**American Chemical Society** 

#### Designing A New Free On-line Chemical Safety Course

#### Foundations of Chemical Safety and Risk Management

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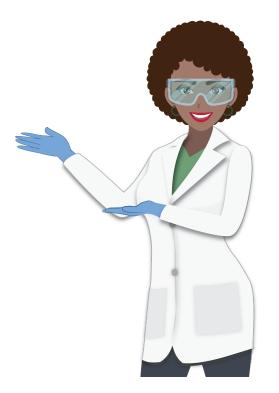


- Why was this course developed?
  - Requests for safety education materials from the community.
  - Originated in the Division of Chemical Health and Safety (CHAS) in 2013.
  - 11 topics on chemical safety authored by several volunteers and submitted to ACS in 2017 for use as a course.
    - Internal review found robust content, but uneven writing styles and presentations.
    - Implementing into a course structure would need effort.
  - Partial support from The Dow Chemical Company.



#### Who was the project Team? (alphabetical order)

Marta Gmurczyk, ACS Project Manager Kirk P. Hunter, Subject Matter Expert, Course Developer\* Vuk Keselj, Instructional Designer, Moodle implementation Daniel Kuespert, Subject Matter Expert, Course Developer Rachel Pricer, Subject Matter Expert, Graphic Designer\* Samuella Sigmann, Subject Matter Expert, Course Developer\* Karen Mueller, copy-editor



\*=extensive Moodle experience



#### What were the parameters?

- Support existing guidelines and recommendations
  - Guidelines for Chemical Safety in Academic Laboratories (CCS)
  - Safety in the Academic Laboratory 8<sup>th</sup> Edition (CCS)
  - Committee on Professional Training (CPT) recommendations for integrating safety into the undergraduate curriculum
- Use the RAMP risk management organizing principle.
- Use materials authored by volunteers as appropriate.
- Use the Moodle Learning Management System (LMS)
- Course must available to the community at no cost.



# **Step 1: Create a game plan!**





#### **Course Design Document Outline**

- 1. Course Context and Justification
- 2. Development Team
- 3. Project/Course Requirements
- 4. Learning Requirements (prerequisites & audience)
- 5. Course Description
- 6. Course Objectives
- 7. Student Performance Goals

- 8. Instructional Strategy
- 9. Assessment Strategy
- 10. Course Format
- 11. Course Evaluation
- 12. Development Tools
- 13. Development Process
- 14. Unit Learning Outcomes and Objectives



#### **Course Description**

This course is an intermediate level course on laboratory chemical safety that introduces the components and tools necessary to develop a strong culture of safety.

#### **Target Audience**

- Undergraduate students with a least two semesters of general chemistry with lab and one semester of organic chemistry with lab
- Faculty, graduate students, teaching assistants
- Staff (stockroom managers)
- Safety professionals



#### **Course Objectives**

- To describe the components and tools of a strong safety culture.
- To apply the principles of RAMP to laboratory operations
- To identify methods to minimize hazards and risks in the laboratory
- To outline processes needed to plan for emergencies





#### **Course Outline** (each unit can be completed in ~1 hour)

- . Introduction: From Rules to Risk
- II. OSHA & EPA Regulations for Laboratories
- III. Communicating hazards: GHS and the SDS
- IV. Communicating Hazards: NFPA
- V. Recognizing Hazards: Toxicity
- VI. Recognizing Hazards: Flammability
- VII. Recognizing Hazards: Corrosivity
- VIII. Recognizing Hazards: Reactivity
- IX. Recognizing Hazards: Physical and Biological Hazards
- X. Assessing Risk: Laboratory Operations
- XI. Assessing Risk: Hazard and Risk Assessments
- XII. Minimizing Risk: Chemical Storage
- XIII. Minimizing Risk: Hazardous waste
- XIV. Minimizing Risk: Elimination, Administrative, & Engineering Controls
- XV. Minimizing Risk: Personal Protective Equipment
- XVI. Preparing for and Responding to Emergencies
- XVII. Capstone RAMP Assessment



- Units must be taken sequentially
- Score >80% on each Unit quiz to progress to next unit.
- Score >80% on the Capstone Assessment
- Successful students will receive a Certificate of Completion from ACS
  - (Note: This is NOT an endorsement!)





# Instructional Strategy: Engage the Learner for Success



- Teach it. (Address various learning styles)
  - Text
  - Graphics
  - Videos
  - Audio voice over
  - Interactive learning exercises
  - Information pop-ups
  - Enrichment materials
- Remind them what they have learned (restate Learning Outcomes / Objectives)
- Assess that they have learned it.



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# **Learning Outcomes and Objectives**



	ACS On-Line Safety Course (Course Planning - Spring 2019)																			
CO1: CO2: CO3:	To apply the principles To identify methods to	of RAN minimi	ind tools of a strong safety of IP to laboratory operations ize hazards and risks in the la o plan for emergengies																	
						quen .O Le	ncing evel				quen O Lev			Blo	for	Enab	ling	Objeo	ssifica ctives	
Unit	Title	Course Objective ID	Unit Learning Goal	Student Learning Outcome By the end of this unit, you will be able to		Intermediate		Objective Number from Guidelines Booklet	Enabling Objectives At the end of this lesson students will be able to	Introductory		Advanced	Knowledge	sion	Application		E	Phenomena	ds to Phenomena	Organization Internalizes Values

# **Example: Unit 8 Learning Outcomes and Objectives**



ACS On-Line Safety Course																						
CO1: 1 CO2: 1 CO3: 1	To apply the principle To identify methods	es of F to mir	ts and tools of a strong AMP to laboratory open imize hazards and risks ad to plan for emergengi	safety culture. rations in the laboratory	_		_		• • • •													
					Sequencing					Sec	quen	cing		Blo			•	/ Classifications Objectives				
					SL	O Le	vel			E	O Lev	vel	(	Cogni	itive	Don	nain		Aff	ectiv	e Dor	nai
Unit	Title	Course Objective ID	Unit Learning Goal	Student Learning Outcome By the end of this unit, you will be able to		Intermediate		Objective Number from Guidelines Booklet	Enabling Objectives At the end of this lesson students will be able to	Introductory	Intermediate	Advanced	Knowledge	sion	Application			Evaluation		is to Phenomena		
8	Recognizing Chemical Hazards: Reactivity	CO2	To describe commonn reactivity hazards.	SLO 8.1 Describe common reactivity hazards.		x			EO8: 1.1.a. Tell the conditions which will classify a a chemical as reactive.	x			_	x					-			
									EO8: 1.1.b. State examples of reactive chemicals		х				х							
									EO8: 1.1.c. Identify the SDS section that contains stability-related information.		x				x							
				SLO 8.2. Describe the hazards associated with oxidizers, organic peroxides and active metals.		x			EO8: 2.1.a. Identify common oxidizers used in the laboratory using their chemical name or their structure.		x			x								
									EO8: 2.1.b. Describe how oxidizers facilitate a fire.		х			х								
									EO8: 2.1.c. Identify organic peroxide using their chemical name or their structure.		x					x						
									EO8: 2.1.d. Tell how organic peroxides may be formed.		x					x						
									EO8: 2.1.d. Give examples of active metals.			x				х						

# Instructional Strategy: Learning Outcomes and Objectives



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8/3/2021

UNIT 1 Learning Outcomes

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https://learning.acs.org/mod/hvp/view.php?id=3132

Dashboard > My courses > Free Online Course: Foundations of Chemical Safety and Risk Management© > UNIT 1: From Rules to Risk > UNIT 1 Learning Outcomes

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#### **UNIT 1 Learning Outcomes**

UNIT 1: From Rules to Risk

#### At the end of this unit, you will be able to:

- Describe the benefits of a strong culture of safety using specific examples;
- Describe the application of RAMP concepts in creating a riskbased culture of safety;
- Match the Globally Harmonized System (GHS) chemical hazard pictograms with the associated hazard category; and
- Describe hazards associated with laboratory operations.
- This unit introduces topics that will be expanded upon in later units.

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team by filling out this form.

Partial support for this course was provided by The Dow Chemical Company. ACS is also grateful to Dow for permission to integrate safety videos from the Dow Lab Safety Academy into this course.



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#### U1 1.0

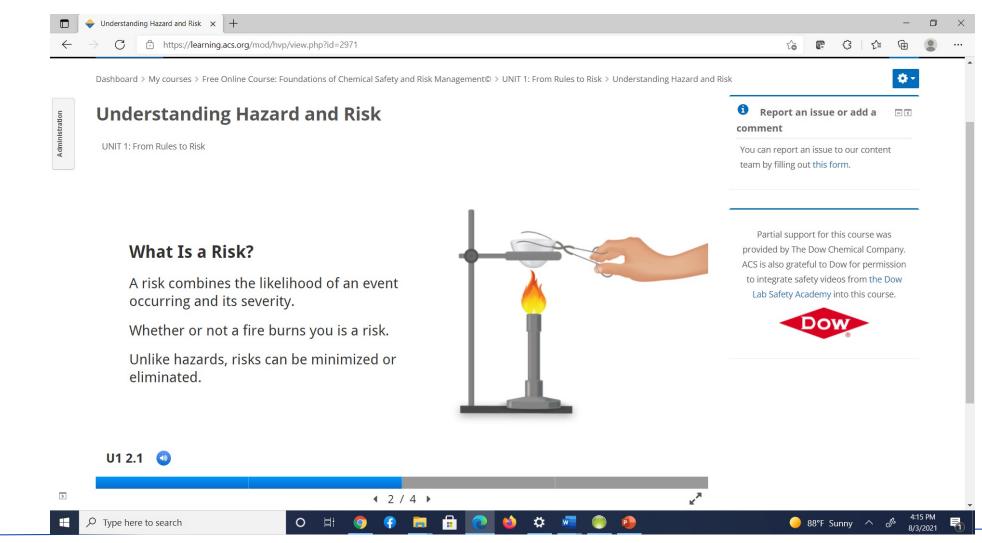
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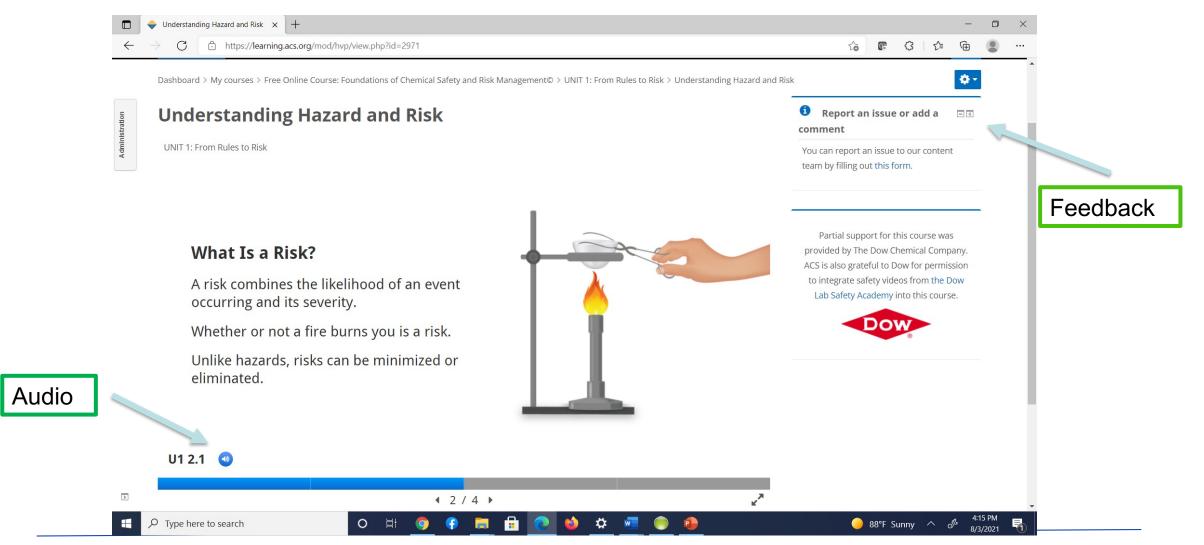
# Instructional Strategy: Text, Graphics, Audio, Comments





## Instructional Strategy: Text, Graphics, Audio, Feedback





### Assessment Strategy: Self-checks and quizzes





- Self-checks
  - Small blocks of material
  - Requires 100% score to proceed with the unit.
- Unit Quizzes
  - Directly tied to learning objectives.
  - Requires 80% score to proceed to next unit.
- Capstone Assessment
  - Directly tied to course learning objectives.
  - Requires 80% score.
  - Waiting period to retake the capstone assessment.

#### Assessment Strategy: Competency / Assessment Matrix



				Competency / As	sessr	nent	: Mat	trix													
				Tem	plate																
CO1.	To do	coribo	the co	mnononts and tools of a strong safety sulture	SLO 1																_
CO1.				mponents and tools of a strong safety culture. principles of RAMP to laboratory operations		SLO 2.															
		-		ntify methods to minimize hazards and risks in the laboratory			SLO 3.														
			CO4:	To outline processes needed to plan for emergengies				SLO 4.	_	_	_	_	_	_	_	_	_				
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										Jogni		Doma		A	ffecti	veD	omai	IN	<u> </u>	Μ	-
									(nowledge	Comprehension	\pplication	Analysis Svnthesis	Evaluation	Receiving Phenomena	oonds to Phenomena	/aluing	anization	Internalizes Values		Medium	
CO1	co2	соз	CO4	Unit XX Quiz Questions	SLO 1	SLO 2	SLO 3	SLO 4	Kno	Con	App	Svnt	Eval	Rece	Respon	Valu	Organiz	Inte	Low	Mec	High

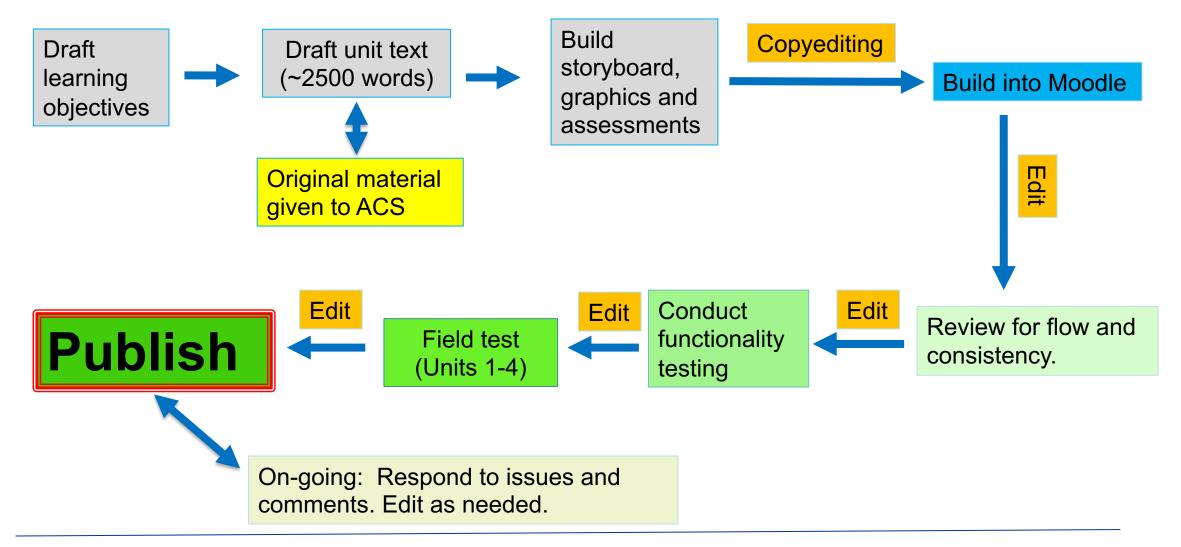
### Assessment Strategy: Example Competency / Assessment Matrix



CO1:	: <u>To de</u>	SLO1: 1. Describe benefits of a strong safety culture by using specific examples.																		
	CO2:	SLO1: 2. Describe the application of RAMP concepts in creating a risk-based culture																		
	CO3: To identify methods to minimize hazards and risks in the laboratory									•					ociated					
			CO4	To outline processes needed to plan for emergengies				SLO1:	1: 4 Describe hazards associated with laboratory operations											
										E	Bloom	Тахо	nom	-	uestio				iculty	
									(	Cogni	tive D	omai	n	Af	fective	Dom	nain	L	МН	
C01	CO2	CO3	CO4	Unit 1 Quiz Questions	SLO 1	SLO 2	SLO 3	SLO 4	Knowledge	Comprehension	Application Analvsis	Synthesis	Evaluation	Receiving Phenomena	Responds to Phenomena	vaiuling Organization	nternalizes Values	Low	Medium Hieh	
Х				1. Risk is a product of the likelihood of an event, its severity, and the frequency of exposure		Х			Х									х		
				2. Which of the following would be common in a risk-based safety culture? The procedures for conducting a																
Х				new experiment safely are developed by the entire lab group.	Х						Х							Х		
x				3. Which on the following would be common in a risk-based safety culture? <b>The chair of the Chemistry</b> <b>Department comes into the laboratory to observe your class. Upon entering the lab, she puts on a lab coat</b>	Y															
^	x		-	and safety glasses 4. The GHS symbol for an <b>oxidizer</b> is:	Х		х			v	^	-						v	<u>-</u>	
	x			5. The GHS symbol for a <b>flammable</b> is:			X			A V								$\hat{\mathbf{v}}$		
	x			6. The acronym RAMP stands for: Recognize Hazards, Assess Risk, Minimize Risk, Prepare for Emergencies		x	^		v	^								$\hat{\mathbf{v}}$		
х	x			7. Scanning the laboratory environment prior to starting work is one way to <b>Recognize Hazards</b>	х	×			^	Y								x		
^	^		-	8. Obtaining the smallest volume of concentrated sodium hydroxide needed for an experiment is an example of	^	^				~								^		
	x	x		Minimizing Risks				х			x								x	
			Х	9. In the case of an incident, the best first response to follow is: <b>Clear the area</b>		Х					Х								х	

# **Unit Development Process**





#### **Course Performance**

- Target: Sept 1, 2021
  - Registered users: 1000
  - Graduates: 100
  - Graduation rate: 10%
- As of 8/12/2021
  - Registered users: 1655
  - Graduates: 141
  - Graduation rate: 8.5%



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### **Instructor Resource Guide**





- Suggested weekly topic outline for a semester-long course
- Suggested pre-laboratory lecture outline
  - 20 minute and 1 hour periods
- Selected slides to emphasize important points
  - Discussion questions
  - Suggested activities



# Thank you!

#### **Course Access**

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

Questions

Email: safety@acs.org