How to Quickly (and Safely) Move a Lab Course Online

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In the difficult weeks ahead, your goal will be to deliver clear instructions to your students and create labs they can perform without a teacher present, while reducing technical glitches. We already have ways to teach a lab online,

but if you've never used them before, they may seem intimidating — especially at a time when everyone is feeling stressed by our global health crisis.

What follows is a quick primer on how to shift a lab course online. First, a look at the three kinds of labs you can offer via technology:

Instructor-created labs. You may be able to modify a previously planned lab so that students can perform it at home. Or, due to limited resources, the better option might be creating a new lab from scratch. So first consider the resources available to your students now, and what they may be able to purchase. Citizen science on iNaturalist and Zooniverse have great projects that allow students to gather and sort data, and can be transformed into labs as well.

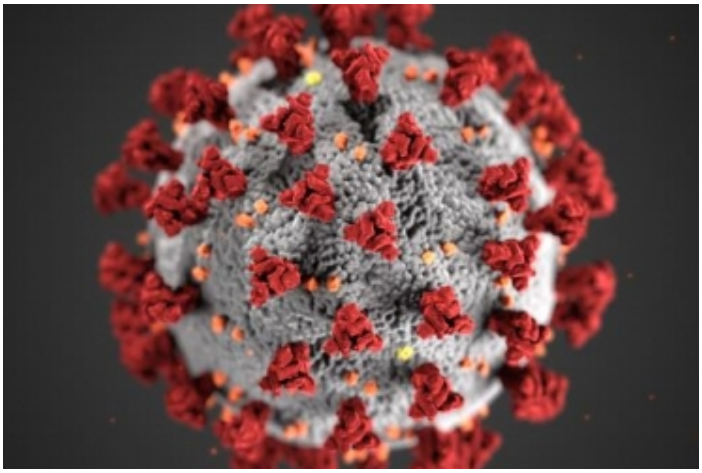
Keep in mind: Students do not always purchase the required lab materials in a timely manner. In addition, they may not have access to some materials if their local stores sell out of supplies. Focus on supplies in the home if you can.

- **Pros:** Teacher-created labs may allow you to better meet your learning objectives for the course. Likewise, you can control the instructions for the lab and post them in your institution's learning-management system.
- **Cons:** Problems may include students not purchasing the lab materials or not having access to them. If the lab is not easy to perform in the home, you may face a lot of time revising it to meet learning objectives. Lab creation takes time.

Lab kits. Companies, such as Hands-On Labs and eScience Labs, provide assembled kits and host predesigned labs on their own online platforms. Both companies report being able to have the online platform ready for students within 48 hours, with the kits arriving shortly afterward. Other companies, like Carolina, allow you to assemble a kit for a lab you've designed and then have students purchase the kit. If you have a lab that could be performed at home

and students just need supplies, this is a great option.

- **Pros:** In-home labs are a good learning experience. Require students to take a picture of their results — with a notecard in the shot that has their name and date on it — to help verify that they performed the lab.
- **Cons:** The kits can be expensive. Glitches can occur with obtaining access to the lab instructions. Ideally, you can post those instructions in the campus learning-management system. I've found lab companies to be very responsive in helping students obtain access as well. Issues may occur with students not purchasing the kit. If possible, have your institution order the kits and send them to students. This is a good option when lab fees have already been collected. Otherwise, post information about ordering the kit as early as possible so students have plenty of time to receive it before they need it.



Virtual labs and simulations. There are different ways to do virtual labs. Some open-access resources can support all the needs of introductory lab courses. For an upper-level lab class, you usually need a more detailed exploration of the content, which can come with a cost. I recommend PhET simulations and the simulations found on the Howard Hughes Medical Institute's BioInteractive website as free resources for an intro lab class.

Labster has detailed simulations that walk students through experiments as if

they were in a laboratory or doing field work. They work well for lower- or upper-level courses. The company reps report they are able to have labs for a class up and running in 24 to 48 hours. Visible Body is a good resource to support, or replace, in-home dissections. Visible Body reps report being able to have you up and running in about an hour. Both of these simulations come with a cost, but lab fees that students have already paid could possibly be applied here.

- **Pros:** Online simulations can let students explore concepts and test their predictions without purchasing anything beyond access to the website, if needed. All the resources discussed here include some form of assignments you may be able to use.
- **Cons:** Online resources may go down. Links break, and organizations may reduce support for their online material preventing access in the coming weeks, when you thought everything was set. Have all the information to perform the lab in your learning-management system, if possible. Be careful about Java simulations in PhET. Not every student may be able to run them. Stick to HTML5 simulations that have wider support in modern web browsers. Students may have lots of questions about accessing a particular lab platform, but once they do have access, these simulations provide a robust alternative to in-person labs.

OK, so you know the options. How do you get started in moving your lab class online?

Start easy. Assume students will not have access to resources that are uncommon around the house. Modify a previously planned lab if possible. If not, go for an open-access simulation and use, or modify, one of the online assignments associated with the simulation. That allows you to post all the lab instructions in your learning-management system, reducing access problems for students. Entire introductory lab classes can be created with open-access

simulations.

Once you've organized that first lab, you will have a little time before students need to perform the next one. If you next want to offer a more-detailed lab, this is when you take some time to explore the options for kits and more-advanced simulations. I recommend the simulations because students can become confused while performing in-home labs when no one is there to answer questions. They may cut open a sheep heart (yes, there are lab kits in which students receive a sheep heart in the mail) at the wrong location or miss a critical step in an experiment — leading to frustration, confusion, and low grades on the lab.

Try to connect the labs to your course objectives. No doubt you wrote learning objectives based on the idea that the labs would be performed in class. Now the abrupt shift to online learning means the objectives and the labs need to be modified. It may be hard to tie the labs you can create — or have access to online — directly to course objectives designed for in-person labs. Do your best to modify them for remote instruction. For example, if a previous learning objective had students using a microscope to identify structures in a cell, if the focus is on structure identification and not microscope use, the learning objective can be modified to use images found online or in a simulation.

Preach lab safety at home. You are not going to be asking students to do anything too dangerous at home. Still, establishing safety precautions for at-home labs is very important. Just like in the laboratory, students need to follow safety protocols at home, whether they are using materials they assembled on their own or lab kits that arrived in the mail. Include online safety videos to prepare students before they do that first lab. Make sure to discuss complications at home that need to be considered before performing the lab, such as kids and pets. Include an assignment or discussion about specific steps students will take to be safe. All of those steps are already common in today's online lab courses.

Be available online. Make sure you are close to the computer to support your students when they are starting new kinds of labs. There will be a lot of questions, and it can be frustrating and overwhelming under time constraints for both you and the students. Take a break when you need it and be flexible with due dates. Do not try to mix several different platforms to create your online laboratory experience. It will cause confusion and frustration for you and the students.

Make your lab instructions as simple and clear as possible. You will not be

standing next to students to answer their questions while performing labs. Consider creating a discussion board for students to post questions for you to answer. And students may be able to answer one another's questions, too. Be lenient on grading if you find that your instructions were not well understood.

If you do any amount of web searching, you will find a great many resources available for online science classes and labs. Some of those resources require more work and some less. I've highlighted here the ones I've had the best experience with in my own teaching. I wish you both luck and patience as you find the lab option that works best for you and your course.

Heather R. Taft is lead faculty member for the natural and physical science at Colorado State University Global. The companies mentioned in the article are ones she has worked with only to create online courses. She has no personal associations with the companies.

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