Enhancing online laboratory experiences: Insights from organic, inorganic, and physical chemistry courses

ACS Webinar, July 22, 2020

Panel Resources

Visit these websites and read these articles for more information about the courses, approaches, and assessments presented during this ACS Webinar.

Maria Gallardo-Williams, Teaching Professor and Director, Organic Teaching Laboratories, North Carolina State University

North Carolina State University Virtual Reality Organic Chemistry Labs: go.ncsu.edu/vrlabs-orgchem

Dunnagan, C. L.; Dannenberg, D. A.; Cuales, M. P.; Earnest, A. D.; Gurnsey, R. M.; Gallardo-Williams, M. T. Production and evaluation of a realistic immersive virtual reality organic chemistry laboratory experience: Infrared spectroscopy. *J. Chem. Educ.* **2020**, *97(1)*, 258−262. DOI: 10.1021/acs.jchemed.9b00705

Dunnagan, C. L.; Gallardo-Williams, M. T. Overcoming Physical Separation During COVID-19 Using Virtual Reality in Organic Chemistry Laboratories, *Journal of Chemical Education,* **Article ASAP**. DOI: 10.1021/acs.jchemed.0c00548

Kyle Grice, Associate Professor of Inorganic Chemistry, DePaul University

July 7, 2020 Supporting Learning with Interactive Teaching: a Hosted Engaging Roundtable (SLiThEr): hosted by the Interactive Online Network of Inorganic Chemists (IONiC): https://www.ionicviper.org/

Nataro, C; Johnson, A. R. A community springs to action to enable virtual laboratory instruction, *Journal of Chemical Education,* **Article ASAP**. DOI: 10.1021/acs.jchemed.0c00526

Michael Seery, Professor of Chemistry Education, University of Edinburgh

Videos for lots of (phys chem) labs at: youtube.com/mkseery

Seery, M. K. Establishing the laboratory as the place to learn how to do chemistry. *Journal of Chemical Education*, **2020**, *97(6)*, 1511–1514. DOI: 10.1021/acs.jchemed.9b00764

Agustian, H. Y.; Seery, M. K. Reasserting the role of pre-laboratory activities in chemistry education: a proposed framework for their design. *Chemistry Education Research and Practice*, **2017**, *18(4)*, 518-532. DIO: 10.1039/C7RP00140A

Seery, M. K.; Jones, A. B.; Kew, W.; Mein, T. Unfinished recipes: Structuring upper-division laboratory work to scaffold experimental design skills. *Journal of Chemical Education*, **2018**, *96(1)*, 53-59. DOI: 10.1021/acs.jchemed.8b00511

Attendee Tips and Resources

Read these comments and visit these websites for more tips and resources shared by the attendees during this ACS Webinar.

Related discussions

- July 9 CHAS Chat: Options for "Laboratory" Learning

General collections/repositories

- For the repository question, I would recommend checking out the Facebook group, "Strategies for teaching chemistry online". There is lots of helpful info there!
- Here is a link to a google sheet [Online Resources for Science Laboratories from POD] where you can freely share resources.
- Merlot is another rich site.
- The National Science Digital Library is one more.
- The OpenScience Laboratory
- Resource list from the June 30 ACS Webinar Teaching remotely together: Lessons learned

See also analytical chemistry resources, inorganic chemistry resources, organic chemistry resources, and physical chemistry resources (below)

Technology tips

Data storage and processing

- osf.io can be a great place to share data if your LMS is limited.
- I use YouTube instead of the LMS for videos because of limits. Also, YouTube automatically captions videos. On YouTube I set as "unlisted".
- We have had students download TopSpin for data processing. Lot's of trouble shooting computer issues, so I wouldn't do it with a large group of students!

Molecular visualization and modeling

- Wavefunction was very generous with complimentary licenses when our spring semester was interrupted. We use Spartan on campus with our lab instruction.

Use of library resources

- My colleagues were impressed by the extent of JoVE materials
- Training in SciFinder and search
- Training in Endnote and citation

Use of remote instrumentation

- We are looking at remote instrumentation at the Open University The OpenSTEM Labs
- Athabasca University does remote online instrument access. A lab tech onsite sets up the instrument. Students then set up and run online. Download data afterward.

*These resources are provided for informational use only. Inclusion on this list does **not** constitute an endorsement by ACS.*

Analytical chemistry resources

- Analytical Sciences Digital Library remote labs and simulations
- Canadian Society of Chemistry (CSC) repository of online analytical resources
- A curated list of analytical videos that are included in the 10th edition of Harris and Lucy's *Quantitative Chemical Analysis*
- Sharing Ideas on Virtual Labs
- CHIMACTIV has some nice analytical online resources
- Agilent Teaching Tools
- CHROMacademy is good for analytical materials. Also comes with an assessment which you can ask students to complete.
- The Royal Society of Chemistry has very nice presentations too, but was more expensive than CHROMacademy.
- Pine Research Knowledgebase
- Cyclic voltammetry simulation
- Look for an overview of free chromatography and electrophoresis simulators which will appear in the August issue of *LCGC North America*.

Inorganic chemistry resources

- Virtual Inorganic Pedagogical Electronic Resource (VIPEr)
- Mercury – crystal structure visualization and analysis

Organic chemistry resources

- OrganicERs is a resource for organic chemistry. We have a resource page and a Facebook group.
- MIT also has a very good page on lab techniques with videos.
- Chemistry Class Advantage lessons are free from CAS for organic chemistry - could be used for both lectures and labs; students will use Scifinder searches via these lessons.

Physical chemistry resources

- Pchem Inspired Pedagogical Electronic Resource (PIPER)