Actionable Steps and Resources for

Mindset – Shifting from the F2F classroom to Blended/Online Version

Approach your new Blended/Online course like a pilot course. Know that this is just a starting point and that throughout your course you will be asking your students for their feedback and suggestions, brainstorming new approaches, and learning from what may not have worked as well as you would have liked. Involving your students in improving your course actually increases student engagement.

Develop key questions for your pilot course. What are you looking for exactly? Do you have a definition of success for your first blended or online course? It's important to develop guiding or focusing questions and criteria to help you and your students to know what to look for, even if these questions are simply, "What works? What doesn't? What should we fix?".

Preparing your learners - Key methods of communicating expectations

Revise your syllabus

a. Indicate where the syllabus has changed from its original form, what assignments have been altered, and how students will be expected to complete the work
b. Which aspects of the course require synchronous participation (logging on at a specified time) and which can be completed at their own pace?
c. If you are moving from a structured curriculum to one that is more self-paced, some students may need help with time management skills. Do you have resources on hand regarding self-regulation strategies and time management skills?
d. Evaluate your assessment strategy. Your first blended or online course may need to have reduced assessments as you adapt to new methods of grading and providing feedback. Ask yourself essential questions like "Why am I assessing? Am I trying to figure out what my learners know before teaching a specific concept? Am I assessing for accountability?" You may need to alter your ratio of diagnostic, formative, and summative assessments during this pilot phase.

Orient your learners

a. Orient them on navigating the learning management system (LMS) or web-conferencing system, uploading and downloading assignments, file management, participating in a discussion forum, and how to reach out for help.

Communicate online classroom expectations

a. Students don't always understand the concept of a blended course and the relationship between the classroom and online components. Clearly state the rationale for your course design and the relationship of the components
b. Do the same behavioral principles apply to your online classroom as your on-campus classroom?
c. Can students join a class while driving or riding in a car? Be clear on what quality classroom participation looks like.

Set classroom participation norms

a. Are you using the "raise hand" feature during live/synchronous lectures?
b. Will you have discussion boards open during lectures or chat threads so students can talk amongst one another? Will this conversation be saved for later review?
c. Think through multiple ways in which you might measure participation in your blended classroom: https://bokcenter.harvard.edu/assessing-online-participation

Provide methods for your students to give you informal feedback on how the course is going

Revising your F2F Curriculum to Blended/Online Version

Start with a description of the curriculum. Writing down what the next two weeks or semester will cover often identifies learning goals, objectives, and outcomes. The description also ensures your familiarity with the curriculum content and helps pinpoint potential digital resources, such as educational games, online quizzes, and videos.

Outline your goals. Goals strip a curriculum description of the fluff, leaving you with a clear focus and targets to hit.

Determine learning objectives. Learning objectives quantify goals. Set these so that you can measure classroom and student performance in real time and at the end of a learning block.

Define learning outcomes. Outcomes define how students will achieve objectives and demonstrate competency in the subject matter. Specific outcomes could include classroom participation, online assignments, oral presentations, et cetera.

Create individual and collective learning goals. You established overarching learning goals earlier. Now, combine them with individual learning goals. Students work at different paces and may be on another learning path than another student. Learn to incorporate that information into your blended learning planning to see success with students and the classroom as a whole.

Reimagining Blended/Online STEM Labs

While laboratory courses provide students with important hands-on learning experiences through experiment development and execution, data acquisition, data analysis and interpretation, and report writing, a move to remote learning will likely require a shift in focus towards data analysis and interpretation as well as report writing. To accomplish this goal, the following are best practices to consider to ensure adequate remote student learning experiences:

- Record a video of the instructor or TA demonstrating all relevant steps of the lab exercise or provide a live broadcast during the normal lab meeting time.
- If your course uses pre-lab assessments, these can be accomplished online in your LMS or alternatively, students can scan and upload their pre-lab work using a tool like Gradescope, a shared Google drive, etc.
- Have the instructor or TA acquire representative raw data in the same form that a student would collect the data (e.g. screenshots of spectra, raw data files, etc.) and distribute to all students. The students would then perform relevant data analysis and interpretation remotely. Please ensure that students have remote access to any software required to accomplish the analysis, noting that this may be a more restricted list than what is available to them on campus.
- Some activities may be replaced by virtual simulations (for example, virtual dissection, night sky apps, computer simulations). There are often resources available from textbook publishers and other peer institutions that may replace some portions of a lab exercise.
- Focus assessment on the data analysis, interpretation and report writing. Submission of lab reports or research papers can be accomplished using your LMS, Gradescope, a shared Google Drive, etc. Please be mindful to enforce a unique file naming scheme to ensure consistency and ease of identification.
- Provide for direct interaction with instructors and TAs or other students using online forums (Piazza, Forum, or ChatRoom tools in your LMS) or with video conferencing (Zoom).

For example, in chemistry, some instructors are providing videos of synthetic steps for the students to review. Raw UV-Vis spectrometer data files are also being provided to students who have the analysis software on their computers, while magnetic susceptibility and IR data are being provided as screen shots. Students will be asked to analyze the data as if it were their own, and submit lab write-ups via your LMS or LabArchives.

Planning your Blended/Online STEM Labs

Pre-lab instruction (describing the techniques and fundamental facts regarding the science behind the experiments) can be performed via Zoom in much the same way as face-to-face instruction. Students can read about the methodology they have been using and ask questions via on-line technology.

For introductory labs, instructors can record short lab demos demonstrating skills/techniques or simply demonstrate the techniques during live streaming of the lab at its normal time. As an alternative, there are many online YouTube videos for lab techniques that can be used by simply sending the students the appropriate links. Additional resources can be found at the end of this guide.

For advanced labs, students will have already learned or performed many of the required techniques, so focus instead on how to analyze and interpret the resulting data. Here are some examples of alternative assignments:

Create a dry lab experiment: lab instructors can post relevant data for students to analyze and interpret. This may be from previous years or from other sources, but work to provide students with data in a form that is appropriate for the discipline and experiment and accessible to all students. The lab faculty an answer questions students may have regarding the analysis during the regular lab period via Zoom. Students can then write up their reports and analyses and electronically send them in for evaluation and grading.

Planning for Studio and Fieldwork courses

- Consider whether remote students can complete an experiential component of your course independently and then engage in structured reflection through writing or virtual group presentations.
- Consider if everyday materials could be used to teach similar techniques or principles that would normally be covered in an in-person studio class.
- Can your class shift objectives towards theory or history rather than production or skill mastery?
- Can other similar skills be substituted (e.g. CAD to replace model building in architecture studio classes)?
- Critique and feedback could be done via video conferencing (Zoom) or comments in Your LMS for uploaded materials.
- These courses may need to focus on design, process, revision, and artistic choices, rather than final products.

Using STEM Resources for Experiential Blended/Online Learning

The following resources may help you identify alternative ways of providing the lab experience to your students.

ChemCollective
This site contains many general chemistry resources, including an interactive virtual lab series. The **virtual lab series** provides students opportunities to solve problems using the materials they would have available in a typical wet-lab session (e.g. choice of glassware and equipment). Therefore, this site might be most beneficial for students that have not yet completed these tasks in lab. Autograded problems are available in association with each lab exercise. These problems are randomly generated and can be printed for the instructor. Importantly, the lab series, unlike many available online, runs directly in the browser and should not require additional software downloads for students. Subjects include stoichiometry, thermochemistry, kinetics, equilibrium, acid/base, solubility, and solutions.

Journal of Visualized Experiments
This site has an extensive number of videos, which could serve as a good visual background, to describe important scientific concepts. In regards to laboratory options, the JOVE video journal, is a catalog of countless live tapings of different experiments. Although the main objective of the video collection is to help people working in the research laboratory, this could serve as a resource to bring alive research processes in more advanced science courses. In addition, there is an introductory biology laboratory manual. Although it is meant to be used in conjunction with in-person wet-lab experiences, given the current extreme conditions instructors are experiencing, it could be used to simulate the experiment and then be followed-up with data analysis.

PhET Interactive Simulations
Subjects: Primarily physics and chemistry, some biology and math. This site provides interactive simulations that can provide students an opportunity to apply basic concepts traditionally covered in a textbook or via problem sets. The majority of simulations can be played directly from a browser but not all. Although the simulations do not contain many instructions for students, most students would be able to easily engage with the programs. These simulations would be most effective when accompanied with instructor-provided goals and questions.

MERLOT
Subjects: All The MERLOT system consists of a curated collection of online resources in a vast array of disciplines, provided by instructors and institutions worldwide. Given the large number of resources, it would be best to start with the search tool and input your topic of interest while filtering the results for the appropriate audience (ex. college upper division) and material type (ex. simulation). Given that all of the sources are linked to outside systems, each source has to be individually evaluated for its utility for your students.

LabXchange
Subject Material: Primarily biology but also other areas, including chemistry and physics. LabXchange is a free online platform that includes high quality digital content to aid your online learning. The interactive laboratory simulations provide students with an opportunity to mimic the wet-lab experience, including the important steps of making predictions and interpreting results. The system runs directly in a browser. The site also maintains a host of interactive and engaging videos, curated from various online sources.

PennState Online Lab Toolkit
Topics include How to create online labs, How to connect with other STEM educators, Curated resources from STEM stakeholders

Online Resources for Science Laboratories - Remote Teaching: This document provides a list of online resources for simulations and virtual labs for many fields, including biology, chemistry,

geology, math, physics, and others. The list is organized by discipline and provides a brief description and a link to the online resource.

Derek Bok Center for Teaching and Learning at Harvard University - Science Labs
https://bokcenter.harvard.edu/remote-labs
learning techniques and their application to specific experimental situations
interpreting experimental data
project-based lab research,

Suggestions for how to do STEM boardwork online

- https://bokcenter.harvard.edu/remote-boardwork
- https://bokcenter.harvard.edu/files/shadowbok/files/displaying_paper_documents_on_zoom.pdf

Additional General Blended/Online Learning Resources

Western Washington University Center for Instructional Innovation - Handbook for Blended/Online Learning
https://www.wwu.edu/teachinghandbook/teaching_delivery/blended-online.shtml
Includes: Teaching strategies, Engagement and Community Building Strategies, and information on learning accommodations

University of Central Florida - BlendKit Reader. https://ucfcdl-wp.s3.amazonaws.com/Blendkit/BlendKit-Reader-V2.2.pdf
The BlendKit Course is a set of subject matter neutral, open educational resources related to blended learning and available for self-study or for group use.

Tips and Tricks: Teachers Educating Using Zoom
https://zoom.us/docs/doc/Tips%20and%20Tricks%20for%20Teachers%20Educating%20on%20Zoom.pdf?zcid=1231&_ga=2.80386079.985977853.1585010294-1643304633.1579719376
Includes information on video delivery, small group instruction, polling, and other educational tools.