A Practical Approach to NFPA 45

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Wisdom to make a difference.

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Reviewing the methanol fire scenario

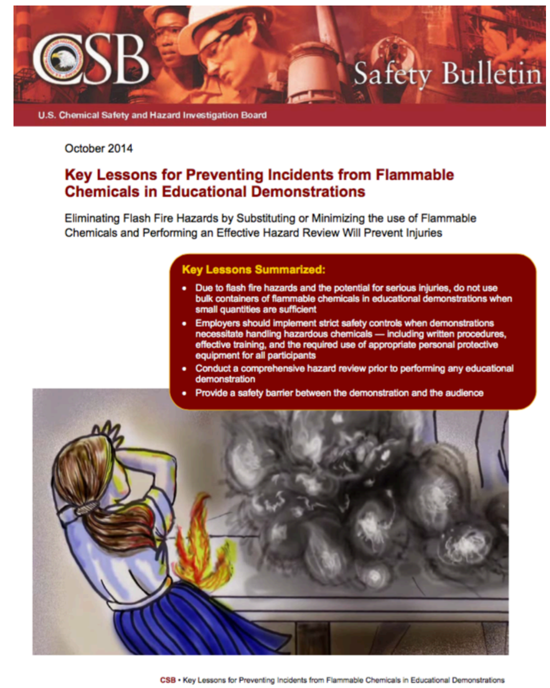
1. Replacing the Hazard
2. Engineering Controls: Fume Hood?
3. Training and Oversight
4. Personal Protective Equipment
5. Emergency Planning and Response

Figure 3. Methanol igniting on the day of the incident[8]

Are we doing better 8 years later?

Recent demonstration methanol fires:

1. New York City, January 2014
2. Reno, Nevada, September 2014
3. Denver, Colorado, September 2014
4. Raymond, Illinois, October, 2014
5. Chicago, November, 2014
6. Tallahassee, Florida, May 2015
7. Washington, DC, October 30, 2015



CSB Safety Bulletin

U.S. Chemical Safety and Hazard Investigation Board

October 2014

Key Lessons for Preventing Incidents from Flammable Chemicals in Educational Demonstrations

Eliminating Flash Fire Hazards by Substituting or Minimizing the use of Flammable Chemicals and Performing an Effective Hazard Review Will Prevent Injuries

Key Lessons Summarized:

- Due to flash fire hazards and the potential for serious injuries, do not use bulk containers of flammable chemicals in educational demonstrations when small quantities are sufficient
- Employers should implement strict safety controls when demonstrations necessitate handling hazardous chemicals — including written procedures, effective training, and the required use of appropriate personal protective equipment for all participants
- Conduct a comprehensive hazard review prior to performing any educational demonstration
- Provide a safety barrier between the demonstration and the audience

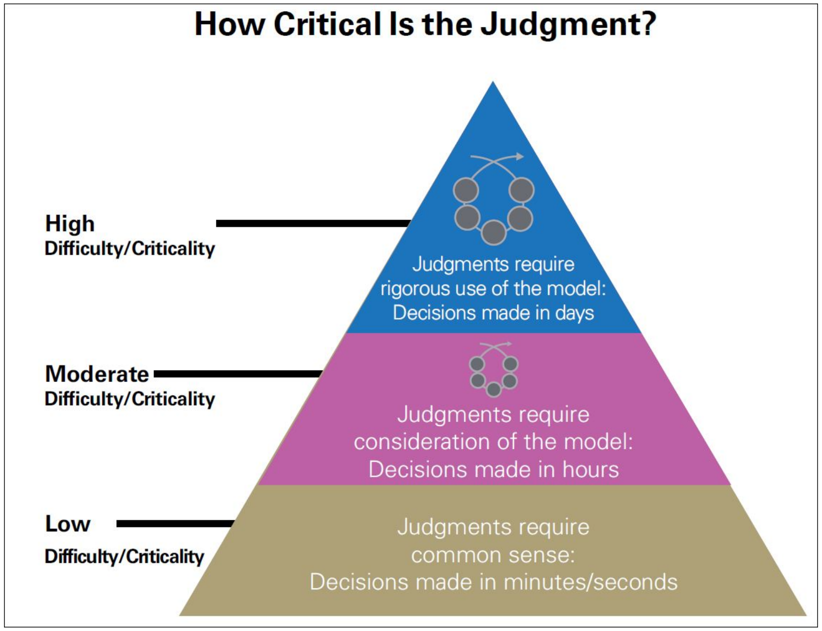
CSB • Key Lessons for Preventing Incidents from Flammable Chemicals in Educational Demonstrations

The Challenge of Risk Assessment: Multiple Levels of Judgment

Individual Expertise

Identifying and Evaluating Hazards in Research Laboratories

Review Required



Guidance for Chartered Accountants (CAs) in a Global Economy

The Resulting Requirement: NFPA 45 Chapter 12, 2015

Instructor Responsibilities

1. Documented hazard risk assessment
2. Safety briefing for students prior to the start of each experiment to review the hazards of the chemicals used, the PPE required for the experiment, and review emergency procedures.
3. **The Big Deal**: These requirements are protocol specific, not a generic set of rules for lab classes

The Scope of NFPA Requirement

• 3.3.13 **Educational Laboratory Unit**.
…students through the twelfth grade…

• 3.3.31 **Instructional Laboratory Unit**.
…education past the 12th grade and before post-college graduate-level instruction …Experiments and tests conducted in instructional laboratory units are under the direct supervision of an instructor .

- Laboratory units used for graduate or post-graduate research are not to be considered instructional laboratory units.

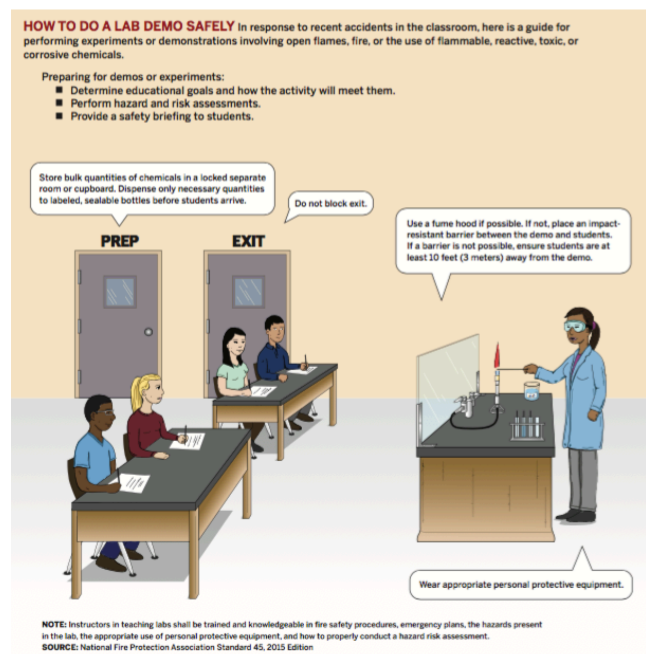
• Instructor includes science teachers, assistant or associate professors, lecturers, substitute teachers, and teaching assistants

NFPA®

An Artist's Rendering of the Change

A

B



So how do we move from A to B?

Risk Assessment

Current Chemical
Risk Assessment Education

- **Caveat emptor**: Chemistry textbooks and laboratory manuals provide a overview of generic rules, followed by "see the MSDS".
- For example, Wikipedia provides links to random MSDS sources; **Linkrot** is a serious problem some sources are kaput, many are dated.

Material Safety Data Sheet [edit]

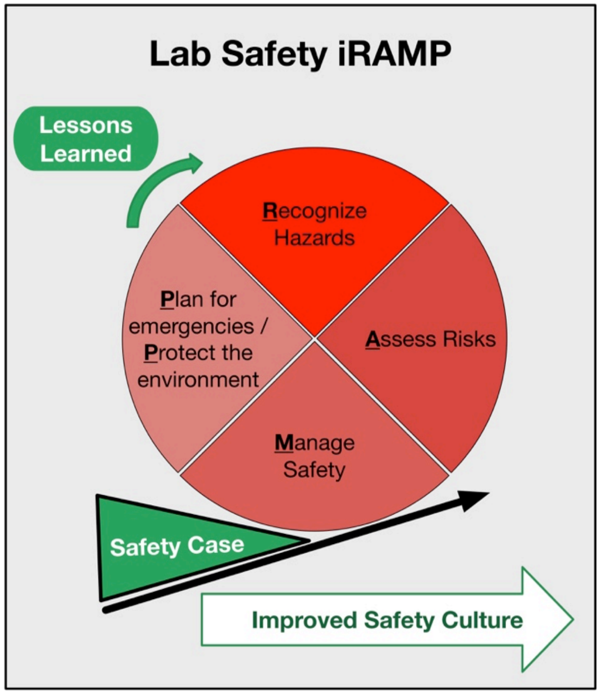
The handling of this chemical may incur notable safety precautions. It is highly recommended that you seek the Material Safety Datasheet (MSDS) for this chemical from a reliable source and follow its directions.

- Mallinckrodt Baker
- Science Stuff

The RAMP approach to Building a Lab Safety System

Developing a Chemical Safety system involves addressing six elements:

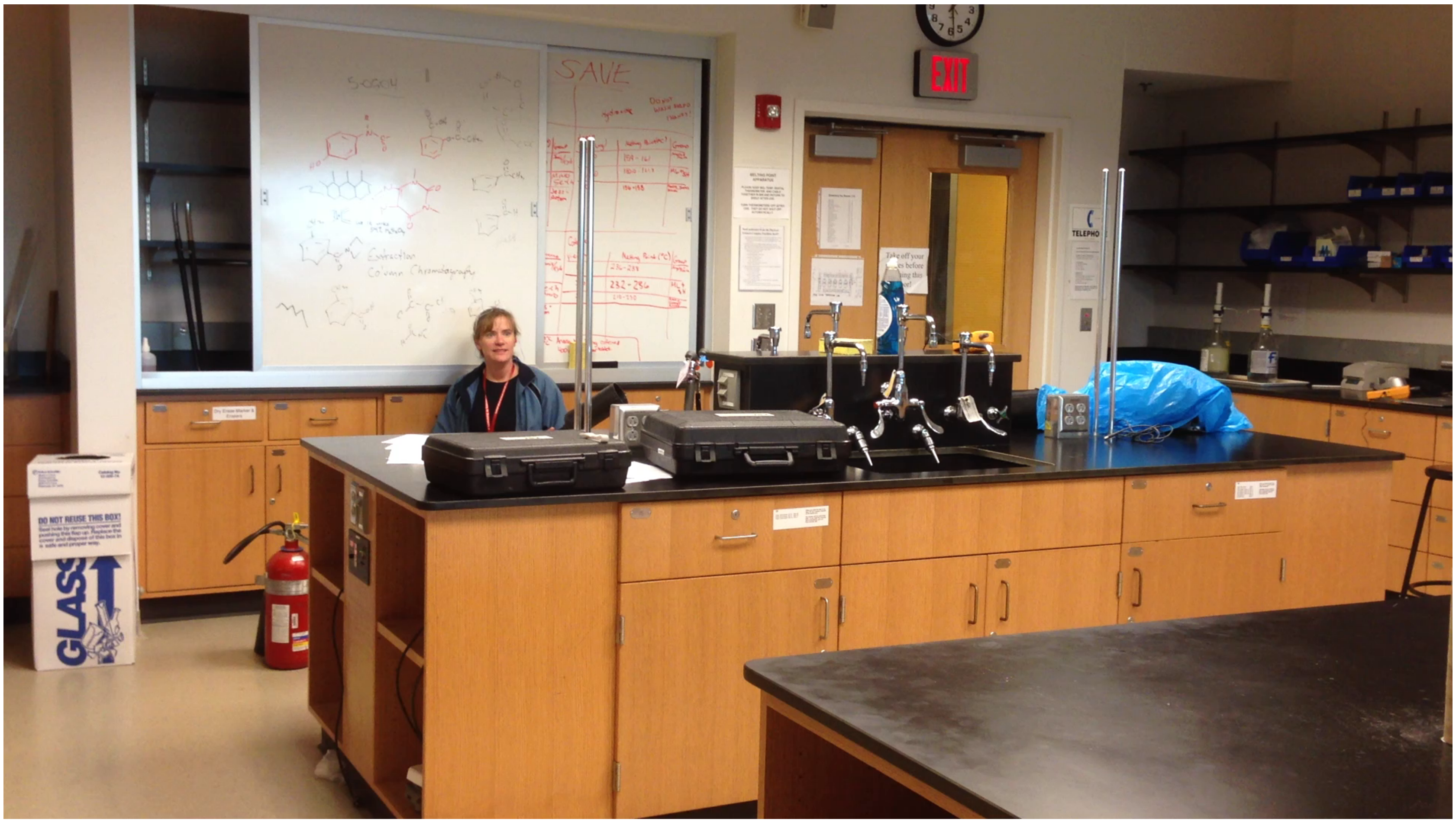
1. EHS Culture
2. Hazard Identification
3. Risk Assessment
4. Managing Safety
5. Planning for Emergencies
6. Protecting the Environment



From Stuart and McEwen. 2016

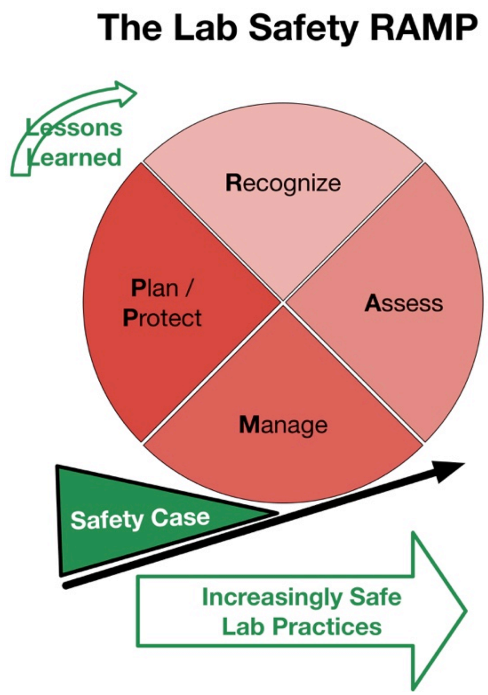
A Sample Procedure: CO_2 Tracer Gas Process

Use fire extinguishers to raise CO_2 concentrations across the lab and then measure its decay in different locations.



The RAMP for CO_2 Release

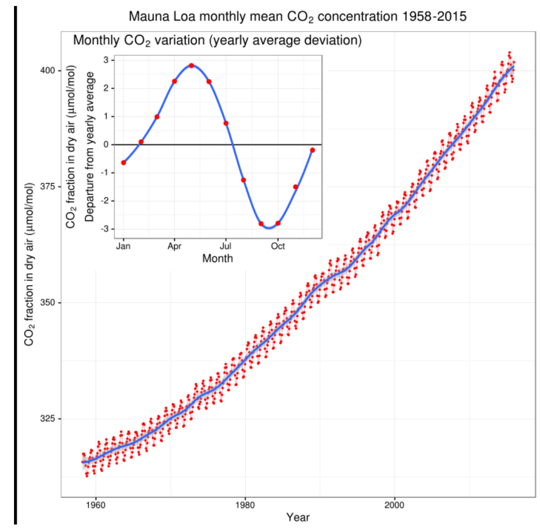
- **Recognize hazards:** CO2 exposures, noise, ergonomics, static electricity
- **Assess Risks** (next page)
- **Manage Safety** (next page)
- **Prepare for emergencies:** monitor CO2 concentrations, don't work alone
- **Protect the Environment:** CO2 is greener than solvents
- **Review Lessons Learned:** improve the management system



Assessing Risks: CO_2 concentrations

- General outdoor environment baseline: **400 ppm**
- Office spaces average between **600** and **800** ppm; comfort issues occur over **1000** ppm
- OSHA PEL:
  5000 ppm over 8 hours
- Target for lab vent work:
  10,000 ppm
- NIOSH IDLH: **40,000** ppm

Target concentration is 10,000 ppm for 5 minutes or less; we have hit 50,000 ppm



[Atmospheric CO2 concentrations measured at Mauna Loa Observatory](#) from 1958 to 2015

The Safety Management System

Organic class lab, about 40 ACH

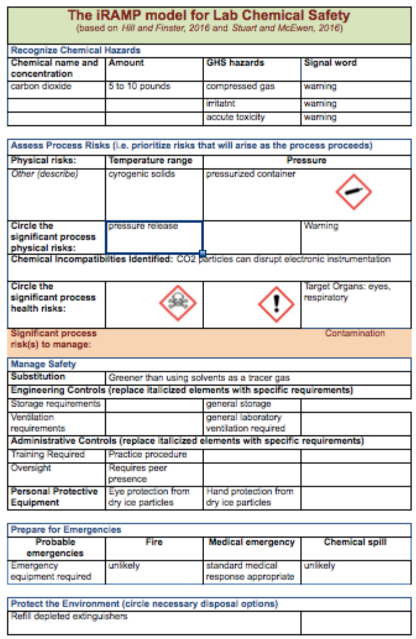
For People:

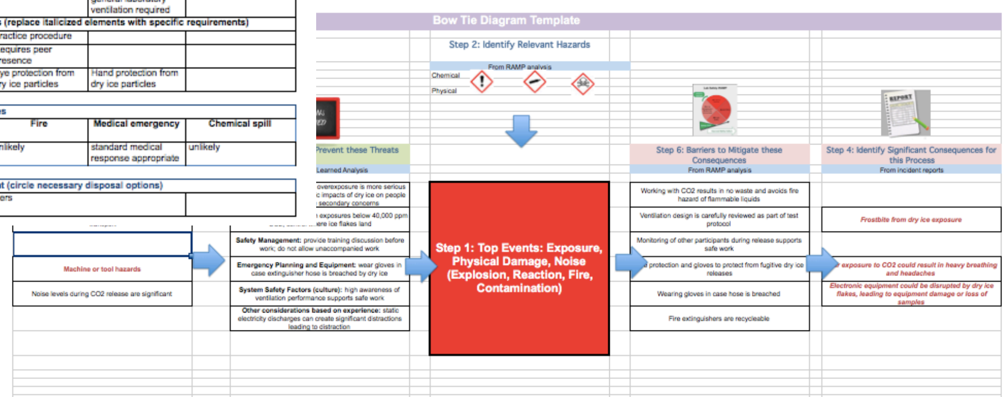
- **CO_2 exposure**: size the extinguisher(engineering)
- **Noise:** wear hearing protection (PPE)
- **Electrostatic discharge:**
  put the extinguisher on the floor (training)
- **Ergonomics:** use carts (engineering)
- **Eye protection:** dry ice flies everywhere (PPE)
- **Gloves:** in case the hose leaks (emergency planning)

For lab equipment and computers:

- **Dry Ice Spatter:** Cover equipment to prevent dry ice from landing on it (engineering)

CO_2 RAMP and Bowtie





Template available at http://dchas.org/bcce2016/

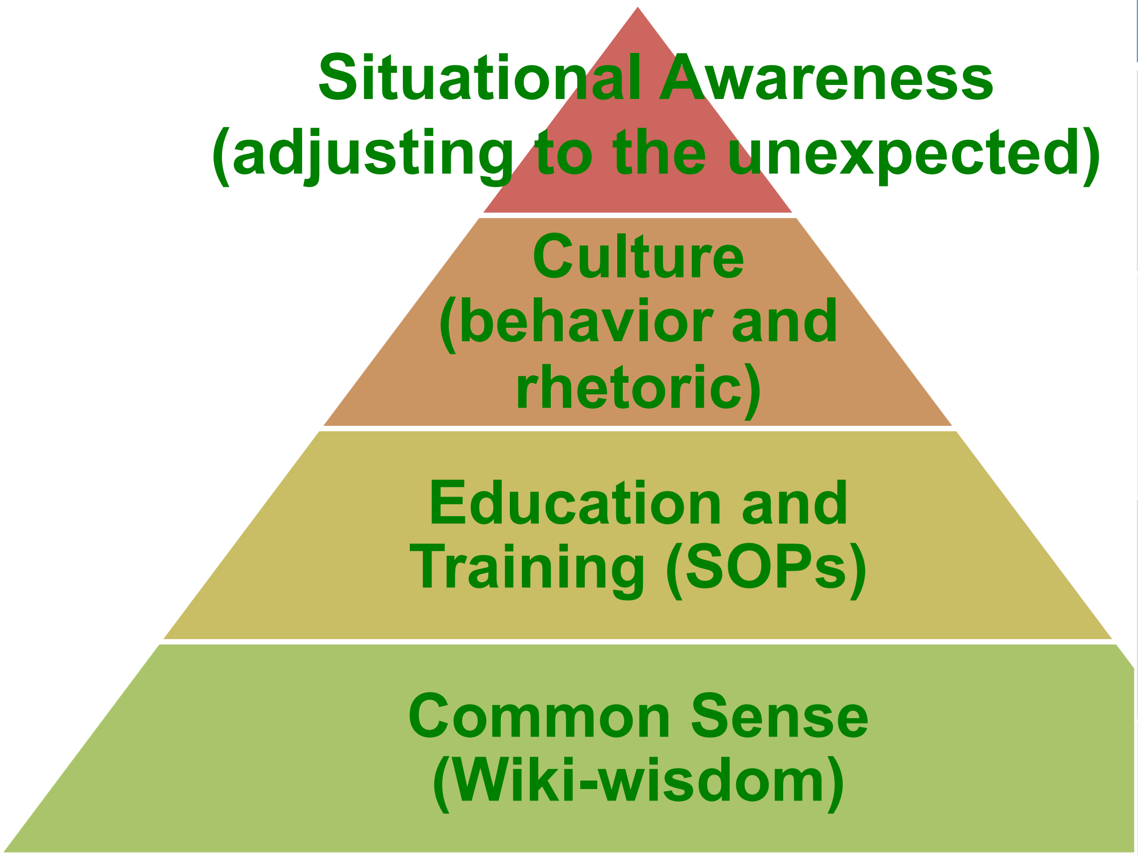
SOP | **Hazard Risk Assessment** | **Bowtie Diagram**

Scope of this Discussion

- **Included:**
  - Laboratories operating at OSHA **"lab scale"**
  - Teaching labs in secondary or undergrad education (and some research labs)
  - Lab support includes faculty and staff who oversee the work
- **Not Included:**
  - People who rely on the name of the chemical to determine the hazard (i.e. the public and emergency responders)
  - Complex research labs where process and hazards evolve unpredictably
  - Work with chemicals beyond OSHA lab scale

The Good News:
Lab Safety is a Creative Process

Safe Decision-Making rests on 4 elements:



Bloom's Taxonomy
Creating
Evaluating / Analyzing
Understanding / Applying
Remembering

References

1. *The Safety "Use Case": Co-Developing Chemical Information Management and Laboratory Safety Skills,* Stuart and McEwen, Journal of Chemical Education http://pubs.acs.org/doi/abs/10.1021/acs.jchemed.5b00511
2. *Safety Data Sheets: Information that Could Save Your Life,* Rohrig, ChemMatters Magazine. http://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/2015-2016/december-2015/safety-data-sheets.html
3. *Assessing general ventilation effectiveness in the laboratory,* Stuart, Sweet and Batchelder. Journal of Chemical Health & Safety, November/December, 2014
4. iRAMP Template available at http://dchas.org/bcce2016/