

Table of Contents

EDITORIAL

Sustaining CBE—Life Sciences Education

Erin L. Dolan

This editorial discusses next steps toward sustaining the journal.

CURRENT INSIGHTS

Insights from Small-*N* Studies

Julia Gouvea

Small-*N* studies have been relatively uncommon in biology education research and are likely less familiar to instructors and administrators than large-*N* studies. This group of recent papers illustrates how small-*N* studies can make contributions to education research and practice.

WWW.LIFE SCIENCES EDUCATION

More Than Metaphor: Online Resources for Teaching Cancer Biology

Amy J. Hawkins and Louisa A. Stark

Cancer biology can be a good hook to emotionally engage students with the life sciences. This Feature highlights free online resources to teach cancer biology, including materials that accompany the film *The Emperor of All Maladies*, lectures by experts hosted by the iBiology and HHMI websites, and a variety of other classroom resources.

ARTICLES

The Math–Biology Values Instrument: Development of a Tool to Measure Life Science Majors' Task Values of Using Math in the Context of Biology

Sarah E. Andrews, Christopher Runyon, and Melissa L. Aikens

This study describes the development of a survey grounded in expectancy-value theory, providing multiple forms of validity evidence to support its use as a measure of students' interest in using math to understand biology, the usefulness of math for one's life science career, and the perceived cost of using math in biology courses.

Gender, Math Confidence, and Grit: Relationships with Quantitative Skills and Performance in an Undergraduate Biology Course

K. M. Flanagan and J. Einarson

This study explores how students' acquisition of quantitative skills and success in an undergraduate biology course are influenced by the interrelationships between confidence in their mathematical abilities, their determination for achieving long-term goals—or grit—and gender.

Do Biology Students Really Hate Math? Empirical Insights into Undergraduate Life Science Majors' Emotions about Mathematics

Lucas P. Wachsmuth, Christopher R. Runyon, John M. Drake, and Erin L. Dolan

Undergraduate life science majors are reputed to have negative attitudes toward mathematics, yet little empirical evidence supports this belief. The adaptation and initial findings of a semantic differential measure of science and math majors' emotional satisfaction with math are reported here.

Reflecting on Graphs: Attributes of Graph Choice and Construction Practices in Biology

Aakanksha Angra and Stephanie M. Gardner

The authors conducted think-aloud interviews to reveal differences in reasoning and graph quality among undergraduate biology students, graduate students, and professors in a pen-and-paper graphing task. Similarities and differences between participant groups and the reasoning that occurred during planning, construction, and reflection phases are discussed.

Investigating Undergraduate Students' Use of Intuitive Reasoning and Evolutionary Knowledge in Explanations of Antibiotic Resistance

Melissa Richard, John D. Coley, and Kimberly D. Tanner

Evidence of relationships between misconceptions and systems of intuitive biological reasoning in undergraduate explanations of antibiotic resistance are presented. The findings indicate promising potential for using cognitive frameworks as a means of addressing common evolutionary and biological misconceptions.

Investigating Novice and Expert Conceptions of Genetically Modified Organisms

Lisa M. Potter, Sarah A. Bissonnette, Jonathan D. Knight, and Kimberly D. Tanner

This work extends previous studies exploring how undergraduate science students apply their classroom biology knowledge to everyday phenomena—in this case, genetically modified organisms (GMOs). Also described are how intuitive ways of thinking might underlie misconceptions that interfere with students applying their biology knowledge to GMOs.

The DNA Triangle and Its Application to Learning Meiosis

L. Kate Wright, Christina M. Catavero, and Dina L. Newman

The DNA triangle integrates three distinct scales at which one can think about DNA. Applying the DNA triangle to topics in meiosis enabled the creation of a new framework for educators and researchers that ties concepts of ploidy, homology, and mechanism of homologous pairing to knowledge about DNA on the chromosomal, molecular, and informational levels.

Do Biology Majors Really Differ from Non-STEM Majors?

Sehoya Cotner, Seth Thompson, and Robin Wright

This study clarifies, in broad terms, how biology majors differ from those not intending to major in STEM fields. The article concludes with suggestions for inclusive teaching for future scientists as well as an informed citizenry.

Introductory Biology Students' Use of Enhanced Answer Keys and Reflection Questions to Engage in Metacognition and Enhance Understanding

Jaime L. Sabel, Joseph T. Dauer, and Cory T. Forbes

This study examined the use of enhanced answer keys and reflection questions to support introductory biology students to engage in metacognition. The scaffolds supported students to consider their own understanding. Students who received directed instruction on the use of scaffolds had even greater benefit than students who received only the scaffolds.

Improving Exam Performance in Introductory Biology through the Use of Preclass Reading Guides

Rebekah Lieu, Ashley Wong, Anahita Asefirad, and Justin F. Shaffer

Custom reading guides for a large-enrollment introductory biology course were created to help students read their textbooks. Results showed that full completion of reading guides before class was significantly correlated with improved exam performance. Reading guides may be a simple way to promote student reading and improve learning.

Values Affirmation Intervention Reduces Achievement Gap between Underrepresented Minority and White Students in Introductory Biology Classes

Hannah Jordt, Sarah L. Eddy, Riley Brazil, Ignatius Lau, Chelsea Mann, Sara E. Brownell, Katherine King, and Scott Freeman

A short, scalable values affirmation intervention reduces the achievement gap between underrepresented minority students and white students in an introductory biology course.

Effectiveness of a Low-Cost, Graduate Student–Led Intervention on Study Habits and Performance in Introductory Biology

Tyler D. Hoskins, J. D. Gantz, Blake R. Chaffee, Kel Arlinghaus, James Wiebler, Michael Hughes, and Joyce J. Fernandes

A low-cost, graduate student–led, metacognition-based study skills course taught alongside introductory biology is described. The course improved scores on lecture exams, study habits, and specific study techniques (outlines/concept maps). Implications of the results for implementation of first-year interventions in STEM are discussed.

Increasing Research Productivity in Undergraduate Research Experiences: Exploring Predictors of Collaborative Faculty–Student Publications

Danielle X. Morales, Sara E. Grineski, and Timothy W. Collins

Biomedical faculty mentors were more productive in publishing collaboratively with undergraduate students when they worked with students for more than 1 year on average, enjoyed teaching students about research, and had mentored Black students.

Mentoring Interventions for Underrepresented Scholars in Biomedical and Behavioral Sciences: Effects on Quality of Mentoring Interactions and Discussions

Vivian Lewis, Camille A. Martina, Michael P. McDermott, Linda Chaudron, Paula M. Trief, Jennifer G. LaGuardia, Daryl Sharp, Steven R. Goodman, Gene D. Morse, and Richard M. Ryan

Mentor education and peer mentoring can enhance the breadth of mentor–protégé discussions and quality of dyad time for underrepresented minority scholars.

Providing Experiential Business and Management Training for Biomedical Research Trainees

Kimberly A. Petrie, Robert H. Carnahan, Abigail M. Brown, and Kathleen L. Gould

The implementation of a semester-long program for biomedical PhD trainees combining didactic exposure to business fundamentals with team projects aiming to solve business problems in institutional core facilities is described. Quantitative and qualitative evaluations suggest that the module succeeded in providing meaningful exposure to business concepts.

What Motivates Biology Instructors to Engage and Persist in Teaching Professional Development?

Jill S. McCourt, Tessa C. Andrews, Jennifer K. Knight, John E. Merrill, Ross H. Nehm, Karen N. Pelletreau, Luanna B. Prevost, Michelle K. Smith, Mark Urban-Lurain, and Paula P. Lemons

This qualitative study uses expectancy-value theory to explore the motivation for college biology instructors to participate and persist in teaching professional development for 2.5 years.

CORRECTION

A Call to Develop Course-Based Undergraduate Research Experiences (CUREs) for Nonmajors Courses

Cissy J. Ballen, Jessamina E. Blum, Sara Brownell, Sadie Hebert, James Hewlett, Joanna R. Klein, Erik A. McDonald, Denise L. Monti, Stephen C. Nold, Krista E. Slemmons, Paula A. G. Soneral, and Sehoya Cotner

On the Cover

Biological Context and Probe: *Herpetosiphon aurantiacus* is a filamentous nonphototrophic bacterium that exhibits gliding motility and is capable of predation on other bacteria. The picture brightness is linearly proportional to the dry mass distribution. Photo Credit: Michael Shribak and Irina Arkhipova.