

Table of Contents

GENERAL ESSAYS AND ARTICLES

ESSAYS

A Road Map for Planning Course Transformation Using Learning Objectives

Rebecca B. Orr, Cara Gormally, and Peggy Brickman

In this essay, we present a roadmap to help faculty who wish to learn how to use LOs to transform courses. We highlight the challenges faced when planning and undergoing a course transformation and present the lessons learned and common roadblocks that are reported in the literature.

Social Justice, Community Engagement, and Undergraduate STEM Education: Participatory Science as a Teaching Tool

Heather D. Vance-Chalcraft, Kalynda Chivon Smith, Jessica Allen, Gillian Bowser, Caren B. Cooper, Na'Taki Osborne Jelks, Colleen Karl, Robin Kodner, and Mara Laslo

We examine the intersection of participatory science, social justice, and higher education in the United States to investigate how instructors can teach about social justice and enhance collaborations to work toward enacting social justice.

Overcoming the Barriers to Teaching Teamwork to Undergraduates in STEM

Gregory R. Goldsmith, Miranda L. Aiken, Hector M. Camarillo-Abad, Kamal Diki, Daniel L. Gardner, Mario Stipčić, and Javier F. Espeleta

This essay synthesizes key issues associated with teaching teamwork, with the goal of providing the basis for overcoming the barriers to teaching teamwork in life science and STEM classrooms. It focuses on the pedagogy and curricula for teaching teamwork itself, rather than team-based learning as a pedagogical approach for teaching STEM curricula.

ARTICLES

Inclusive Research Environments for Deaf and Hard of Hearing English Speakers

Jason D. Listman, Kim B. Kurz, Amanda Picioli, and Paul Craig

Need guidance on creating an inclusive lab environment for deaf and hard-of-hearing undergraduate students? This article describes the experience of deaf and hard-of-hearing students in the lab environment and lists recommendations for mentors to optimize access and gain cultural competence.

Variations in Student Approaches to Problem Solving in Undergraduate Biology Education

Jeremy L. Hsu, Rou-Jia Sung, Su L. Swarat, Alexandra J. Gore, Stephanie Kim, and Stanley M. Lo

We investigated undergraduate student approaches to problem solving in biology and identified five aspects, including knowledge, strategy, intention, metacognition, and mindset, that define three qualitatively different approaches to problem solving; each approach is distinguishable by variations across the aspects.

The Value of Support: STEM Intervention Programs Impact Student Persistence and Belonging

Erin E. Shortlidge, MacKenzie J. Gray, Suzanne Estes, and Emma C. Goodwin

STEM Intervention Programs (SIPs) can influence student persistence in science. A survey measured multiple persistence factors among STEM students at one non-traditional university and focus groups triangulated nuances of the student experience. Overall, students in SIPs are more likely to persist and experience belonging.

What Makes a Good Match? Predictors of Quality Mentorship Among Doctoral Students

Trevor T. Tuma, and Erin L. Dolan

Deep level similarity and culturally aware mentoring, not sociodemographic similarity, predict quality doctoral student mentoring.

An Undergraduate Health Care Experience Course Increases Confidence and Improves Student Understanding of Health Care Careers

Adrienne Williams and Matthew Williams

A health care experience (HCE) course was created for undergraduate students to increase accessibility to career experiences for students interested in health care careers. The HCE included training, active learning exercises, and coordinated shadowing experiences, which contributed to increased confidence in and understanding of health care.

Perspectives from Undergraduate Life Sciences Faculty: Are We Equipped to Effectively Accommodate Students With Disabilities in Our Classrooms?

Emma C. Goodwin, Danielle Pais, Jingyi He, Logan E. Gin, and Sara E. Brownell

The authors interview life sciences faculty instructors to explore their motivation to provide accommodations for students with disabilities. They find that faculty motivation is largely influenced by personal belief that providing accommodations is “the right thing to do,” and argue that this is an inequitable system for both students and faculty.

Exploring Undergraduate Biochemistry Students’ Gesture Production Through an Embodied Framework

Lora Randa, Song Wang, Zoe Poolos, Vanna Figueroa, Anna Bridgeman, Thomas Bussey, and Rou-Jia Sung

Students often use gesture to complement verbal descriptions of 3D biomolecular structure. Here, the authors uncover two emergent patterns of gesture production by undergraduates while explaining the mechanism of K⁺ channel function. They also identify shifts in gesture use following exposure to an augmented reality-based virtual 3D model of the channel.

A CURE Lab in Introductory Biology at a Regional Comprehensive University Negatively Impacts Student Success in the Associated Lecture Course Among Students from Groups Underrepresented in Science

Anne M. Casper and Marianne M. Laporte

When a traditional lab was replaced with a CURE a Regional Comprehensive Institution, students who are both BIPOC and Pell eligible have lower scores on the exams in the associated lecture course. Also, students who did not volunteer for the CURE report a lower sense of discovery and relevance in the course.

How Do Students Critically Evaluate Outdated Language That Relates to Gender in Biology?

Ryan D. P. Dunk, Sarah J. Malmquist, Kristina K. Prescott, Sharday N. Ewell, Jeremiah A. Henning, and Cissy J. Ballen

Students were not able to recognize the inherent gender implied by terms such as “woman” though they frequently corrected text about an infant’s gender. This language is common in textbooks, and this paper shows that more work is needed to rid the biology curriculum of implied equality between an individual’s gender and their sex characteristics.

Growth Mindset Messages from Instructors Improve Academic Performance Among First-Generation College Students

Elizabeth A. Canning, Makita White, and William B. Davis

In a large-enrollment Introductory Biology course, students received either growth mindset or control emails. Growth mindset messages increased grades among first-generation college students. Performance increased as a function of increased activity on the course website.

Who is Represented in the Research on Undergraduate Research Experiences in the Natural Sciences? A Review of Literature

Emma C. Goodwin, Logan E. Gin, Allyson Aeschliman, Adwoa Kumi Afoakwa, Bryttani A. Allred, Sarah T. Avalle, Amanda Bell, Jessica Berkheimer, Hannah Brzezinski, Rachel Campos, Hozhoo Emerson, Savage Cree Hess, Arron M. Montelongo, Nereus Noshirwani, W. Levi Shelton, Emma M. Valdez, Jennifer White, Quinn White, Ehren Wittekind, Katelyn M. Cooper, and Sara E. Brownell

We conducted a review of the education research literature on student outcomes from participation in undergraduate research experiences to document how demographic variables are reported and considered in analyses. This information is critical to assess whether goals to diversify research undergraduate research experiences are being met.

Development of the Mentoring in Undergraduate Research Survey

Lisa B. Limeri, Nathan T. Carter, Riley A. Hess, Trevor T. Tuma, Isabelle Koscik, Alexander J. Morrison, Briana Outlaw, Kathren Sage Royston, Benjamin H. T. Bridges, and Erin L. Dolan

This study presents the development of a new measure of the mentoring that undergraduate researchers experience with evidence of seven distinct types of mentoring experience that are supportive or destructive in nature.

Mentorship for Transfer Student Success in STEM Research: Mentor Approaches and Reflections

Austin L. Zuckerman, Stanley M. Lo, and Ashley L. Juavinett

This study describes variations in how mentors in undergraduate research experiences acknowledge and integrate the transfer student experience and identity in their approach to mentorship. Our findings suggest that the transfer student experience may need to be better foregrounded in conversations on inclusive mentorship approaches.

Metacognition and Self-Efficacy in Action: How First-Year Students Monitor and Use Self-Coaching to Move Past Metacognitive Discomfort During Problem Solving

Stephanie M. Halmo, Kira A. Yamini, and Julie Dangremond Stanton

This qualitative study of 52 first-year life science students’ metacognition and self-efficacy in action shows that students monitor in a myriad of ways and use self-coaching to overcome the discomfort associated with being metacognitive while solving challenging biochemistry problems.

Beyond Gender and Race: The Representation of Concealable Identities Among College Science Instructors at Research Institutions

Carly A. Busch, Tala Araghi, Jingyi He, Katelyn M. Cooper, and Sara E. Brownell

Few college science instructors reveal concealable identities to students, causing undergraduates to perceive exaggerated underrepresentation of those identities.

Few LGBTQ+ Science and Engineering Instructors Come Out to Students, Despite Potential Benefits

Carly A. Busch, Parth B. Bhandari, Katelyn M. Cooper, and Sara E. Brownell

Study I assesses whether LGBTQ+ science and engineering instructors reveal their identities in various contexts and why they reveal or conceal to undergraduate students. Study II demonstrates via undergraduates' evaluations of a teaching demonstration video that an instructor coming out does not affect perceptions of teaching and improves rapport.

Undergraduate Biology Lecture Courses Predominantly Test Facts about Science Rather than Scientific Practices

Crystal Uminski, Sara M. Burbach, and Brian A. Couch

National calls have emphasized the importance of integrating scientific practices into science courses, but the authors' analysis of exams from 111 undergraduate biology courses found that scientific practices were largely absent from course assessments.

On the Cover

The Arabidopsis Exo70E2 is the nucleus for recruiting other exocyst complex proteins to EXPO. EXPO (exocyst-positive organelle) is a double-membrane organelle mediating unconventional protein secretion in plants. The diagram and images here demonstrate that the Arabidopsis exocyst subunit Exo70E2 serves as the nucleus to recruit other exocyst subunit such as Sec6 from cytosol to EXPO. When singly expressed in Arabidopsis suspension protoplasts, fluorescently tagged AtExo70E2 (green; lower image in the left panel) localize as discrete punctae at the plasma membrane and in the cytoplasm. In contrast, fluorescently tagged Sec6 (red; lower image in the middle panel) give rise to diffuse signals throughout the cytoplasm. However, when coexpressed with Exo70E2, Sec6 can be recruited by Exo70E2 to EXPO sites (yellow; lower image in the right panel). The diagram in the upper panel further illustrates the recruitment nature of Exo70E2 in the lower panel. By Yu DING, Juan Wang and Liwen Jiang, The Chinese University of Hong Kong, Hong Kong, China