

# Laboratory Experiences that Require Hands-on Experience:

A response to COVID-19

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While many skills associated with the laboratory can be developed in a virtual setting, not all practical experiences can be replaced by virtual labs or simulations because of the manipulative and problem solving skills that students develop. Practical lab experiences help students develop greater awareness of working in a lab environment and laboratory safety.

All laboratory experiences, regardless of their setting, should help students build the skills described in the Guidelines. Students need to experience “failures” in the lab so they recognize not all samples / experiments behave ideally and that trouble shooting and critical thinking are an essential element of chemistry laboratory work.

This is a list of laboratory skills typically covered in the undergraduate curriculum that require hands-on activities to develop proficiency. Not all of these skills are developed by all programs. If developing a particular skill is a learning goal for your program, you should find a way to give students hands-on experience with that skill so that your students can meet your program goals. In addition to complying with OSHA and CDC requirements, best practices for laboratory safety, as described in the Guidelines for Chemical Laboratory Safety in Academic Institutions, should be employed in all hands-on activities.

## **Analysis & Measurement**

- Working with glassware and balances
- Working with real samples
- Solution handling skills: making solutions, dilutions, pipetting
- Making calibration curves
- Titrations
- Interfacing with instrumentation: software, hardware, awareness of the physical space and parts of instrumentation
- Reporter assays for biochemical systems / in vivo or in vitro
- Analysis of enzymatic properties, kinetic behavior, or protein structure-function

## **Synthesis, Characterization, and Preparation**

- Synthesis and preparation of different classes of molecules

- Sample and reagent preparation (solution preparation, dilutions, purification, extractions, digestions, buffer preparations, etc.)
- Air-free manipulations (Schlenk line, glovebox, air-free handling of sensitive reagents)
- Purification - solvent selection, recrystallization, chromatographic approaches
- Sample preparation for measurement on instrumentation
- Glassware / reactionware selection
- Safe handling of chemicals and appropriate disposal of waste
- Standard protein and nucleic acid characterization methods (size, purity, identity)