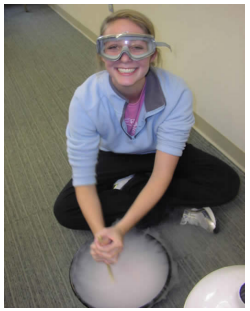


Developing an Education Path for all Chemists

A Proposal to Develop a Comprehensive Resource to Support Long-Term Goals for Chemical Health and Safety Instruction Across the Vertical Curriculum

257th National Meeting & Exposition
Boston, August 2018

David C. Finster
Department of Chemistry
Wittenberg University

ACS Committee on Chemical Safety
CHED Safety Committee
(disclaimer)

A Proposal: to develop a comprehensive resource to support Long-Term Goals for Chemical Health and Safety Instruction Across the Vertical Curriculum

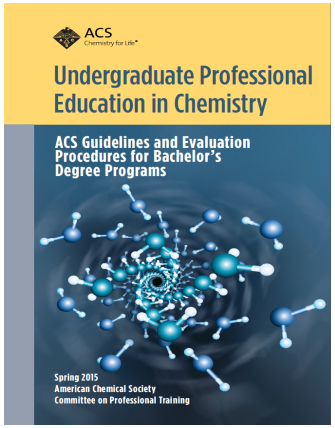
The Plan: Produce a document that includes…

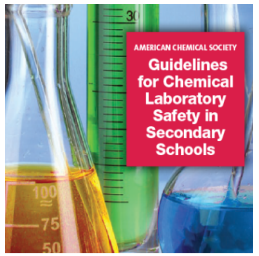
What to teach?	What are the Learning Goals?
How to teach?	Lots of examples; recognition of the learner as more than a receptacle of knowledge; understand assumption of learner's abilities, and educational context ("grade level")
Why?	To ("again") make a compelling case to various stakeholders.

"What to Teach" → Learning Goals

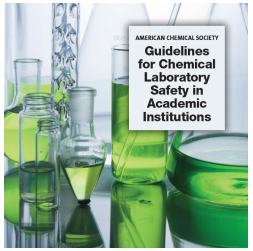
This is not new territory:

CPT general comments in Guidelines and Safety Supplement

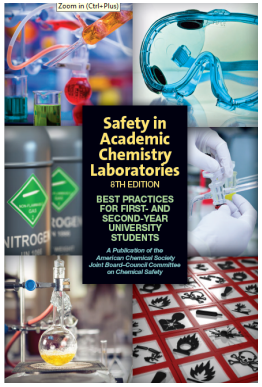




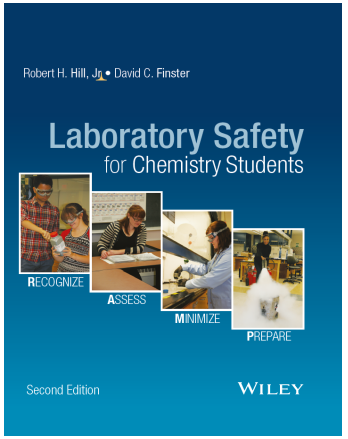
CCS "square booklets"



"rectangular" *Safety in Academic Chemistry Laboratories* (SACL-8)



And, if you want it all, in detail: *Laboratory Safety for Chemistry Students*



When and where to we teach all of this?

MS/HS → Undergraduates → Graduate students

A story…

“Backward Design”…

MS/HS → Undergraduates → Graduate students

Most of the systematic focus will be on MS/HS and BA/BS-level instruction

From a recent workshop at the *Biennial Conference on Chemical Education*: participants brainstormed learning goals for the BA/BS student:

-Read procedure and identify dangers and protocol
-Good attitude
-How to read SDS
-"think"
-Confidence to question another (i.e., point out when something isn't being done safely)
-Understand what spills can/can't be cleaned up (know when to get help)
-Disposal guidelines
-Know fire safety
-PPE selection
-Labeling
-Awareness of incompatible chemicals

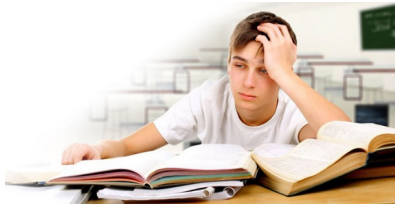
Not bad…

But, we should first ask a wide range of questions when designing a course (or a program):

What do I want student to know?
What do I want students to be able to do?

What *images* of this disciplines do I want students to adopt?
What *values* of this discipline do I want students to adopt?

What can I do in this course to make the chemistry relevant to them?



What will students learning about the "nature of knowledge" in this discipline?
What do "we know" in chemistry? How do we know it? How do we construct arguments in this field to defend what we believe to be true?

What is uncertain? How much uncertainty? About what are we "100%" certain?

How do we incrementally foster a safety culture and, for students, a safety ethic?

The Student Safety Ethic

I work safely,
avoid unnecessary risk, and
accept responsibility for safety

How to teach

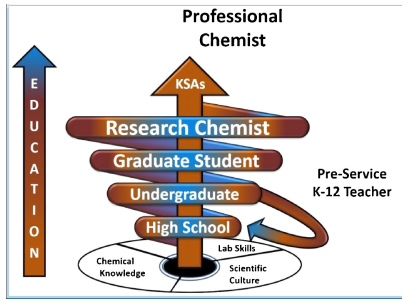
Many ways; institution- and department-dependent

Examples in JCE (past and future…)

Embedding safety instruction across the vertical curriculum

Sammye Sigmann: spiral approach

Fire service parallel: awareness
operations
technician



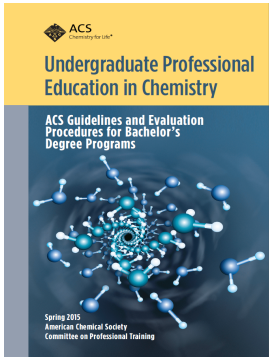
From the ACS CPT Supplement on *Laboratory Safety:* **Curricular Approaches**

Laboratory safety education and training is an ongoing process and therefore must be integrated into every laboratory course.

Three possible approaches are suggested:

1. A seminar course devoted entirely to laboratory safety;
2. Laboratory safety as part of a seminar devoted to chemistry as a profession; and,
3. Online materials where students would be required to do reading and then pass exams, the grades being recorded.

☹



7.3 Laboratory Safety Skills. Programs must instruct students in the aspects of modern chemical safety *appropriate to their educational level and scientific needs.*

Shall we *train* or *educate*?

Table 1.1.1.2 (LSCS-2) Comparing Safety Education and Safety Training

Safety training	Safety education
Focuses on skill-building, Preparing learners to do specific things	Focuses on mind-building; teaches principles, concepts with increasing complexity as knowledge builds
Targets behaviors	Targets thought processes
Emphasizes specific applications and short term learning	Emphasizes principles for long-term learning
Learning is step-by-step regarding what to do and how to do something; focusses on memorization	Learning is long-term and more in-depth, focuses on application of principles and concepts
Is insufficient to teach critical thinking	Teaches critical thinking and problem solving with safety
Does not explain "why" rules exist	Emphasizes the "why" reasoning behind safety with the application of principles and concepts
Used as evidence for employer documentation	Used to prepare students to handle laboratory and chemical safety and safety issues independently once they move into the employment arena

Critical thinking questions?

What is "safe"? Who decides? Is "safe" the same for everyone?
How do we measure "safety"? How do we measure toxicity?
Who is responsible?
How do we interpret SDS information?

"Committee on Professional Training → "*Committee on Professional Education*" ?

Why to teach CH&S?

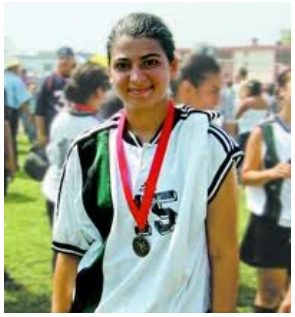
Convincing arguments to ourselves to the various constituencies
Faculty, students, deans, parents…

Why: *"It's the right thing to d*o."

And finally… a question:

How many students have died because…

… they could not properly calculate the number of theoretical plates in a chromatography column?
… they could not predict the results of a Diels-Alder reaction?
… they could not describe the splitting of the *d* orbitals in an octahedral field?
… they could not describe how the four DNA bases interact?
… they had an *inadequate education in chemical health and safety*?



Questions?

… and other answers to my questions?

Establish a *Task Force* from CCS, CHED, SOCED, CPT, AACT, … others?