Finster. *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.*

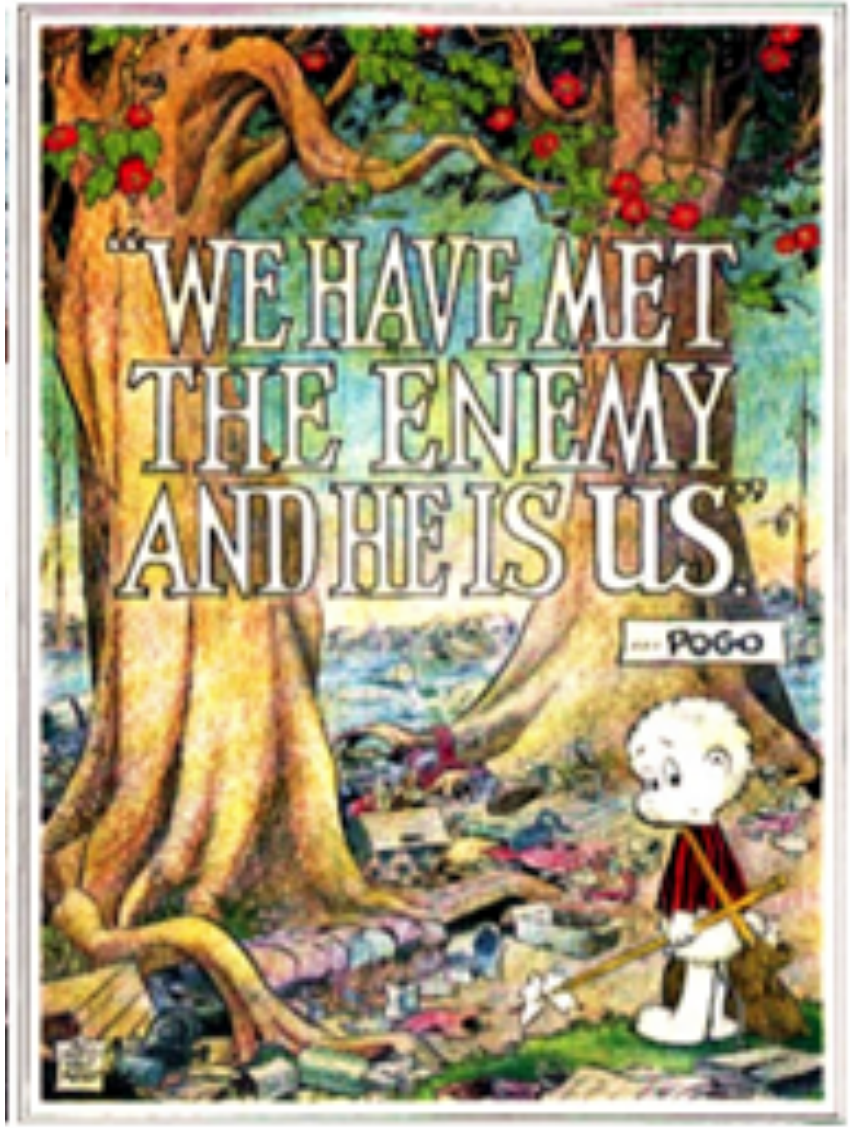
Haile Selassie
Ethiopian Statesman

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