

Table of Contents

SPECIAL ISSUE ON COMMUNITY COLLEGE BIOLOGY EDUCATION RESEARCH

EDITORIAL

Centering the Experiences of Community College Students and Faculty in Biology Education Research

Stacy M. Alvares, Beatriz Gonzalez, James A. Hewlett, Jennifer D. Kurushima, Jenny L. McFarland, Jeffrey N. Schinske, Kimberly D. Tanner, and Sheela Vemu

Thriving or Simply Surviving? A Qualitative Exploration of STEM Community College Students' Transition to a Four-Year University

MacKenzie J. Gray, Sandhya A. Gunarathne, Nikki N. Nguyen, and Erin E. Shortlidge

Community college transfer students will play a key role in increasing and diversifying the science, technology, engineering, and mathematics (STEM) workforce, but these students face unique barriers when transferring to a university. This study utilizes Schlossberg's model for analyzing human adaptation to transition to understand how STEM transfer students adapted to a 4-year university.

Narrative Analysis of a Woman's Experience Transferring from a TYC Reveals Impact of Supporting Characters

Laura A. H. Wood and Vashti Sawtelle

Narrative analysis of a transfer student's story highlights differences in her sense of community at the two institutions. Instructors and programmatic staff at 4-year colleges (FYCs) who aim to better support transfer students in their transition can learn from the kinds of scenes this student cited as helpful in her time at the 2-year college (TYC) as well as the FYC.

Supervised Study: Required Independent Research at a Community College Supports Persistence in Science

Anne B. Allison, Virginia V. York, Donna M. Hoefner, Melinda E. Clark, Marlena C. Yost, and Joanna R. Vondrasek

A community college science degree program with a required, mentored authentic research experience is evaluated. Students demonstrate gains in several factors related to persistence in the sciences. Students show high rates of graduate-transfer and bachelor's degree completion in the physical and natural sciences among all demographic groups.

Community College Student Understanding and Perceptions of Evolution

M. Elizabeth Barnes, Rebekkah Riley, Chloe Bowen, Jacqueline Cala, and Sara E. Brownell

A comparison of university and community college students' evolution education variables revealed evidence of similarities and differences between populations. Community college students perceived more conflict between their religions and evolution, and their understanding of evolution was less associated with acceptance compared with university students.

GENERAL ESSAYS AND ARTICLES

CURRENT INSIGHTS

Recent Research in Science Teaching and Learning

Sarah L. Eddy

This installment of *Current Insights* introduces life science educators and researchers to a collection of three articles from the fields of psychology and STEM education that explore the impact of a novel study strategy (making deliberate mistakes), how evoking interest may have costs for learning, and how faculty beliefs influence diversity, equity, and inclusion efforts.

EVIDENCE-BASED TEACHING GUIDES

Writing and Using Learning Objectives

Rebecca B. Orr, Melissa M. Csikari, Scott Freeman, and Michael C. Rodriguez

This essay introduces an evidence-based teaching guide that presents research and resources on the uses and benefits of learning objectives (LOs). It summarizes key articles and includes a checklist, with the goal of encouraging instructors to incorporate LOs into their teaching practice. Ideas for further research are also discussed.

RESEARCH METHODS

Literature Reviews, Theoretical Frameworks, and Conceptual Frameworks: An Introduction for New Biology Education Researchers

Julie A. Luft, Sophia Jeong, Robert Idsardi, and Grant Gardner

This *Research Methods* essay is designed to provide an overview of literature reviews, theoretical frameworks, and conceptual frameworks as critical elements of the research and writing processes and delineate the purpose of each in the educational research process.

ESSAY

Sustainability and Justice: Challenges and Opportunities for an Open STEM Education

Carrie Diaz Eaton, Kaitlin Bonner, Karen Cangialosi, Bryan Dewsbury, Maggie Diamond-Stanic, Jason Douma, Michelle Smith, Robin Taylor, Jeremy Wojdak, and Krystie Wilfong

Open educational resources (OER) provide important opportunities to address and promote social justice and open and accessible education philosophies. This essay provides general information about OER, describes communities developing OER for STEM education, and presents insights about challenges of sustaining OER, with a focus on educational justice.

ARTICLES

Guides to Advance Teaching Evaluation (GATEs): A Resource for STEM Departments Planning Robust and Equitable Evaluation Practices

Sandhya Krishnan, Jessica Gehrtz, Paula P. Lemons, Erin L. Dolan, Peggy Brickman, and Tessa C. Andrews

This article describes the iterative development of the Guides to Advance Teaching Evaluation (GATEs) and provides examples of potential uses. This research-based resource is designed to serve as a long-term planning tool for STEM departments to reform teaching evaluation practices.

The DNA Landscape: Development and Application of a New Framework for Visual Communication about DNA

L. Kate Wright, Emalee Wrightstone, Lauren Trumpore, Julia Steele, Deanna M. Abid, and Dina L. Newman

The DNA Landscape provides a research and learning tool that describes figures of DNA in two dimensions: scale and abstractness. Undergraduate biology textbooks tend to focus on particular parts of the landscape, but overuse of certain types of images may not be optimal for learning.

Postsecondary Faculty Attitudes and Beliefs about Writing-Based Pedagogies in the STEM Classroom

Solaire A. Finkenstaedt-Quinn, Anne Ruggles Gere, Jason E. Dowd, Robert J. Thompson Jr., Audrey S. Halim, Julie A. Reynolds, Leslie A. Schiff, Pamela Flash, and Ginger V. Shultz

This study presents the analysis of a nationwide survey focused on STEM faculty use of and beliefs about writing-based pedagogies. The findings indicate that beliefs about behavioral control, rather than the effectiveness of writing pedagogies, primarily differentiate the faculty who do and do not use writing assignments in their courses.

Relationships between Prediction Accuracy, Metacognitive Reflection, and Performance in Introductory Genetics Students

Jennifer K. Knight, Daniel C. Weaver, Melanie E. Peffer, and Zachary S. Hazlett

Students often overpredict their grades. This study explored whether predictions correlated with grades and changed over time and connected predictions to post-grade metacognitive reflections. Students who are already performing well both predict more accurately and provide the most metacognitive reflections.

“Oh, that makes sense”: Social Metacognition in Small-Group Problem Solving

Stephanie M. Halmo, Emily K. Bremers, Sammantha Fuller, and Julie Dangremond Stanton

When students collaborate they can stimulate metacognition in one another, which can lead to improved learning. Life science students were recorded during small-group problem-solving sessions. Through discourse analysis of their conversations, metacognitive statements and questions associated with high-quality reasoning were uncovered.

Developmental Trajectories of Student Self-Perception over a Yearlong Introductory Biology Sequence

Megan F. Cole and Christopher W. Beck

In a study of student self-perception over the course of a two-semester introductory biology sequence, students showed similar rates of increase in self-efficacy and science identity for all demographic groups. However, female and persons excluded due to ethnicity or race (PEER) students had lower initial scores that failed to “catch up” to male and non-PEER scores by the end of the year.

Biology Students’ Math and Computer Science Task Values Are Closely Linked

Alicia M. Caughman and Emily G. Weigel

Biology students are interested in and find utility in using math and computer science (CS) in biology courses, but also report costs. Previous course experience best predicts student attitudes. Overall, math and CS should be incorporated early and throughout the undergraduate biology curriculum to help students learn these vital skills.

Why Students Struggle in Undergraduate Biology: Sources and Solutions

Claire B. Tracy, Emily P. Driessen, Abby E. Beatty, Todd Lamb, Jenna E. Pruett, Jake D. Botello, Cara Brittain, Ísada Claudio Ford, Chloe C. Josefson, Randy L. Klabacka, Tyler Smith, Ariel Steele, Min Zhong, Scott Bowling, Lucinda Dixon, and Cissy J. Ballen

Student struggle in undergraduate biology is largely correlated with incoming preparation, instructor, and course performance. In this study, students often attributed their struggle to external sources (i.e., classroom factors, external resources, etc.); however, they were more likely to overcome internal sources of struggle.

All Groups Are Not Created Equal: Class-Based Learning Communities Enhance Exam Performance and Reduce Gaps

Vivian Hye-In Chi and Pavan Kadandale

We describe the design and implementation of a class-based learning community in which student collaboration is incentivized using principles from behavioral economics. We show that such learning communities correlate with increased student performance, and a narrowing of performance gaps for females and minoritized students.

Which Group Dynamics Matter: Social Predictors of Student Achievement in Team-Based Undergraduate Science Classrooms

Joshua Premo, Brittney N. Wyatt, Matthew Horn, and Heather Wilson-Ashworth

While group work tends to benefit students, less is known about the specific peer–peer dynamics that optimize learning during group interaction. This study explores how different group qualities either promote willingness to work with a group member or predict student achievement in group-based science courses.

Longitudinal Education and Career Outcomes of a Cancer Research Training Program for Underrepresented Students: The Meharry-Vanderbilt-Tennessee State University Cancer Partnership

Meredith L. Meadows, Sarah V. Suiter, Linda J. Sealy, Dana R. Marshall, Margaret M. Whalen, and Samuel E. Adunyah

A quantitative, longitudinal assessment of a multi-institution program designed to increase the number of underrepresented students participating in cancer research and entering cancer research careers.

Understanding the Benefits of Residential Field Courses: The Importance of Class Learning Goal Orientation and Class Belonging

Stephanie Shaulskiy, Alison Jolley, and Kari O’Connell

This study examines scientific literacy and future science plans of students in both residential field courses and on-campus courses, finding a unique benefit for these outcomes in residential field courses. Mediation analyses demonstrate the important role of class learning goal orientation and class belonging in explaining these benefits.

A Course-Based Undergraduate Research Experience Improves Outcomes in Mentored Research

Justin Fendos, Liang Cai, Xianmei Yang, Guodong Ren, Lin Li, Zhiqiang Yan, Boxun Lu, Yan Pi, Jinbiao Ma, Bin Guo, Xiaohui Wu, Pingli Lu, Ruilin Zhang, and Ji Yang

This study employed a course-based undergraduate research experience (CURE) to improve mentored research (MR) outcomes. Both CURE and MR outcomes are reported, with the former used to help explain the latter. A comprehensive implementation process is described, offering a model for the design of programs with similar research enhancement goals.

Evaluation of a Culturally Responsive Mentorship Education Program for the Advisers of Howard Hughes Medical Institute Gilliam Program Graduate Students

Christine Pfund, Fátima Sancheznieto, Angela Byars-Winston, Sonia Zárate, Sherilynn Black, Bruce Birren, Jenna Rogers, and David J. Asai

Culturally responsive mentorship education, like the Mentorship Skills Development course implemented as part of the Howard Hughes Medical Institute’s Gilliam Fellows Program, can increase knowledge and efficacy in effective mentorship practices and improve mentorship experiences of both mentors and mentees.

Examining the Variations in Undergraduate Students’ Conceptions of Successful Researchers: A Phenomenographic Study

Austin L. Zuckerman and Stanley M. Lo

This paper examines undergraduates’ conceptions of successful researchers. Three conceptions were identified based on variations within the following aspects: process of research, interactions with other researchers, and scope of contribution.

Understanding Homeostatic Regulation: The Role of Relationships and Conditions in Feedback Loop Reasoning

Andrea Kieseletter and Philipp Schmiemann

By applying established systems thinking theories, this study explores skills necessary to understand homeostatic regulation in life science education. It examines the influence of conditions and relationships on the requirement of homeostatic tasks. Item response theory models are applied to provide measures of item difficulty.

On the Cover

Image 2nd Place Cell Bio 2021 Image and Video Contest, American Society for Cell Biology. A flower blossoms for its own joy-Mitotic chromosomes, by Sounak Sahu, National Cancer Institute, NIH.