
Virtual Lab Instruction



Sam Pazicni
Department of Chemistry
University of Wisconsin-Madison



Matt Mio
Department of Chemistry and Biochemistry
University of Detroit Mercy



24 July 2020



An Important Distinction

Early March 2020 = “**The Pivot**”

A quick move to remote instruction necessitated by the Covid-19 pandemic meant to last a few weeks

Fall Semester 2020 (beyond?) = “**Remote Instruction**”

A multi-month solution to a need for safety on higher ed campuses

Goals for this session concern **Remote Instruction**

Proposed Learning Outcomes

1. Familiarize newer faculty with their options regarding remote lab instruction.
2. Challenge the assumption that 100% of lab instruction must be face-to-face and in-person.
3. Leverage the specific learning outcomes you have for laboratory activities.
4. Call attention to ACS CPT role – Chair's statement.

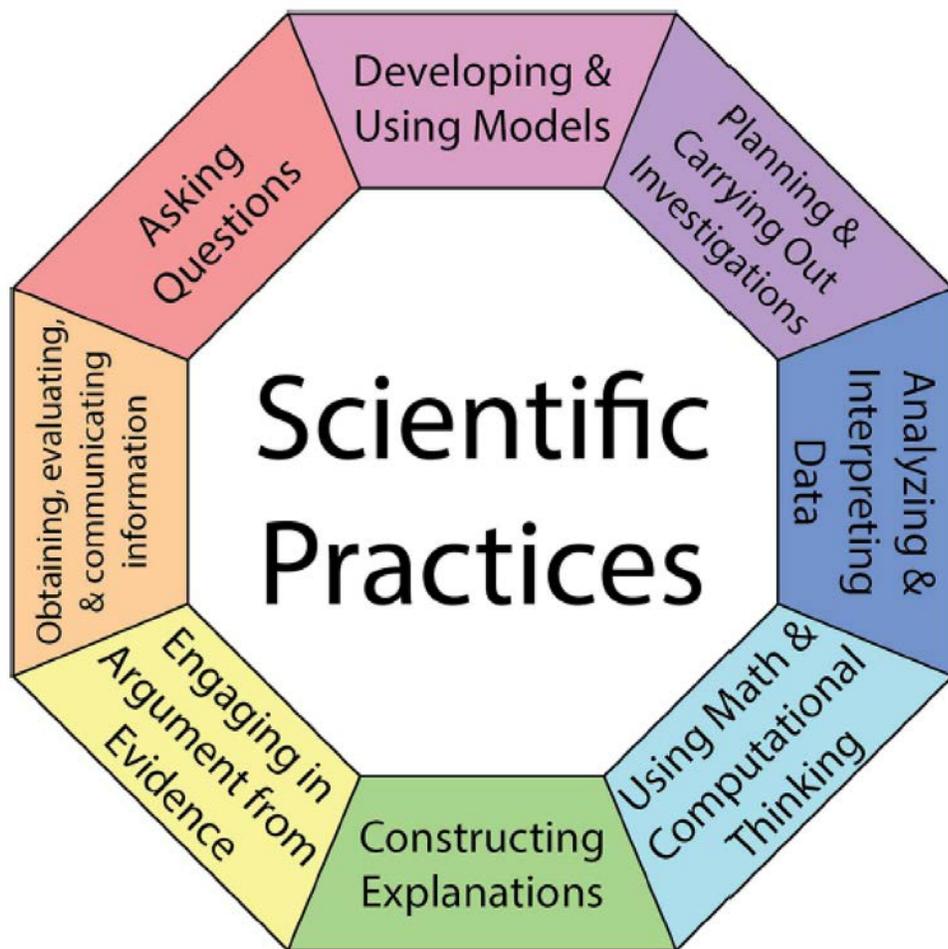
Current perspective shifts in Chemistry Ed.

Rely on Your Lab Learning Outcomes

- To write these, you need to think about what you want your students **to do with their knowledge.**
- “Getting in the lab” is not an outcome
- What is *rigor* to you? What are reasonable expectations, esp. in light of global pandemic?

Spend time thinking now, versus repairing later

Resources for Learning Objective Design



Chemistry-specific practices identified by the NRC report *Beyond the Molecular Frontier*:

- analysis
- modeling
- synthesis
- transformation

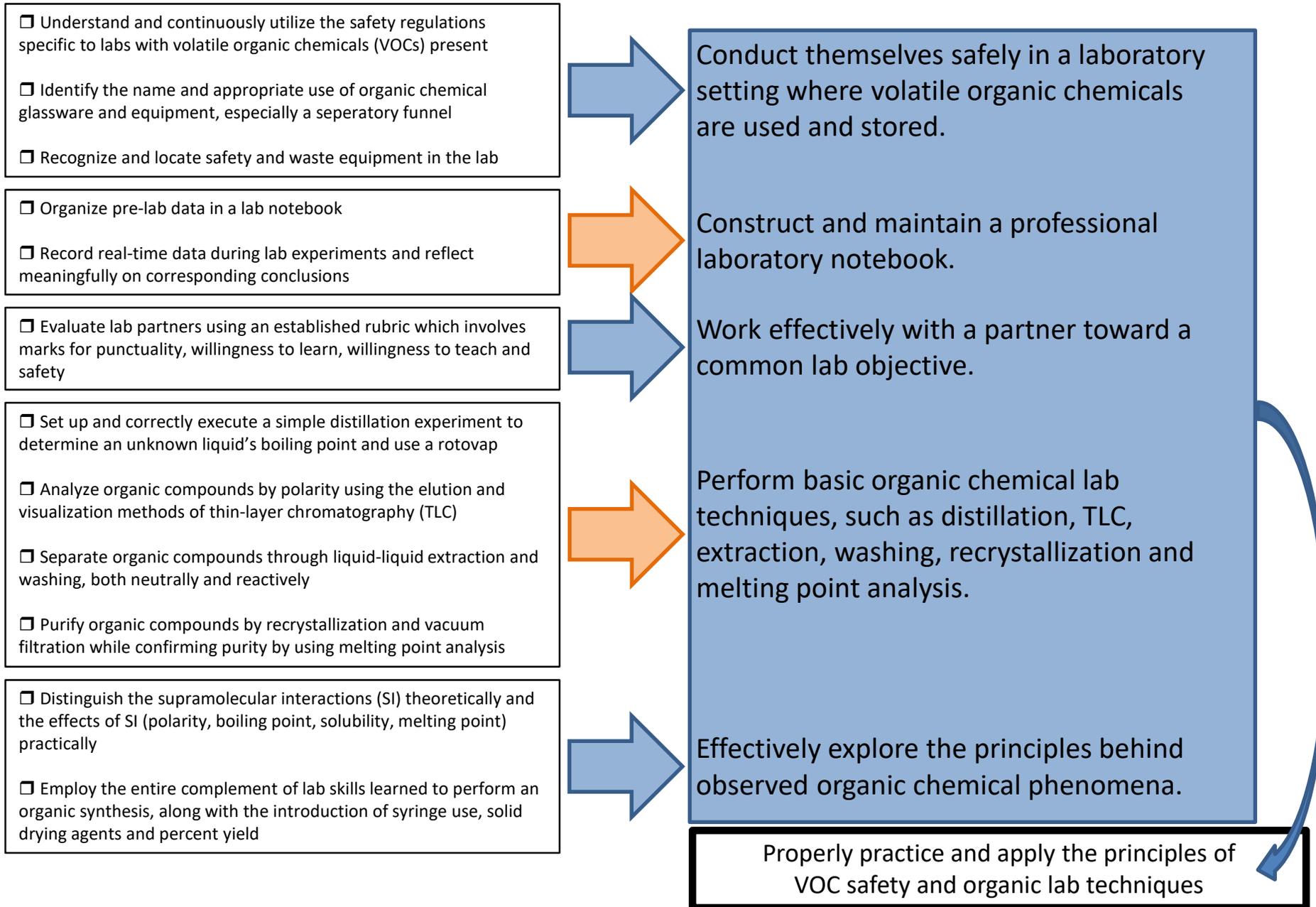
More Questions About Lab Course Outcomes

- What do you know about your population of students?
- Majors? (esp. w/r service vs. majors)
- What does your experience tell you that your students **REALLY** need to know?

Uncertain times call for abbreviated measures

CHM 2250 Outcomes Map Fall 2019

As students progress through the course, they will be able to...



Re-examinations of Laboratory Learning

“Chemists can no longer afford to believe that the importance of teaching laboratories is a truth we hold to be self-evident. As scientists we must support our research claims with evidence. Our claims about student learning require this same standard.”

S. L. Bretz

J. Chem. Educ. **2019**, *96*, 193-195.

Actively Re-examine Laboratory Learning

“I never said lab experiences were unimportant or not worth the cost. Instead chemical educators don’t have sufficient evidence to defend the importance of general chemistry labs when faced with tough questions about where to cut costs.”

S. L. Bretz

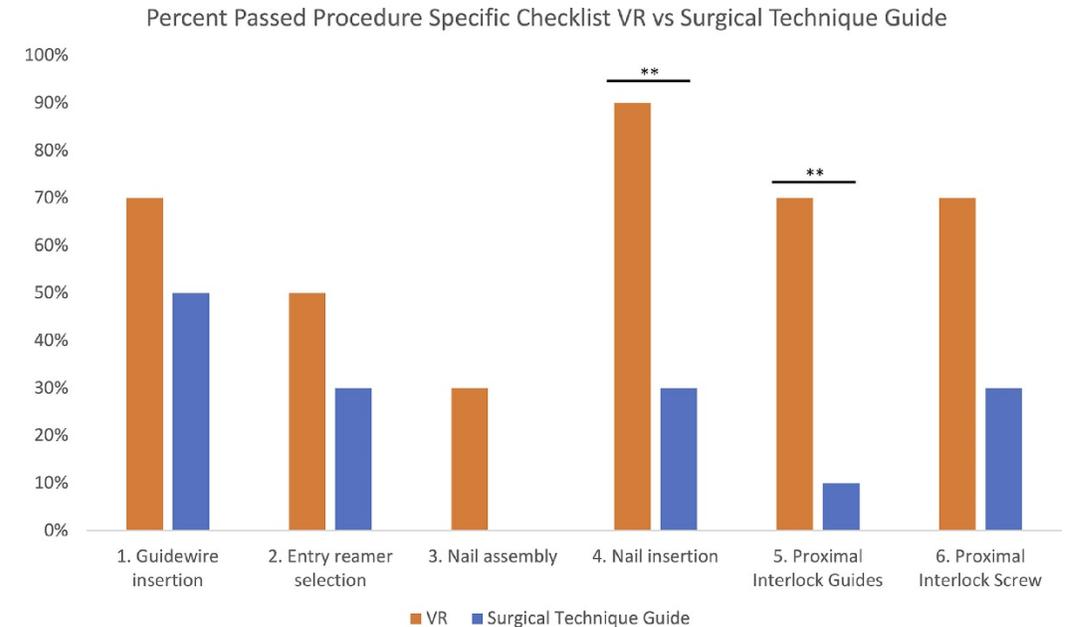
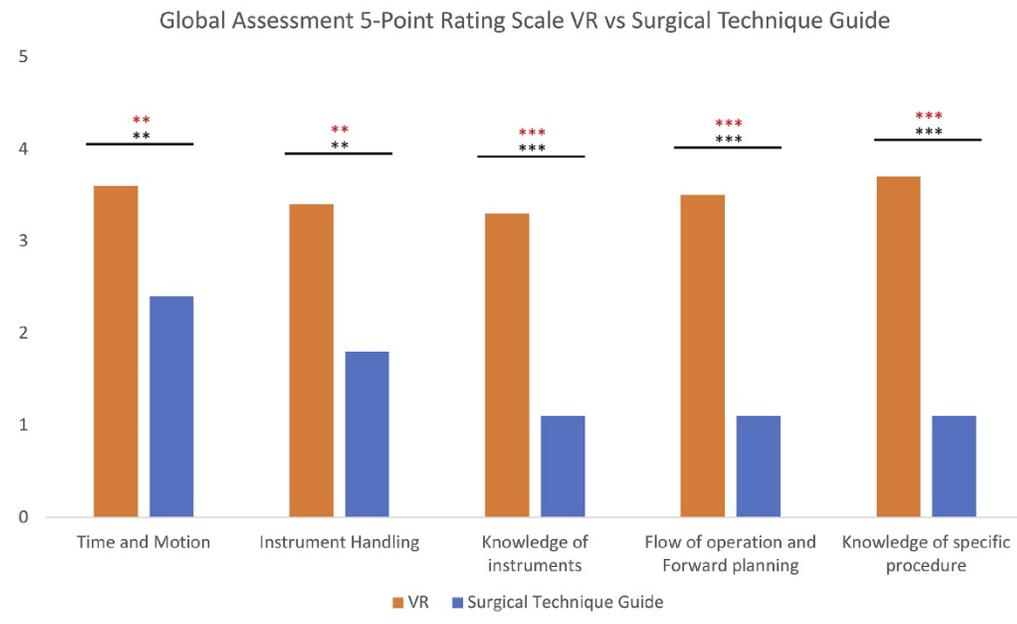
“ **E**very time we give students a scripted lab with a known outcome and then congratulate them on getting the exact same answer that people everywhere got, we’ve completely misrepresented science.

— *Joi P. Walker, chemistry professor, East Carolina University*

Chem. Eng. News. **2020**, 98 (18).

Do Students Need To Be *In The Lab*?

- Modern medical training
 - intramedullary nailing of a tibia



Do Students Need To Be *In The Lab*?

- Chemistry
 - IR Spectroscopy in Organic Chemistry I

Worksheet

1. What are the characteristic IR absorption bands for your unknown?
 - a. Alkane vs aromatic
 - b. Functional group
2. What are the correct units for IR absorption?
3. What does an IR spectrometer do?
4. What was the purpose of running a background IR?
5. What is the correct set of software commands required to collect an IR spectrum using the instrument available in the lab?

Measure	Traditional Lab Mean Score, N = 41	VR Lab Mean Score, N = 29	Cohen's <i>d</i>	Effect Size, <i>r</i>
Worksheet Question				
1	85.4 ± 33.6	69.0 ± 20.6		
2	18.3 ± 37.9	19.0 ± 18.1		
3	71.5 ± 34.3	72.4 ± 24.6		
4	58.2 ± 35.3	72.4 ± 24.6		
5	96.9 ± 27.4	74.1 ± 23.7		
Worksheet average	66.6 ± 17.9	61.4 ± 23.4	0.25	0.12
Quiz Question				
1	63.4 ± 31.3	58.6 ± 34.9		
2	14.6 ± 15.3	22.4 ± 20.7		
3	75.6 ± 39.9	79.3 ± 39.7		
4	51.2 ± 32.9	55.2 ± 30.5		
Quiz average	51.2 ± 23.9	54.0 ± 23.6	0.12	0.06

Delayed Quiz

1. What are the characteristic IR absorption bands for your unknown?
 - a. Alkane vs aromatic
 - b. Functional group
2. What are the correct units for IR absorption?
3. What does an IR spectrometer do?
4. What was the unknown compound assigned to you?

There is little reason to believe that learning *can't* occur outside of a lab environment.

Reality Check: Students May Not Be In Lab

Questions to ask yourself *yesterday*...

- What is replaceable? What is not?
- What about fundamentals, like safety?
- How can you use scientific principles to maintain continuity?

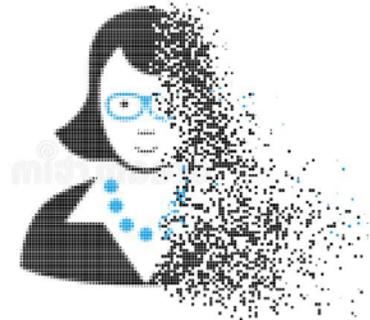
What makes a lab course unique?

What Is/Is Not Replaceable?

A continuum of lab course learning outcomes



Can best be taught
face-to-face



Can best be taught
remotely

dreamtime.com

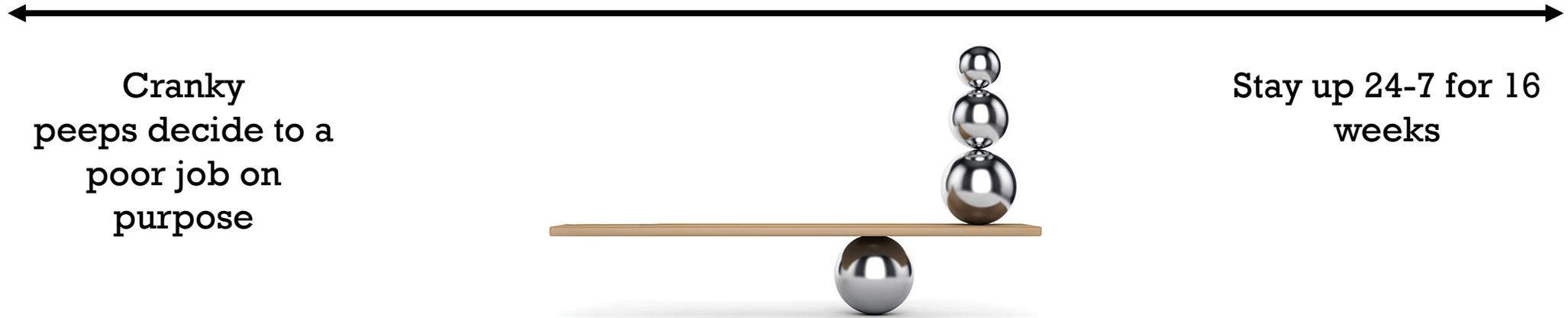
Results From Your Presurvey

Your Data

Results From Your Presurvey

Find the Happy Medium

Balance work input
to course
vs.
What's best for
students
vs.
pressure from
colleagues/admin



The Positive and Negative of the Continuum

The Online Lab Motif

- **Recall reality check: sometimes you have a say in this, sometimes you do not**
- **“Not the best” instruction will win over poor or no instruction at any time**

Opportunities for pedagogical innovation

Online Lab Motifs

- Immersive (virtual reality) vs. non-immersive (navigate a POV screen)
- Remote kits (kitchen chemistry), computer simulations (point and click, PhET simulations)
- How to scaffold engagement? i.e., watch video is not the best, so combine with reflection

Many choices – Time? Talent? Treasure?

Resources are constantly being developed!

American Chemical Society > ACS Webinars > Popular Chemistry > The Future of the Chemistry Laboratory Course

The Future of the Chemistry Laboratory Course

ACS Webinars | July 15, 2020

Establishing the Laboratory as the Place to Learn How to Do Chemistry

Michael K. Seery*

 Cite This: *J. Chem. Educ.* 2020, 97, 1511–1514

 Read Online

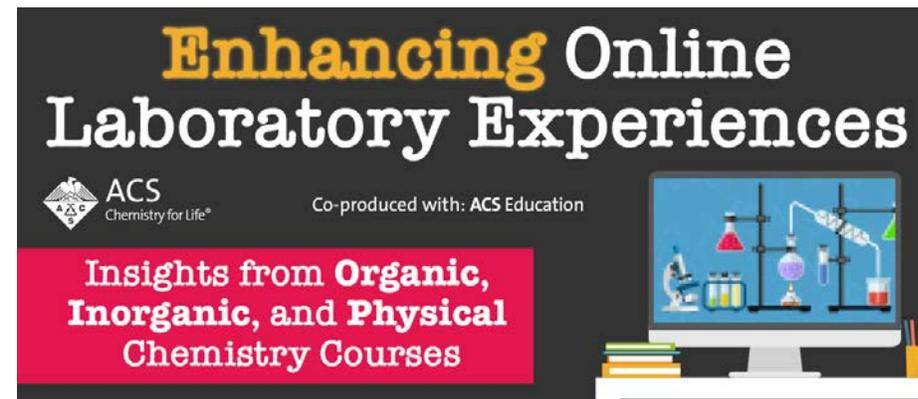
A Community Springs to Action to Enable Virtual Laboratory Instruction

Chip Nataro* and Adam R. Johnson

 Cite This: <https://dx.doi.org/10.1021/acs.jchemed.0c00526>

<https://www.youtube.com/watch?v=TyT0j3ytNjY&t=1s>

<https://www.beyondlabz.com/>



Issue 4, 2017



From the journal:
Chemistry Education Research and Practice

Reasserting the role of pre-laboratory activities in chemistry education: a proposed framework for their design

[Hendra Y. Agustian^a](#) and [Michael K. Seery^{ib} *^a](#)

<https://phet.colorado.edu/>

curated list of remote teaching resources by Stacey Bretz: <http://chemistry.miamioh.edu/bretzsl/>

News from ACS Committee on Professional Training

- **Chairs' meeting Weds. 29 July 3-5 pm EDT**
- **Inquire with your Chair as to whether they are going, possible proxy**
- **Statements regarding the winter/spring pivot and chemistry instruction moving forward at [acs.org](https://www.acs.org)**

<https://www.acs.org/content/acs/en/about/governance/committees/training.html>

“What are those other folks doing?”