Teaching Remote Labs

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CEITL Talk About Teaching

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Overview for Today:

- Address challenges to teaching remote labs

- Explore available resources for remote lab teaching

- Forum to discuss converting labs to remote learning:
  - Describe how you converted your Spring 2020 lab courses
  - Share lessons learned and what you plan to keep or modify for Fall 2020

Different Versions of Remote Learning Labs

- Online Synchronous vs. Asynchronous (merits & challenges for both)
- Blended Learning (includes both face-to-face & remote learning)
- Flipped Classroom (material completed prior to synchronous face-to-face)

Challenges to Remote Lab Teaching

- Difficulty with engagement & connection remotely

- Discussion and problem solving in person & online

- Downloading materials & submission of assignments

- Remote & in-person viewing lectures, discussions, & lab demonstrations

Teaching Goals for Labs

- Promote active learning: students are more engaged & learn to think critically

- Students learn to accept struggling to find the answers

- Science labs are designed to follow the scientific process
  - Remote or blended science labs can retain scientific process

Scientific Inquiry Pentagram

Warner and Myers: *Figure 1. Tasks of Inquiry Credits: Carin, Bass, & Contant, 2005, p. 21*
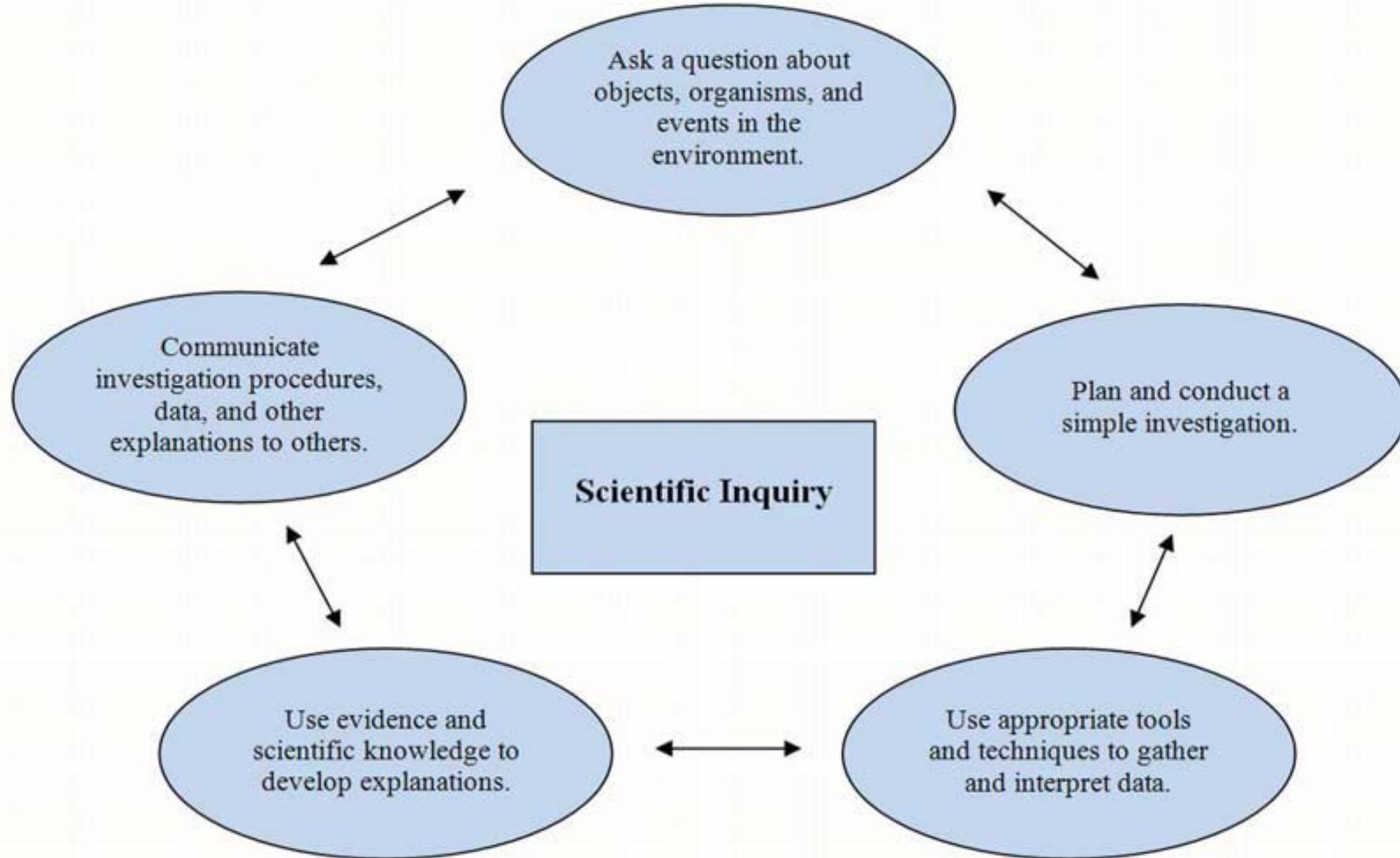
Teaching STEM Labs Remotely

- Students can remotely complete all components of scientific inquiry process
  - Asking questions
  - Planning and conducting research:
    - Students collect data in the lab
    - Through online simulations
    - Watching lab video (provide data)
  - Gather the and interpret data
    - See above for data collection
  - Develop Explanations
  - Communicate Findings

Resource for discussions, problem solving, etc.

- Collaborative Learning Techniques: A Handbook for College Faculty
  - For every activity, there are explanations for *face to face & online learning*
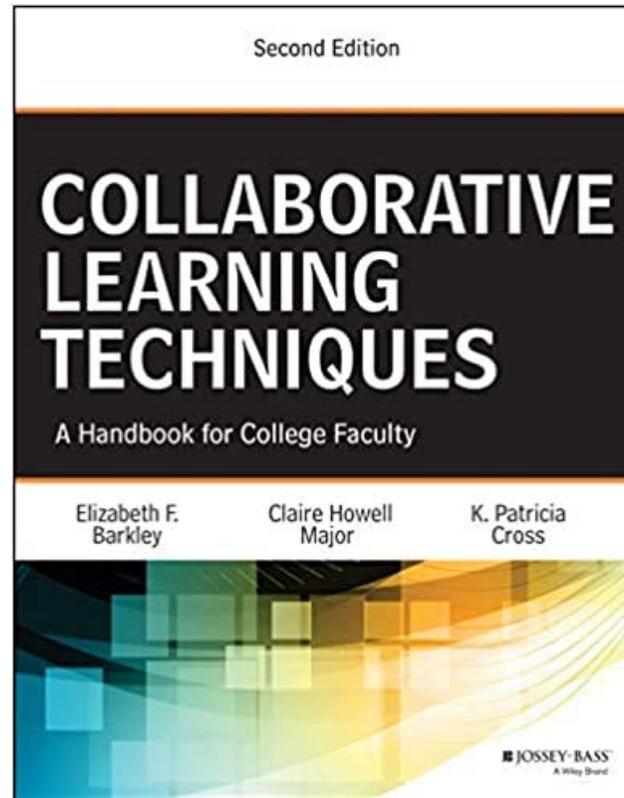
Resource for Discussions, Problem Solving, etc.
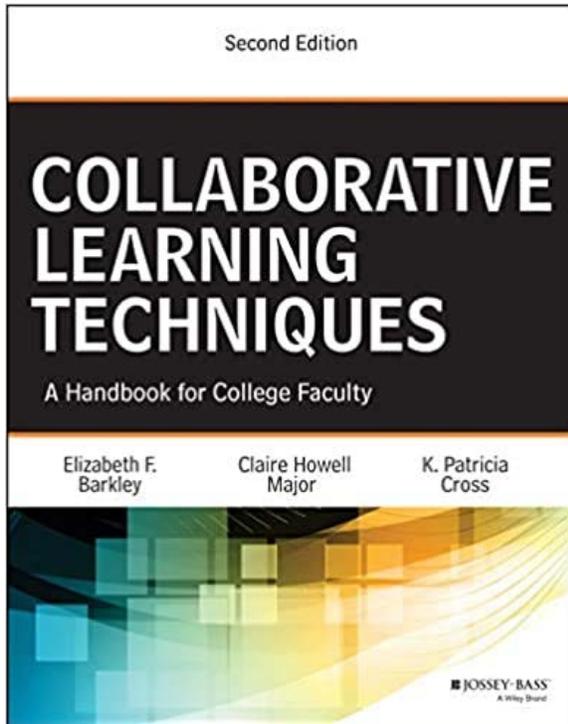
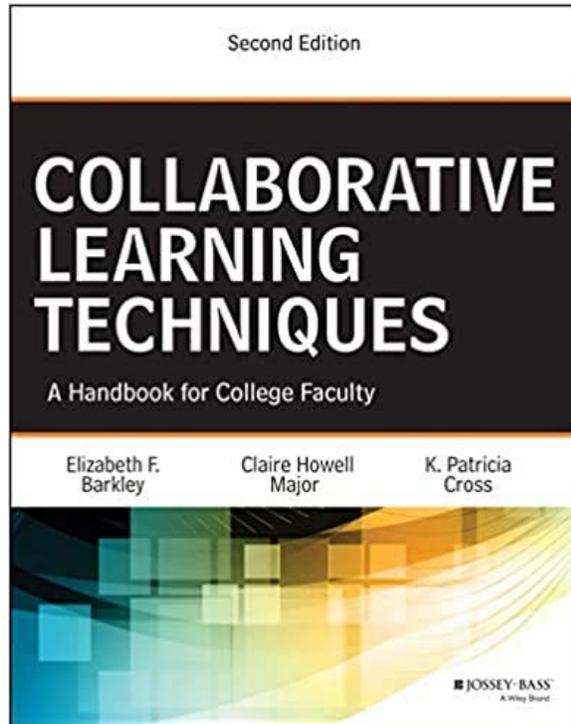

Techniques for Discussion:

Buzz Groups: Students discuss questions in small groups, which helps prepare them for large class discussions.

Examples include classes ranging from sociology to chemistry

# Resource for Discussions, Problem Solving, etc.

Techniques for Problem Solving:

Case Study: Reviewing real-world scenarios and solutions, which present theoretical situations in a relevant way for students to work on problems.

Examples include classes ranging from from international relations to teaching (they are also used in STEM courses)

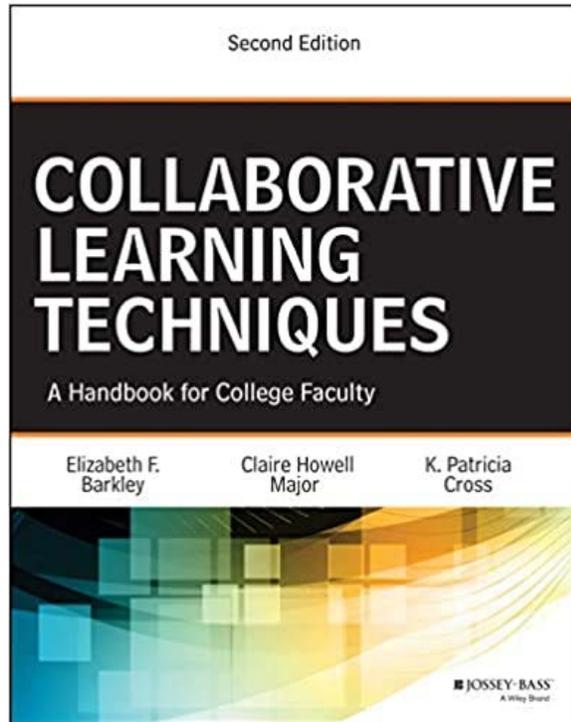# Resource for Discussions, Problem Solving, etc.
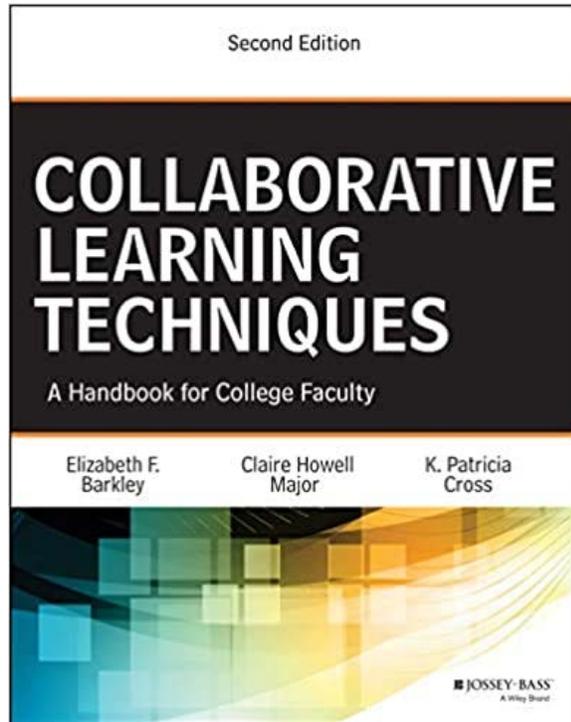
Techniques for Problem Solving:

Structured Problem Solving: problems are divided into discrete steps, to help students learn to systematically identify, analyze, and solve problems.

Examples include classes ranging from music history and literature to chemistry.

Resource for Discussions, Problem Solving, etc.

Techniques for Problem Solving:

Group Investigation: Students plan and conduct research, & then report findings, which helps them learn how to do research and gain subject knowledge

Examples include classes ranging from Biology to Music of Multicultural America

Resources for Remote Lab Teaching: Case Studies

- ***National Center for Case Study Teaching in Science*** (STEM courses)
- https://sciencecases.lib.buffalo.edu/
  - *Example Biology:* **A Curious Mission: An Analysis of Martian Molecules**
  - *Example Chemistry:* **A Calculated Bang** (apply stoichiometry to combustion rxns)
  - *Example Physics:* **Applying Newton's Third Law of Motion in the Gravitron Ride**
  - *Example Mathematics:* **Markov vs. Markov** (Markov chain probability model)
  - *Example Psychology:* **Mini Cases in Psychoactive Drugs & their Effects on the Brain**

STEM Remote Lab Teaching Resources

- <u>The Journal of Virtualized Experiments (JOVE):</u>
  - biology, chemistry, nursing, mechanical engineering, physiology, physics, psychology
  - Video content of experiments & instruction for remote teaching
  - https://www.jove.com/facultyresources

- <u>Merlot Virtual Labs:</u>
  - biology, chemistry, physics, earth/environmental science, engineering, mathematics
  - Interactive lab activities for students
  - https://virtuallabs.merlot.org/index.html

- <u>Vlabs (Virtual Labs):</u>
  - Engineering (chemical, mechanical, electrical & biomedical), chemical, physical & computer sciences
  - Interactive lab activities for students
  - http://www.vlab.co.in/

JOVE: *Biology Example*

- **An Introduction to *Saccharomyces cerevisiae*** *Saccharomyces cerevisiae* (commonly known as baker's yeast) is a single-celled eukaryote that is frequently used in scientific research. S. cerevisiae is an attractive model organism due to the fact that its genome has been sequenced, its genetics are easily manipulated, and it is very easy to maintain in the lab.

- **VIDEO**

JOVE: *Mechanical Engineering Example*

- This collection introduces a range of concepts that are essential for understanding and designing mechanical systems. Each video examines a specific topic and describes fundamental analytical methods commonly employed to understand physical behaviors.

- Stability of Floating Vessels (video)

- Propulsion and Thrust (video)

Merlot Virtual Labs: *Chemistry examples*
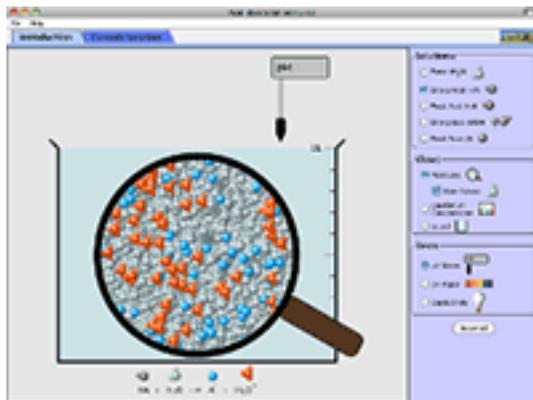
Online Activity Labs:	Topics:

Acid-Base Solutions

How do strong and weak acids differ? Use lab tools on your computer to find out! Dip the paper or the probe into solution to measure the pH, or put in the electrodes to measure the conductivity. Then see how concentration and strength affect pH. Can a weak acid solution have the same pH as a strong acid solution?

Details and get access to *Acid-Base Solutions*

Check out *Acid-Base Solutions*

Build a Molecule

Starting from atoms, see how many molecules you can build. Collect your molecules and see them in 3D!

Details and get access to *Build a Molecule*

Check out *Build a Molecule*

Merlot Virtual Labs: *Physics examples*

Online Activity Labs:	Topics:
Alpha Decay	Watch alpha particles escape from a polonium nucleus, causing radioactive alpha decay. See how random decay times relate to the half life. **Details and get access to *Alpha Decay*** **Check out *Alpha Decay***
Bending Light	Explore bending of light between two media with different indices of refraction. See how changing from air to water to glass changes the bending angle. Play with prisms of different shapes and make rainbows. **Details and get access to *Bending Light*** **Check out *Bending Light***

Vlabs: *Computer Science Examples*

Problem Solving Lab:

Welcome to the Problem Solving Virtual Lab developed at IIIT Hyderabad. The interactive experiments in this lab will give the students an opportunity for learning and better understanding of using computer programming as a tool to solve basic to advanced problems.

Data Structures – 1:

Welcome to the Data Structures Lab - I developed at IIIT Hyderabad. Data Structures (also called Data Structures and Algorithms in some places) is a core course in all computer science undergraduate curricula. The course is the basis for understanding several data structures and also algorithms that operate on them. The course forms the foundation for almost all computer science subjects.

Teaching & Learning Resource Hub (UNH)

- https://mycourses.unh.edu/courses/69598
- Teaching Online Labs
  - Links to remote lab resources
  - *For example:* **PhET** (free STEM simulations: physics, chemistry, math earth science biology)

PhET: *Earth Sciences Example*

The Greenhouse Effect

- This short lesson concerns the atmosphere and the greenhouse effect. Covered topics include how to calculate the temperature of the earth with the greenhouse gases and the effect of clouds...

  Level: high school or introductory undergraduate

Forum Discussion of Remote Lab Teaching:

- Before we open the forum for open discussion, an example from lab teaching this spring by Jenny Calawa

Forum Discussion Questions

- What worked well and what was less successful in remote lab teaching in your course(s) this spring semester?

- What tools do you plan to use in your lab teaching this fall?
  - What components are in-person and what components are remote?

- What areas do you foresee wanting assistance for fall preparation?

Additional Resources and Contacts:

- Additional *Talk about Teaching* sessions this summer
- Email CEITL staff with questions or to schedule a meeting:
  - teaching.excellence@unh.edu
  - Lauren.Kordonowy@unh.edu
  - Catherine.overson@unh.edu