



iRAMP: A 21st Century Model for Laboratory Chemical Safety

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The Tradition

Chemistry textbooks and laboratory manuals have treated laboratory safety as an introductory topic which involves a brief overview of rules associated with *Personal Protective Equipment, fume hoods and emergency situations*. These generic rules are followed by a statement similar to *Wikipedia's* disclaimer:

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.

Publications from the **National Research Council, the American Chemical Society** and the National Fire Protection Association have reviewed laboratory safety incidents and found this educational approach to chemical safety in the lab to be inadequate.

Abstract: A flexibly structured ecosystem of data, domain expertise and workflow tools is mapped to the essential connections between the research process and laboratory safety planning in academic labs.

Changing Expectations

Documentation of risk analysis and safety planning is a key element of a laboratory safety culture.

NFPA Standard 45 Chapter 12 outlines new expectations for educational (high school) and instructional (undergraduate) labs. This standard is based on pro-active risk assessment of laboratory processes, which enables effective supervisor and institutional oversight; improves the quality of the work being conducted; and provides evidence of adherence to prudent practices if a problem arises during the work. This risk assessment can be assisted by the use of emerging chemical information technologies. The iRAMP described in J Chem Ed special issue on Chemical Information describes how this might work in the undergraduate chemistry curriculum.



Diane Neuberger, a ninth grader in Minnesota who was one of four students burned in a science demonstration involving methanol. "My face was actually on fire," he told local media. Photograph: RICHARD TSONG TAA/TARU/Minneapolis Star Tribune

<http://www.nfpa.org/newsandpublications/nfpa-journal/2015/september-october-2015/features/unsafe-science>

Instructor Responsibilities under NFPA 45-12

- Documented hazard risk assessment
- Safety briefing for students
- Provide Personal Protective Equipment for the audience
- Safety barriers, as required
- Be trained and knowledgeable in fire safety procedures, emergency plans, hazards present

HOW TO DO A LAB DEMO SAFELY In response to recent accidents in the classroom, here is a guide for performing experiments or demonstrations involving open flames, fire, or the use of flammable, reactive, toxic, or corrosive chemicals.

Preparing for demos or experiments:

- Determine educational goals and how the activity will meet them.
- Perform hazard and risk assessments.
- Provide a safety briefing to students.

Store bulk quantities of chemicals in a locked separate room or cupboard. Dispense only necessary quantities to labeled, sealable bottles before students arrive.

Do not block exit.

Use a fume hood if possible. If not, place an impact-resistant barrier between the demo and students. If a barrier is not possible, ensure students are at least 10 feet (3 meters) away from the demo.

Wear appropriate personal protective equipment.

NOTE: Instructors in teaching labs shall be trained and knowledgeable in fire safety procedures, emergency plans, the hazards present in the lab, the appropriate use of personal protective equipment, and how to properly conduct a hazard risk assessment.
SOURCE: National Fire Protection Association Standard 45, 2015 Edition

<http://cen.acs.org/articles/93/i46/Make-Chemistry-Classroom-Demonstrations-Experiments.html>

The Emerging Model

General Safety Information from GHS

Physical Hazards			Health Hazards		
Icon	GHS class	Signal Words	Icon	GHS class	Signal Words
	Explosive	Danger or Warning		Corrosive	Danger only (health)
	Oxidizer	Danger or Warning		Toxic	Danger only
	Flammable	Danger or Warning		Health Hazard	Danger or Warning
	Corrosive	Warning only (physical)		Irritant	Warning only
	Compressed Gas	Warning only		Environmental	Warning only

No GHS Hazard Class; No Pictogram

Detailed Safety Information on PubChem LCSS

<https://pubchem.ncbi.nlm.nih.gov/lcss/>

PubChem OPEN CHEMISTRY

LCSS: Laboratory Chemical Safety Summary for CAS 100

Acetone

PubChem CID: 180
Chemical Name: Acetone, 2-propanone, Propanone, Dimethyl ketone, Methyl ketone, Dimethylformaldehyde
Molecular Formula: C₃H₆O
Molecular Weight: 58.0784 g/mol

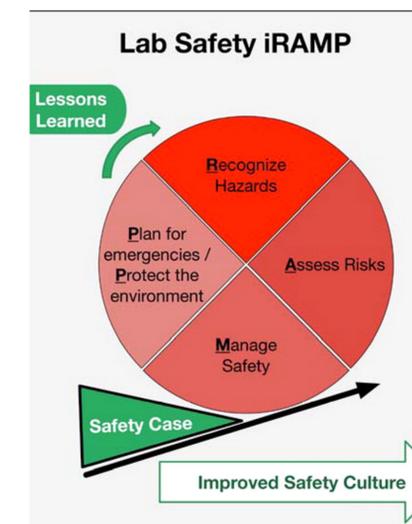
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GHS Classification

- 1 GHS Classification: Flammable liquid, Category 2
- 2 Signal Word: Danger
- 3 Hazard Statement: H226: Highly flammable liquid and vapor
- 4 Precautionary Statement: P201+P202: Attention
- 5 Signal Word: Danger
- 6 Hazard Statement: H228: Highly flammable liquid and vapor
- 7 Precautionary Statement: P210: Keep away from heat, open flames, naked flames, and other ignition sources
- 8 Signal Word: Danger
- 9 Hazard Statement: H314: Causes severe eye irritation
- 10 Precautionary Statement: P303+P361+P353: Wash thoroughly after contact with eyes

The Risk Assessment Paradigm



from *The Safety "Use Case": Co-Developing Chemical Information Management and Laboratory Safety Skills*, Ralph B. Stuart and Leah R. McEwen J. Chem. Educ. 2016, 93, 516–526

Safety Glasses or Goggles

Lab Coat

Chemical Resistant Gloves

Long Pants

Closed Toe Shoes

Material Safety Sheet

1. IDENTIFY THE COMPANY IDENTIFICATION

2. HAZARD IDENTIFICATION

3. COMPOSITIONAL INFORMATION OR INGREDIENTS

4. FIRST AID MEASURES