**Labs in an Online Environment Small Group Discussion**

In each of the three discussions (April 1, 3, and 8), there were some ideals that emerged that faculty were trying along with some advantages and concerns for them. Some of the ideas include:

1) For experiments that can be performed without specialized equipment, have students do them at home and write a report about their findings (a physics instructor did this the Archimedes principle and some work with planes). Some also asked to students to submit a video of them performing the experiments.

Advantages: students get some hands on experience; works well for non-majors classes. Concerns: difficult to guide students through an experiment, difficult to observe and coach technique and to determine when something does not work

2) Have students do simulations (which might require a slight modification of experimental procedures) and write lab reports based on them.

 Advantages: Many thought this approach does well for teaching laboratory concepts

Challenges: does not address skills attainment; may not prepare students with the lab skills for subsequent courses in a sequence.

3) Have students view videos of lab techniques and procedures and provide data for the students to process and report on. One variation on this was to incorporate some mistakes and have students identify and offer corrections.

Advantages: May be able to find or make videos of the experiments currently in the syllabus; content (and support of lecture content) will remain consistent

Challenges: Finding desired videos may be difficult, many instructors are unable to have access to the labs or necessary equipment to make their own videos

4) Have students search for labs or simulations online and report back to the class including links as appropriate. One variation of this included having students perform several of researched simulations and do lab reports on them.

Advantages: Besides leveraging the instructors time and resources, teaches students research and evaluation skills; allows students to perform simulations or view videos and write reports and discuss with the rest of class; class gets exposure to a larger variety of experiences

Challenges: May not work well for introductory level classes; experiments chosen may not fully cover essential lab topics

5) Have students perform a research projects and prepare a report. One variation of this was to have the students make presentations in Canvas

Advantages: can work well for intro level and more advanced courses; Online presentation allowed for a more deliberate and more inclusive discussion via chat

Challenges: may not be appropriate for all course; students may not have enough skill yet to do appropriate level research topic; may not adequately address lab topics

In addition, some preferred to do lab synchronously with all students meeting at regular lab time, while some preferred asynchronous approach with deadlines to have the experiment completed. For synchronous experiments, some preferred having the students in Zoom breakout rooms where the instructor could drop in on the students.

**Some of the challenges centered mostly around skills attainment and transfer.**

1) When students typically work together in groups, part of the skill is how to accomplish that. How can that be replicated? (the synchronous breakout room idea above might help)

2) What happens when students need to attain skills for use in a more advanced course? Some suggestions include offering a noncredit course on lab skills prior to the more advanced course or dedicating the first week or so to lab skills in the subsequent course.

3) If we’ve changed our lab courses to accommodate remote learning, will they still be accepted for transfer? The CSUs and UCs are not being sticklers on this. The assumption is that we continue to meet the content of our CORs regardless of the methodology used.

Use of Available Online Resources

Groups discussed a number of online resources available including challenges and benefits of using them.

General Concerns:

1. One of the primary concerns was about troubleshooting the use of apps and simulations. Since students have limited technology available and the technology varies greatly by student, often some (or many) students can’t get the technology to work right away and the instructor may need to troubleshoot many devices often for each type of simulation used.

One Approach: to have students create a virtual help archive by having them trouble shoot using online resources and report back.

1. Some students only access to technology is their cell phone. Doing are considerably more challenging and time consuming if this is the case.

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Labster—Although readily available to colleges, biologist were especially frustrated with the limited rigor and approach.

One Approach: stitch together material from various labs to create what the instructor thought was a more appropriate lab curriculum

McGraw-Hill Virtual Labs—Although reported that this is good for both majors and non-majors courses, it is only available free if you are using their textbooks

PHET—Established simulation resource at phet.colorado.edu is available free and well received by physics and some chemistry faculty

A list of other resources faculty have tried include:

JOVE Education resources

<https://www.holscience.com/> (virtual labs)

<http://web.mst.edu/~gbert/Electro/Electrochem.html> for electrochem

<https://simbucket.com/chemthinkserver/chemthink/index.html?as>

<https://ccconlineed.instructure.com/courses/4543/pages/introduction-to-oer-for-biology>

<https://serc.carleton.edu/highered/index.html> for earth science (biology)

<https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs/activities/simulations.html>

<http://www.physics-chemistry-interactive-flash-animation.com/chemistry_interactive.htm>

<http://www.chemcollective.org/>

<https://www.edumedia-sciences.com/en/node/86-chemistry>

<http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/main.htm?utm_medium=redirect&utm_campaign=redirects-https&utm_source=/tm-ps/chem/100/dgodambe/thedisk/equil/equil.htm>

Also expressed were some concerns about assessment of learning in the laboratory. How could a lab practical be performed?

And some offer some resources for virtual spaces (where students and instructors can share the same board seamlessly, for example)

https://awwapp.com/

<https://www.adobe.com/products/adobeconnect.html>

Also there was concern expressed about what would happen in subsequent semesters such as summer and fall. How should we be prepared for that?