American Chemical Society

ACS Chemistry for Life™

Risk-based Safety Education Fosters Sustainable Chemistry Education

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CHAS symposium: Safety Across the Chemical Disciplines

August 20, 2022

Safety is an ACS Core Value

In December 2016, the ACS Board of Directors identified "Professionalism, Safety, and Ethics" as a core value of the Society.

We support and promote the safe, ethical, responsible, and sustainable practice of chemistry coupled with professional behavior and technical competence. We recognize a responsibility to safeguard the health of the planet through chemical stewardship.

Traditional Safety Education

- Develops an awareness of safety rules but not a transferable and expandable knowledge of safety
  - Instructors providing a list of rules at the start of each semester (safety orientation or training)
  - A brief mention of hazards at the beginning of each lab period
  - Emphasis on PPE (safety goggles, gloves, lab coat)

Laboratory Safety Skills

- Safety awareness
  - Safety and dress rules
  - Knowing when to use fume hoods
  - Knowing when/how to use safety/emergency equipment
  - Handling, storage, and disposal of waste
  - Understanding and use of safety data sheets
  - Knowing how to effectively handle laboratory emergencies

21st Century Safety Education

Knowledge

Knows how to retrieve information about hazards, identify risks, use a variety of tools to minimize the risks

Skills

Makes decision to minimize hazards and risks

Attitude

Safety leadership

"Skill-based laboratory activity is valuable and can be specifically transferred to the next task, but knowledge and attitudes assist future learning in a nonspecific transfer and must be taught as ideas and principles."

Sigmann, *J. Chem. Health Safety,* 2017

ACS Safety Education Guidelines

ACS Committee on Professional Training (CPT)

ACS Guidelines for Bachelor's Degree Programs

- Emphasize the importance of integrating safety education throughout entire chemistry education
- Provide guidance on the desired depth of student's knowledge, skills, attitudes (KSA) and competencies in the area of chemical safety
- Organized around the framework of RAMP

Problem-Solving Skills and RAMP

Students should be able to apply the scientific method to

- Define a problem clearly
- Develop testable hypotheses
- Analyze data using appropriate statistical methods
- Draw appropriate conclusions

Students should be able to design a safe laboratory operation by

- **R**ecognizing Hazards
- **A**ssessing Risks
- **M**inimizing Risks
- **P**reparing for Emergencies

Integrating Safety with Other Skills

- Problem-solving: Open-ended lab experiments
- Chemical literature (SDS): RAMP
- Communication: Written and oral
- Team: Sharing safety information and providing feedback
- Ethics: Safety as a core value, everyone's responsibility, safe science is good science

Creating a Competency for Risk Assessment in the Professional Chemist

Educational Stage	Knowledge	Skills	Cultural Aspects
Professional chemist	Identify and estimate significance of emerging risks	Make risk decisions and teach risk assessment	Accountable for group performance
Graduate researcher	Develop procedures with reducing risks in mind	Use Risk Assessment tools to propose risk levels for review	Oversee others' safety practices
Mentored researcher (UG, CURE, REU, etc.)	Review procedures; locate information to identify hazards	Learn to use Risk Assessment tools	Raise questions and concerns related to risk
High school student	Learn the elements of risk assessment; understand rules	Select Applicable Rules	Respect Rules

Sigmann, S. (2018). Chemical safety education for the 21st century—Fostering safety information competency in chemists. *Journal of Chemical Health & Safety*, *25*(3), 17-29.

Learning Evolution of a Professional Chemist

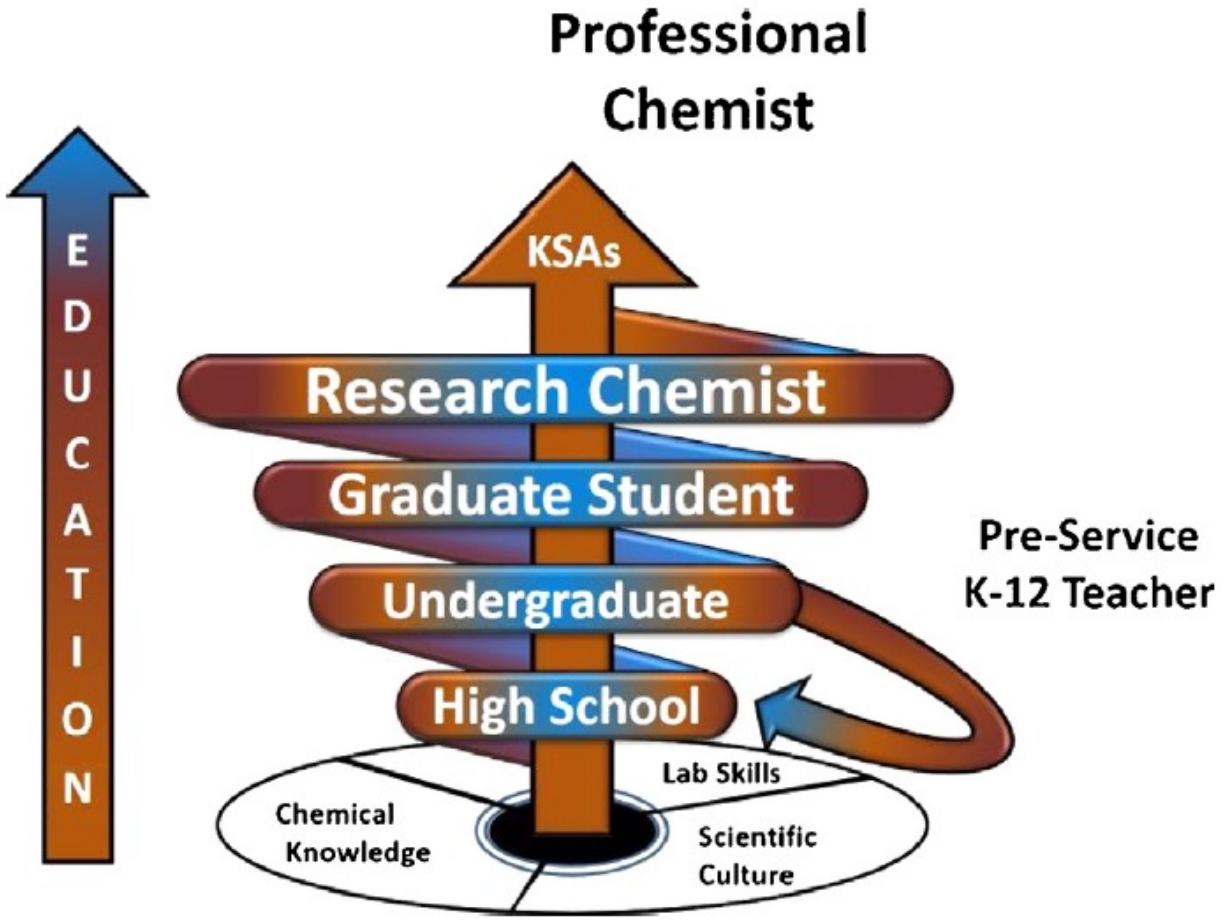
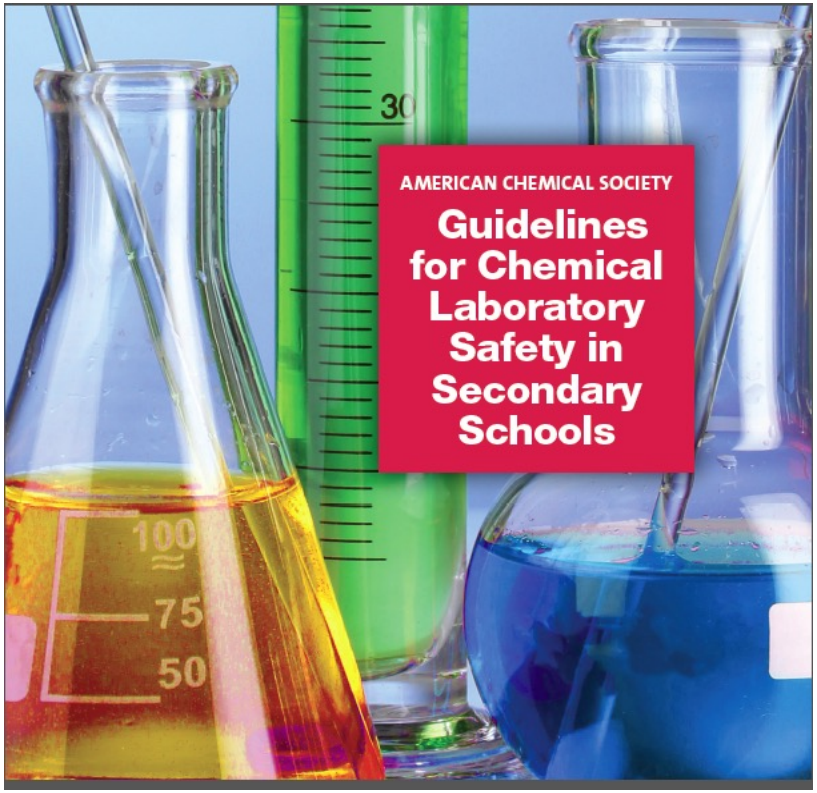
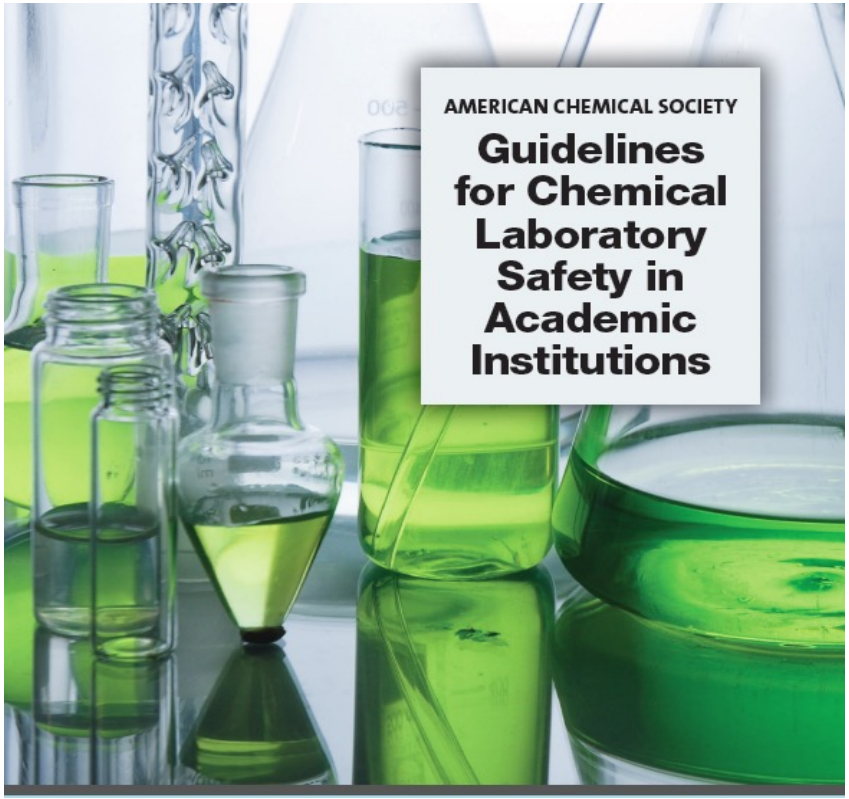


Figure 1 in Sigmann, S. (2018). Chemical safety education for the 21st century—Fostering safety information competency in chemists. *Journal of Chemical Health & Safety*, *25*(3), 17-29.

Safety Education Guidelines

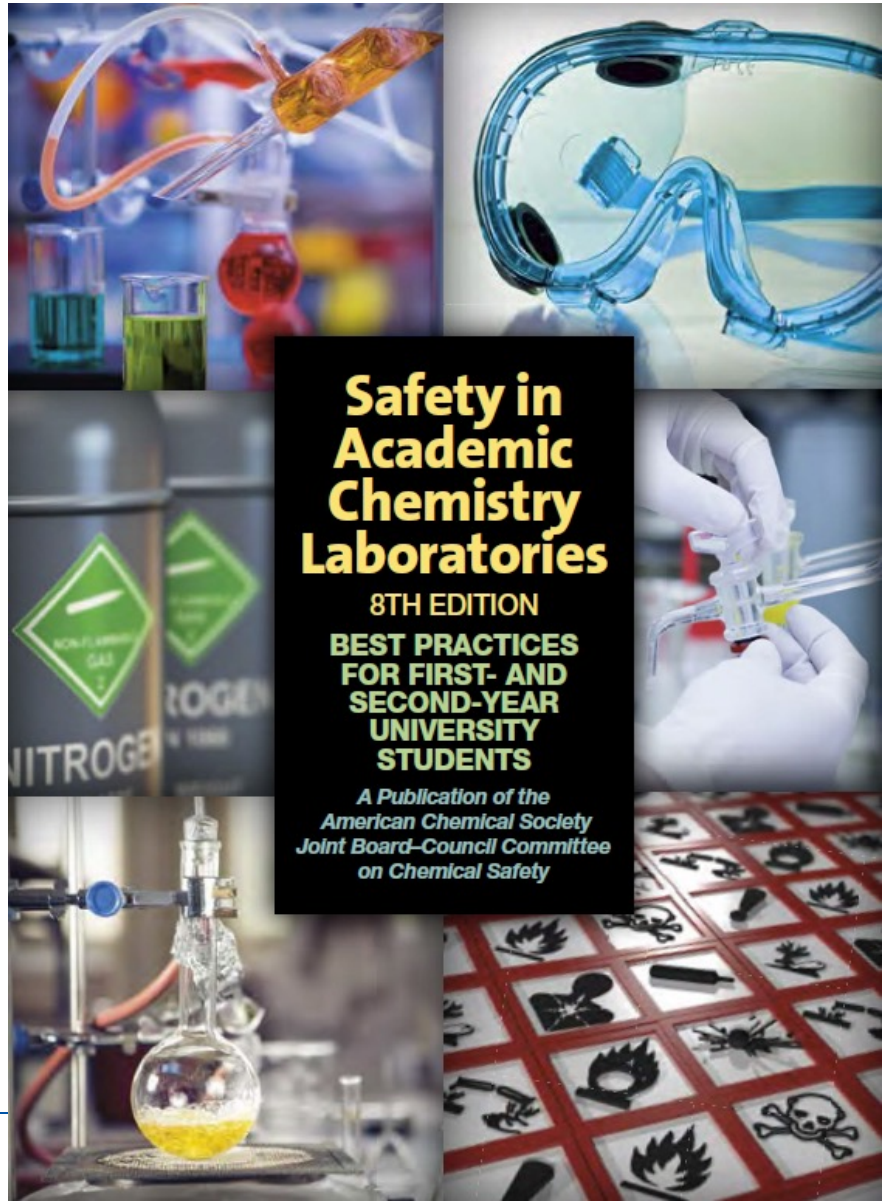
- Download at www.acs.org/safety





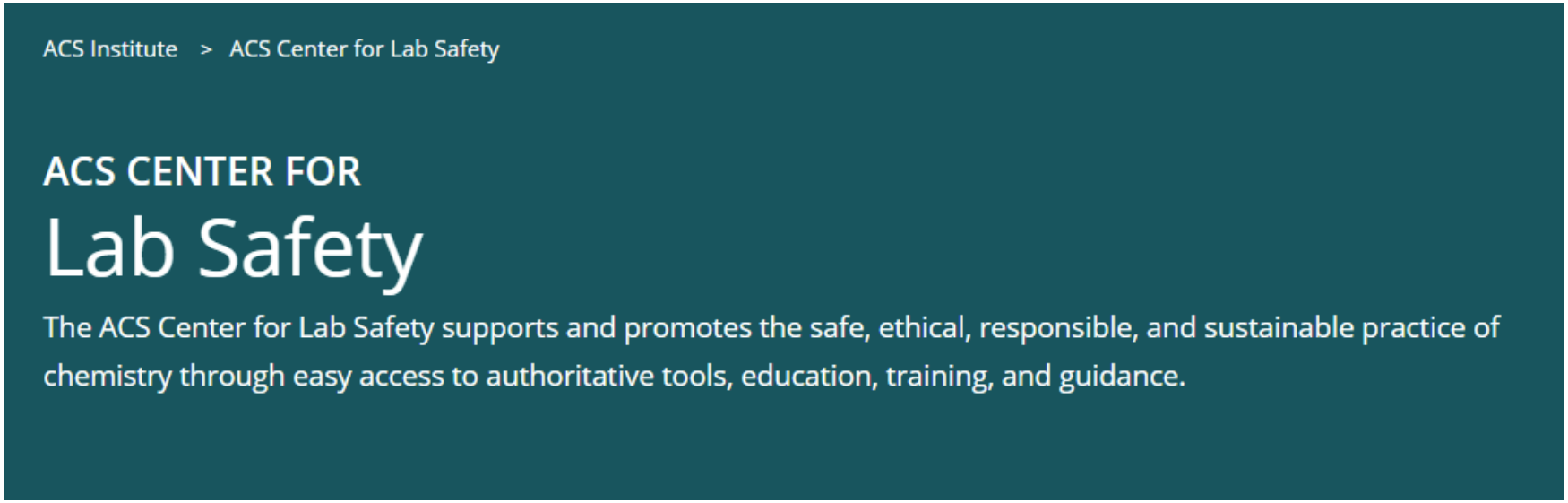
Safety Academic Chemical Laboratory (SACL)

- Download at https://institute.acs.org/lab-safety/education-and-training/college-univ-guidelines.html



ACS Institute:

https://institute.acs.org/lab-safety.html



Brochure summarizing Safety materials:

acs.org/rampupsafety

College Chemistry Safety Videos: www.acs.org/safetyvideos

ACS Chemistry for Life™

1. 

From Chemical Safety Rules to Risk Management | ACS College Safety Video #1
American Chemical Society

2. 

Chemical Safety Information Resources | ACS College Safety Video #2
American Chemical Society

3. 

Assessing Risks in the Chemistry Laboratory | ACS College Safety Video #3
American Chemical Society

4. 

Minimizing Risks in the Chemistry Laboratory | ACS College Safety Video #4
American Chemical Society

5. 

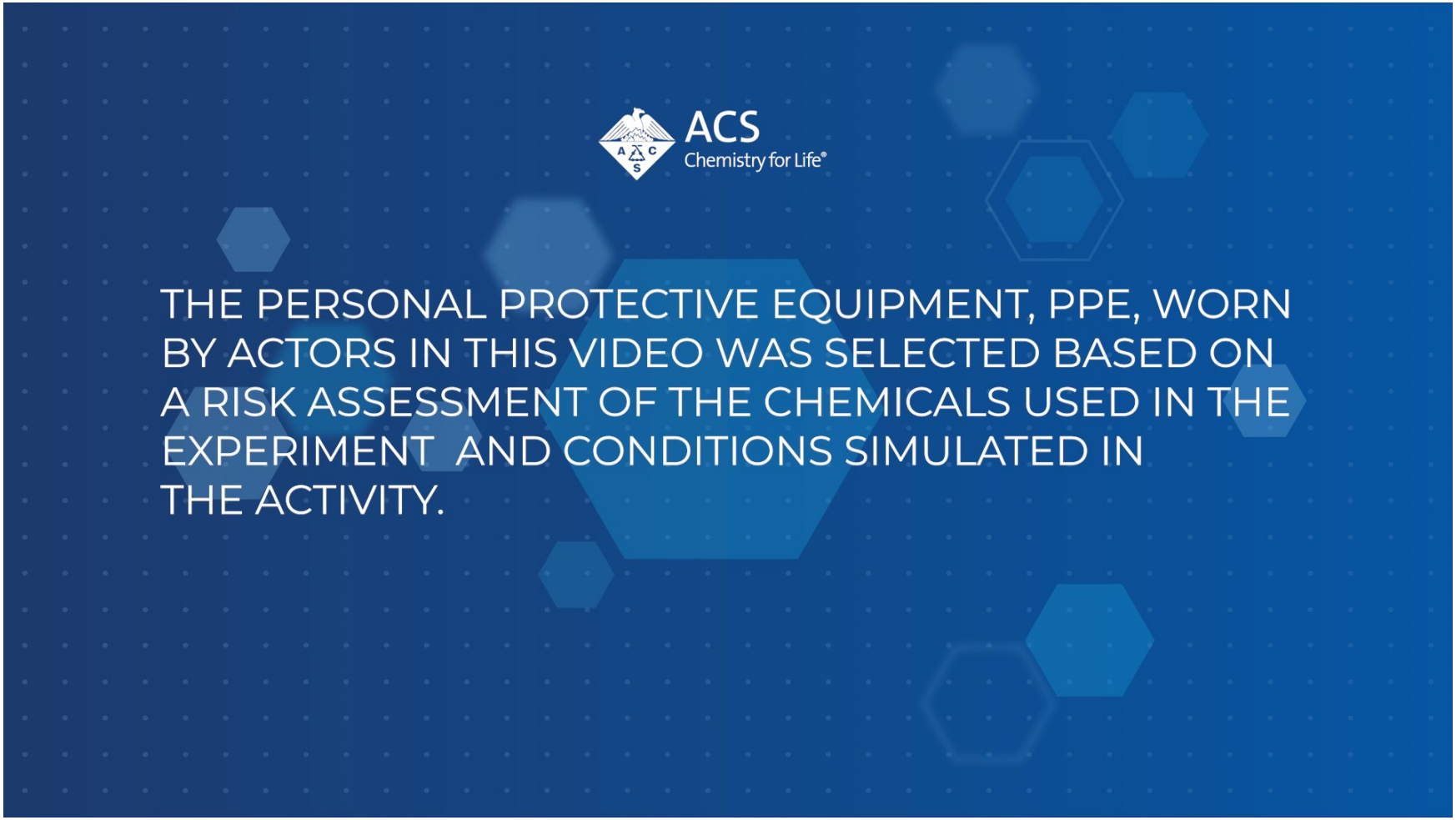
Minimizing Risks in the Chemistry Laboratory: Techniques | ACS College Safety Video #5
American Chemical Society

6. 

Emergencies in the Chemistry Laboratory | ACS College Safety Video #6
American Chemical Society

College Chemistry Safety Videos:

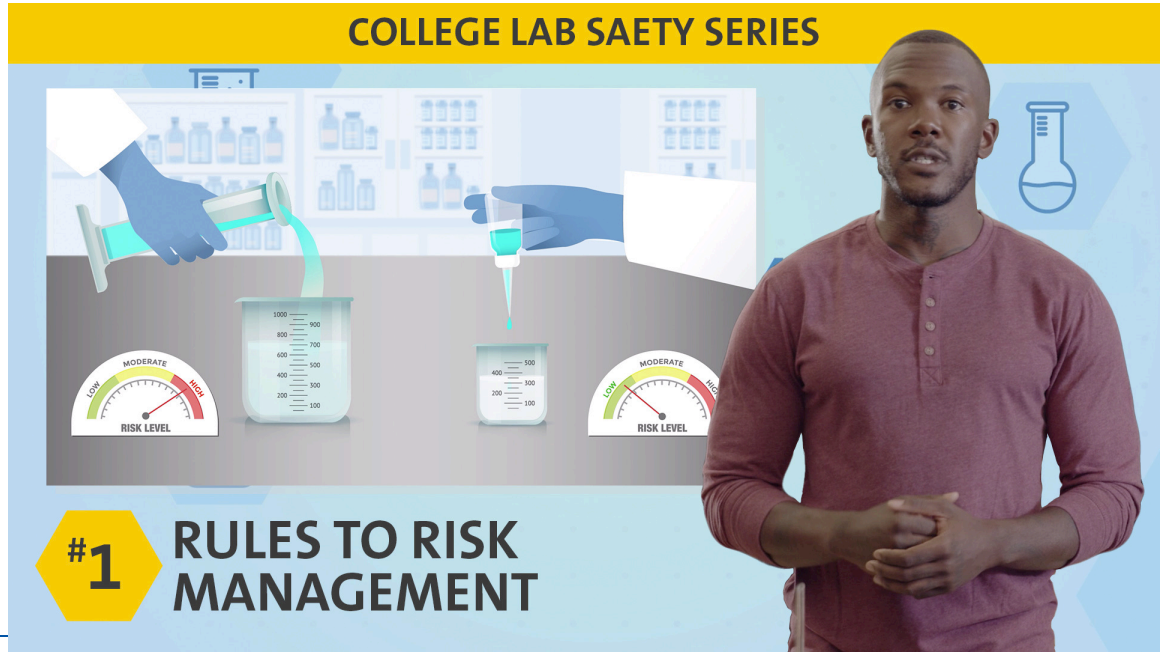
www.acs.org/safetyvideos



College Chemistry Safety Videos:

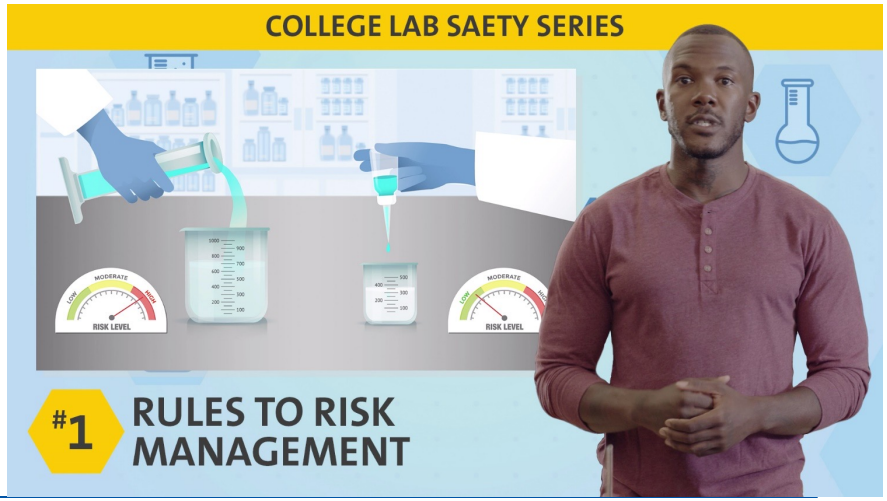
ACS Chemistry for Life™

https://institute.acs.org/lab-safety/education-and-training/safety-videos.html



Options for Using College Chemistry Safety Videos at your Academic Institution:

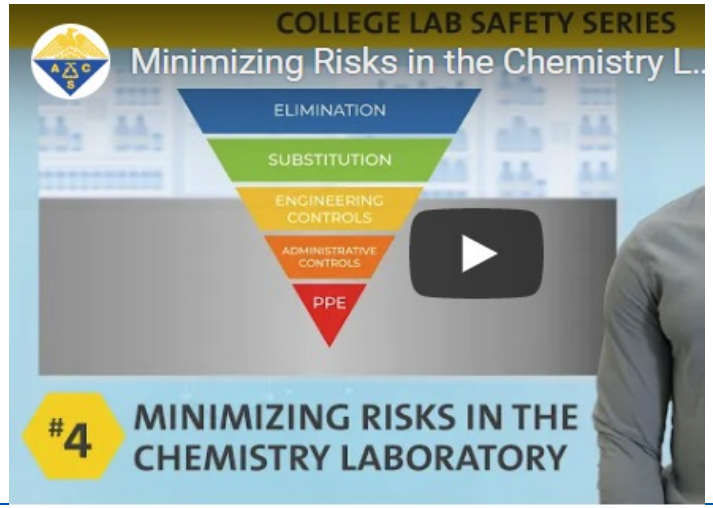
- Pre-lab requirement (students watch on their own)
- In-person (lab recitation)
- On-line learning system or in-person quiz to check understanding
- Discussion with students



www.acs.org/safetyvideos

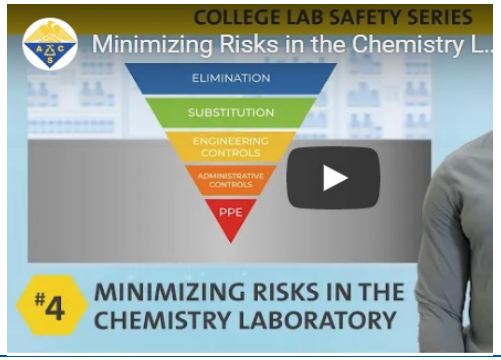
Using College Chemistry Safety Videos at your Academic Institution:

- Watch all of them at the start of the semester (on-line) (pre-lab assignment)
- Watch just a portion related to a specific lab experiment during recitation
- Use as a reminder during the semester of key aspects of RAMP



Using College Chemistry Safety Videos at your Academic Institution:

- Student's use as a reminder of key aspects of RAMP before a lab exam (quiz)
- Build on student's comprehension of how to apply RAMP
- Moving towards student's application of knowledge (recognize, assess, minimize, prepare) requires repetition

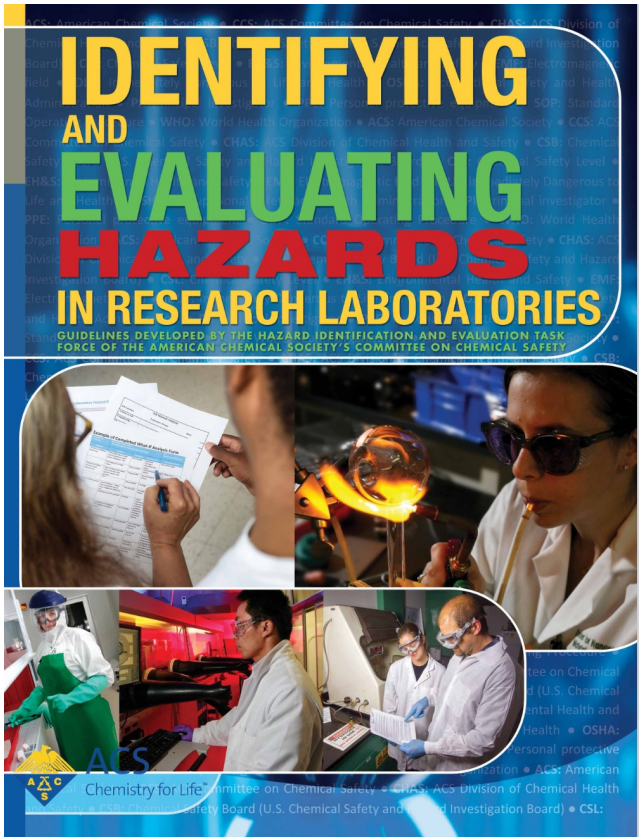


ACS Resources for Risk Assessment

https://institute.acs.org/lab-safety/hazard-assessment/fundamentals/risk-assessment.html

- **Collection of methods and tools for assessing hazards in research laboratories based on the publication, Identifying and Evaluating Hazards in Research Laboratories [PDF].**

https://institute.acs.org/lab-safety/hazard-assessment/ways-to-conduct/checklists.html



< The ACS Center for Lab Safety

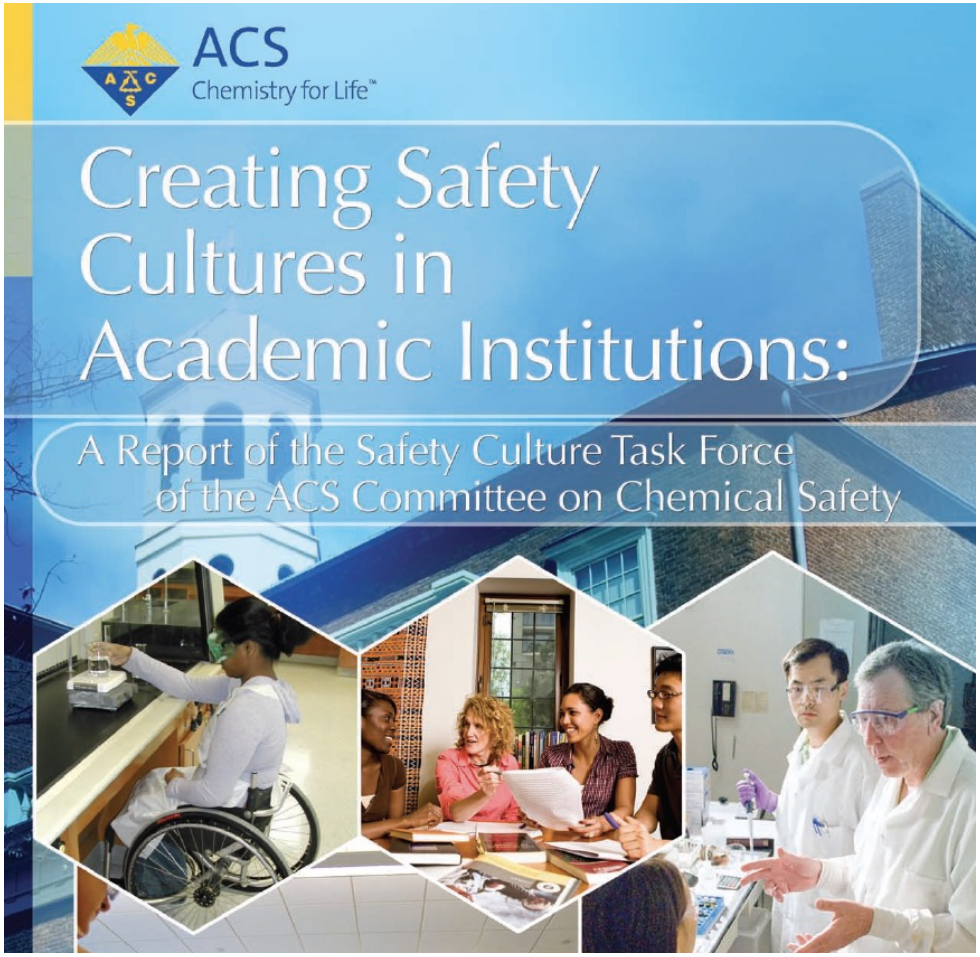
Checklists

Education & Training | Safety Basics | Hazards | Get Involved

What-if Analysis | Job Hazard Analysis | Checklists | Standard Operating Procedures

ACS Resources for Safety Education

https://www.acs.org/content/acs/en/education/students/graduate/creating-safety-cultures-in-academic-institutions.html



Lists 17 recommendations that serve as guidelines for building strong safety cultures

Foundations of Chemical Safety and Risk Management – Free On Demand

Help Share the news about the College Chemistry Safety Videos:

- Communicate with colleagues in your local section and/or college about ACS College Safety Videos
- Share your thoughts (suggestions for supplemental resources) with CCS (safety@acs.org)

  Subject line: College Safety Videos
- 5 minutes for discussion

- THANKS FOR LISTENING!