

Techniques and Activities to Achieve Laboratory Goals in Remote and Physically Distant Learning Environments

Learning Goal	Remote Learning	Physical Distance Learning
<p>If students need to learn laboratory or conceptual techniques.</p>	<ul style="list-style-type: none"> ● Film the experiment and share via Canvas. Consider the value of the students seeing the instructor talk to the camera rather than only seeing their hands or the instruments. ● Ask students to complete a simulation and write a reflection about the process. ● Demonstrate the technique as a livestream via Blackboard Collaborate. 	<ul style="list-style-type: none"> ● Follow campus COVID-19 safety guidelines. ● Consider a scheduled lab dedicated to technique learning and testing. ● Rotations of students (physical or in time) ● View risk as a continuum from low risk (i.e. remote with no contact to high risk (standing close with no PPE). Be creative with solutions to reduce risk such as using a camera & projection for groups to view a common machine or specimen
<p>If students need to work together.</p>	<ul style="list-style-type: none"> ● Use breakout rooms in Blackboard Collaborate. ● Use the group discussion feature in Canvas. ● Collaborate using apps like Google Docs or Sheets. ● Suggest students to create their own video conference sessions to work with their lab partners. 	<ul style="list-style-type: none"> ● Collaborate using apps like Google Docs or Sheets. ● Use a virtual whiteboard like Padlet to share ideas ● Give each student a small whiteboard to show their work at a scale that can be seen by students sitting 6 feet away. ● Designate students to complete parts of the experiment for their small group.
<p>If students need to interact with instructors.</p>	<ul style="list-style-type: none"> ● Visit students as they work in small groups within breakout rooms in Blackboard Collaborate. ● Host additional office hours in place of lab time. Consider both phone and video conference options to connect. 	<ul style="list-style-type: none"> ● Use live polling software like TopHat or Poll Everywhere to get real-time input on student understanding and questions. ● Use a backchannel chat such as Slack, GroupMe, or Microsoft Teams for questions and comments.
<p>If students need to record, analyze, write up, or present data for a lab experiment.</p>	<ul style="list-style-type: none"> ● Record their findings in apps like Google Docs or Sheets ● Create group assignments in Canvas for students to submit lab reports 	<ul style="list-style-type: none"> ● Collaborate using apps like Google Docs or Sheets. ● Use a virtual whiteboard like Padlet to share ideas

Example Activities for Learning the Scientific Process in Remote Settings

Scientific Process	Example Activities
Hypothesis Generation	<ul style="list-style-type: none">● Write a literature review and identify a gap in the literature. Write a hypothesis or research question to address the gap.● Create a series of structured reading assignments for students to connect concepts from lecture to the primary literature.● Ask students to make predictions and then watch a video of an experiment.
Experimental Methods	<ul style="list-style-type: none">● Share a video or simulation of the experimental procedure. Ask students to develop or annotate a lab protocol accompanied by reflection on use of the protocol or limitations.● Ask students to explain the reasons behind specific steps in a protocol to understand why specific procedures are performed.● Pose a hypothesis and ask students to identify experimental methods that could be used to gather evidence for the hypothesis.● Randomize the steps of a protocol and ask students to put into the correct logical order.
Data Analysis	<ul style="list-style-type: none">● Provide students with data in the format as if they collected it themselves.● Ask students to analyze a sample dataset and write a lab report.
Conclusion Making and Communication	<ul style="list-style-type: none">● Ask students to summarize and synthesize their analysis of the literature or of sample data sets through digital posters, presentations, blog posts, etc.