Tested Studies for Laboratory Teaching
Proceedings of the Association for Biology Laboratory Education
Vol. 37, Article 48, 2016

Integrating STEM Laboratory Instruction at the Introductory Level – Opportunities and Challenges

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Introductory courses offer unique challenges for STEM educators to engage students who often view these courses simply as prerequisite or general education requirements. Even students who are pursuing STEM majors frequently struggle to see how introductory courses relate to their anticipated professions or apply to the "real world." Lower-division coursework tends to be compartmentalized with limited purposeful linkages in content and skills across disciplines. Although interdisciplinary linkages are eventually made in upper-division courses and synthesis experiences, these courses are sequenced at risk of missing opportunities to improve student engagement and reinforce important content and skills development during initial exposure. We have taken a novel approach to integrate laboratory investigations between our General Biology and General Chemistry courses in an attempt to build a contextual framework for synthesizing knowledge across disciplines, develop proficiency in laboratory skills, and improve attitudes toward science. During this mini-workshop participants will explore and discuss their perceptions of the challenges and benefits of integrating lower-division laboratory instruction among STEM disciplines, and we will share our experiences with integrating our particular laboratory courses during the last three years. For example at the beginning of their first semester, students used Chemistry laboratory to practice using balances, glassware and probes to inform a field ecology investigation for their General Biology lab. Later students applied new solution preparation skills to prepare experimental nutrient solutions to investigate bacterial growth under equal molar concentrations of different forms of inorganic nitrogen. In a longitudinal investigation spanning both semesters, students explored parallels between electron release by plant pigments (from blackberries) to create electrical currents in mini-solar cells, to the detection of reducing capacity by intact chloroplasts using dye-coupled reactions. Students then used column chromatography to isolate and collect plant pigments in order to create a composite light absorption spectrum that then informed a controlled experiment on the effect of light quality on photosynthesis.

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Citing This Article

McGee, G., and N. Abrams. 2016. Integrating STEM Laboratory Instruction at the Introductory Level – Opportunities and Challenges. Article 48 in *Tested Studies for Laboratory Teaching,* Volume 37 (K. McMahon, Editor). Proceedings of the 37th Conference of the Association for Biology Laboratory Education (ABLE). http://www.ableweb.org/volumes/vol-37/?art=48