

# Considerations for teaching labs online

## WHAT IS THIS RESOURCE?

This resource provides options for faculty who may need to teach their labs online because teaching assistant support is not available to them. It includes pedagogical considerations, links to databases of STEM content, and links to simulation and video resources.

## HOW DO I USE IT?

Review the list of considerations and explore the resources to find materials that align as closely as possible with your course objectives and student needs. [CET](https://cet.usc.edu/contact-us/) is available to discuss pedagogical options in using online lab resources.

### Steps for incorporating online lab content into your course

1. Review the platform you will be using to teach online and explore the tools available for interaction and discussion. Even in large online class environments with no teaching assistants, you can [increase online student engagement using Zoom chat](https://cet.usc.edu/teaching-resources/using-zoom-chat-to-increase-learner-engagement/) and create meaningful [online STEM assessments](https://cet.usc.edu/teaching-resources/online-stem-assessments/).  For more ideas, take a look at CET’s resources on [practical online teaching methods](https://cet.usc.edu/teaching-resources/practical-online-teaching-methods/).
2. Contact your [school or department IT office](https://itservices.usc.edu/contact/school-list/) to identify what educational technology resources are available in your department. For example, you may wish to incorporate online polling to replace quiz questions in labs.
3. Consider your existing learning objectives for the course. Identify the specific skills students are expected to learn from lab activities. Select online learning experiences that address those specific lab-based objectives. These might include:
	* Specific laboratory or fieldwork techniques,
	* Specific STEM content or phenomena,
	* Interpreting, visualizing, or presenting data,
	* Experimental protocol or project design.
4. Identify alternative activities that would provide students with reasonably comparable learning outcomes as your typical laboratory activities, but don’t require additional assistance to implement. Types of activities that could be done online include:
	* Recorded or live experiments or demonstrations,
	* Virtual labs and simulations,
	* Data analysis–individually or in groups,
	* Case studies,
	* Journal club.
5. If possible, collaborate with colleagues to share tools or resources, or co-produce original content that aligns with your curriculum. **See the next sections for a list of resources and strategies.**
6. Revisit your syllabus and course policies, and consider whether they are feasible without a teaching assistant and whether they align with your expectations for students’ engagement with online labs.
7. Consider whether your chosen activities are accessible for all students, including those who require specific accommodations. For questions about accessibility, please contact the [Office of Student Accessibility Services](https://osas.usc.edu/).
8. Identify ways to regularly check in with students that would not require teaching assistants, such as:
	* low-stakes quizzes that can be graded automatically in the LMS to check for understanding and encourage engagement,
	* implementing 1 or 2 multiple choice surveys to gather feedback from students on how activities worked for them,
	* adding an open discussion board where students can post and answer each other’s questions, and you can check and correct for accuracy.

### Online STEM lab content resources

A wide variety of high-quality lab content that can be implemented without a TA is already available to USC instructors:

* All USC faculty using a USC-supported LMS have access to [Labster virtual labs](https://keepteaching.usc.edu/faculty/full-toolkit/virtual-labs/labster-beyond-labz/). The resources listed in this section are free or accessible to USC community members via the USC Libraries with your university credentials.
* For discipline-specific support, [reach out to your school’s library](https://libraries.usc.edu/subject-librarians). For fee-based or subscription services, please consult with your department or school for access.
* Reach out to the [Office Student Accessibility Services](https://osas.usc.edu/) if you have concerns about accessibility or accommodations regarding online labs.

#### Simulations and virtual labs with associated assessment support materials

* [Labster virtual labs](https://keepteaching.usc.edu/faculty/full-toolkit/virtual-labs/labster-beyond-labz/) immersive online simulations. The [Labster Implementation](https://www.labster.com/implementation) page reviews strategies for mapping to your curriculum, LMS integration, and other teaching support resources.
* [Phet](https://phet.colorado.edu/) interactive simulations for science and math. Review the [PhET Teaching](https://phet.colorado.edu/en/teaching-resources/tipsForUsingPhet) page for tips on incorporating simulations into different course activities or use with in-class assessments such as polling or clickers. Teaching materials such as practice questions can be found on the individual simulation pages.
* [MyPhysics Simulations](https://www.myphysicslab.com/): An open-source collection of interactive simulations of physical phenomena, which can also be customized and shared offline. The homepage includes step-by-step instructions for adapting individual simulations to your content or assignments. Conceptual questions and practice problems can be found on each individual simulation’s page.
* [ChemCollective](https://chemcollective.org/home): a collection of virtual labs, scenario-based learning activities, tutorials, and concept tests.
* [MATLAB](https://matlab.mathworks.com/) (paid by USC): A computing environment for engineers and scientists to analyze data, develop algorithms or create models and applications. MATLAB Academy includes collections of topic-specific modules to support practice and assessment of skills.

#### Multimedia content and visualizations with associated assessment support materials

* [The Journal of Visualized Experiments (JoVE) and JoVE Education](https://libproxy.usc.edu/login?url=https://www.jove.com/) (USC Libraries link): A video database dedicated to teaching laboratory fundamentals through simple, easy-to-understand video demonstrations. The website includes curated lists of [videos mapped to specific STEM course curricula](https://app-jove-com.libproxy1.usc.edu/syllabus-mapping) (under the “Education” menu), and [additional teaching resources](https://info-jove-com.libproxy1.usc.edu/highschools/teacher_resources) to support textbook alignment and integrating content into your LMS. Free individualized syllabus mapping services are also available by emailing JoVE customer support.
* [AccessMedicine](https://libproxy.usc.edu/login?url=https://accessmedicine.mhmedical.com) from McGraw Hill (USC Libraries link): A collection of anatomy videos, animations, modules, and health science-related case studies. Includes [pre-written multiple choice questions](https://accessmedicine-mhmedical-com.libproxy1.usc.edu/qa.aspx?groupid=962) for both basic sciences and clinical topics (under “Study Tools”) and prepared PowerPoint slides under the “[Instructor Tools](https://accessmedicine-mhmedical-com.libproxy1.usc.edu/instructorresource.aspx)” menu (must create a free account to access).
* [Springer Nature Experiments](https://libproxy.usc.edu/login?url=https://experiments.springernature.com/) (USC Libraries link): Step-by-step presentation of protocols for cell and molecular biology, genetics, bioinformatics, protein science, and imaging. Consider the collection of [Methods Primers](https://experiments-springernature-com.libproxy1.usc.edu/search?term=&sortType=recent&sourceFacet=Nature%2520Research%253ANature%2520Reviews%2520Methods%2520Primers&startDate=1980-01-01&endDate=2024-12-31&isNewSearch=false) for course activities involving protocol development or evaluation.
* [University of Toronto Open Modules](https://ocw.utoronto.ca/open-resources/): These sets of self-contained learning modules may be used in online, blended, or flipped classes, or may be used as part of the curriculum for a fully online course. Modules include a variety of prepared teaching and assessment materials, such as aligned learning objectives, pre- or post-tests, and practice questions.

#### Crowd-sourced online STEM content, simulations, and labs

* [OpenEd: University of Guelph Virtual Labs](https://opened.uoguelph.ca/instructor-resources/resources/Virtual-Labs.pdf).
* Colorado School of Mines Arthur Lakes Library [Simulations and Virtual Labs](https://libguides.mines.edu/oer/simulationslabs).
* The University of Vermont Center for Teaching and Learning and Writing in the Disciplines Program [compendium of resources for teaching in the disciplines, with compassion & focus amid disruption](https://docs.google.com/document/d/e/2PACX-1vSqLa-IT0POxmhYlZdWaQSIl27CaJ7f3JW5QCV1IiUT8Vuai6cbGNlKCA5Z_dPZeyddnUAxmMl-rODK/pub#h.6226p2d8cpda).
* The POD Network’s [Online Resources for STEM Labs](https://docs.google.com/spreadsheets/d/18iVSIeOqKjj58xcR8dYJS5rYvzZ4X1UGLWhl3brRzCM/htmlview#gid=0).
* [LabXchange](https://www.labxchange.org/): A curated collection of STEM content in a variety of formats collected by Harvard University with support from the Amgen Foundation.

### Pedagogical considerations for online lab activities

Provide students with explicit instructions about how to engage while watching the demonstration or performing an experiment online, such as:

* Taking notes on observations.
* Recording or engaging with sample data during a presentation or simulation to practice analysis skills.
* Asking students to complete an online quiz afterward. Consider allowing multiple attempts so that students can re-try a part of the simulation and then submit a new response after clarifying their understanding. Consult ITS for automatic quiz grading options in the LMS.

Build in places to pause so that students can share predictions about the outcome of a demonstration or experiment.

* If synchronous, consider asking students to share predictions in Zoom chat while the demonstration video is paused.
* If asynchronous, insert an explicit pause point in the video where students should stop and make a prediction, and then share it on a discussion forum for your course, or record in a document to submit as classwork.

### References

Gamage, K. A. A., Wijesuriya, D. I., Ekanayake, S. Y., Rennie, A. E. W., Lambert, C. G., & Gunawardhana, N. (2020). [Online delivery of teaching and laboratory practices: Continuity of university programmes during COVID-19 pandemic](https://uosc.primo.exlibrisgroup.com/permalink/01USC_INST/273cgt/cdi_doaj_primary_oai_doaj_org_article_eceed612af66461c81a4681b84a86978). *Education Sciences*, 10(10), 1–9.

Lashley, M., & McCleery, R. (2020). [Intensive Laboratory experiences to safely retain experiential learning in the transition to online learning](https://uosc.primo.exlibrisgroup.com/permalink/01USC_INST/273cgt/cdi_doaj_primary_oai_doaj_org_article_4a646bcc3cd545fcbe6eeca81dfb1427). *Ecology and Evolution*, 10(22), 12613–12619.

Taft, H. R. (2018, March 23). [How to Quickly (and Safely) Move a Lab Course Online](https://www-chronicle-com.libproxy1.usc.edu/article/how-to-quickly-and-safely-move-a-lab-course-online/). *Chronicle of Higher Education*.