

BASIL: A biochemistry laboratory CURE with flexibility across learning modalities

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First published: 14 May 2021

<https://doi-org.ezproxy.rit.edu/10.1096/fasebj.2021.35.S1.03692>

Abstract

Since 2015, a collaboration of instructors at a diverse range of institutions have developed a biochemistry laboratory curriculum known as BASIL (Biochemistry Authentic Scientific Inquiry Laboratory). Scientific objectives of BASIL focus on characterizing biochemical activities of proteins with known structure and unknown function. BASIL curriculum (freely available on GitHub <https://basilbiochem.github.io/basil/>) includes modules on computational predictions of protein function, protein purification, and analysis of biochemical activity and kinetics. Three main challenges for our implementation included 1) scaling of research training from the “apprentice” model to the classroom, 2) alignment of course learning objectives, activities and assessments with research goals to create optimal conditions for productive struggle, 3) student buy-in. To understand if/how students in our course develop laboratory research skills, we began assessing anticipated learning outcomes, focusing on students’ evaluation of protein purification experiments. Initial assessment results revealed learning difficulties and led to modifications in instructional activities, including use of simulated experiments.

The BASIL curriculum was intentionally designed to provide flexibility in its use in terms of sequencing and scope of experiments, content, and focus to meet desired course learning objectives. This flexibility proved beneficial in maintaining learning objectives when switching from the traditional lab format to online or hybrid delivery necessitated during the COVID-19 pandemic. Using a combination of lecture and video based explanations students were able to investigate their protein of interest completely online. Students working in this format reported gains in knowledge, experience and confidence. We did find that these gains were more pronounced in the bioinformatic experiments and concepts than about their wet-lab counterparts. In order to address these gaps in understanding interactive online resources are under current development by the BASIL team. In addition to addressing the short-term need for a set of coordinated electronic materials for biochemistry laboratory courses, this adaptation of the BASIL curriculum provides a meaningful distance-learning alternative in future years and may serve as a platform to broaden access to quality STEM education to more diverse student populations well after the pandemic has past.