

## Table of Contents

### CURRENT INSIGHTS

#### Recent Research in Science Teaching and Learning

*Sarah L. Eddy*

Three articles that explore the relationship between student evaluations and active learning, how instructors can encourage student metacognition through their classroom talk, and how instructors can encourage students to use more scientific reasoning in class discussions are summarized.

### MEETING REPORT

#### Formation of the Inclusive Environments and Metrics in Biology Education and Research (iEMBER) Network: Building a Culture of Diversity, Equity, and Inclusion

*Rachel E. Tennial, Erin D. Solomon, Latanya Hammonds-Odie, Gary S. McDowell, Michael Moore, Alberto I. Roca, and Jana Marcette*

The newly forming Inclusive Environments and Metrics in Biology Education and Research (iEMBER) network brings together interdisciplinary stakeholders with interests in diversity, equity, and inclusion. This report focuses on the network structure, takeaways that emerged from the 2017 iEMBER conference, and ways to become involved.

### RESEARCH METHODS

#### One Size Doesn't Fit All: Using Factor Analysis to Gather Validity Evidence When Using Surveys in Your Research

*Eva Knekta, Christopher Runyon, and Sarah Eddy*

The theoretical background for instrument validation is briefly reviewed, and how to use factor analysis to gather evidence about the number and nature of the latent variables in a survey is described. Example data, annotated codes, and output for factor analyses in R are provided.

### ESSAY

#### Classroom as Genome: Using the Tools of Genomics and Bioinformatics to Illuminate Classroom Observation Data

*Robert M. Erdmann and Marilyne Stains*

In this essay, a new approach to the analysis of classroom observation data, termed “classroom as genome,” or CAG, is introduced. Parallels between classroom observation data and genomic data are examined, and examples are provided to show how the tools of genomics and bioinformatics can be applied to classroom observation outputs.

## ARTICLES

### **A Model for Holistic Review in Graduate Admissions That Decouples the GRE from Race, Ethnicity, and Gender**

*Marenda A. Wilson, Max A. Odem, Taylor Walters, Anthony L. DePass, and Andrew J. Bean*

Work at the University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences highlights a method of holistic applicant review of doctoral applicants by which the Graduate Record Examination could be used as a tool in admissions in a manner that is independent of race, ethnicity, and gender and does not reflect its reported biases.

### **Prevailing Questions and Methodologies in Biology Education Research: A Longitudinal Analysis of Research in *CBE—Life Sciences Education* and at the Society for the Advancement of Biology Education Research**

*Stanley M. Lo, Grant E. Gardner, Joshua Reid, Velta Napoleon-Fanis, Penny Carroll, Emily Smith, and Brian K. Sato*

Biology education research (BER) is a growing field. To facilitate discussions on how BER has matured, a content analysis of *LSE* articles and SABER abstracts focusing on research questions, study contexts, and methodologies was conducted, with longitudinal trends being examined. Implications for the future of BER as a scholarly field are discussed.

### **Identifying Troublesome Jargon in Biology: Discrepancies between Student Performance and Perceived Understanding**

*Jenna M. Zukswert, Megan K. Barker, and Lisa McDonnell*

Types of discipline-specific vocabulary that students struggle with the most were identified. Students more often struggle with molecular terms describing abstract phenomena. Students very often overestimate their understanding of terms, typically those that are likely more familiar.

### **Molecular Concepts Adaptive Assessment (MCAA) Characterizes Undergraduate Misconceptions about Molecular Emergence**

*Andrea Gauthier, Stuart Jantzen, Gaël McGill, and Jodie Jenkinson*

Misconceptions regarding the emergent nature of molecular environments are deeply ingrained and resistant to change in undergraduate biology education. In this study, an adaptive assessment designed to provide a detailed characterization of these misconceptions was developed and distributed.

### **GenBio-MAPS: A Programmatic Assessment to Measure Student Understanding of *Vision and Change* Core Concepts across General Biology Programs**

*Brian A. Couch, Christian D. Wright, Scott Freeman, Jennifer K. Knight, Katharine Semsar, Michelle K. Smith, Mindi M. Summers, Yi Zheng, Alison J. Crowe, and Sara E. Brownell*

The *Vision and Change* report called for biology programs to focus instruction around core concepts. The development of a multiple-true-false assessment instrument designed to assess student understanding of these core concepts at different time points in a general biology program to guide curricular transformation is described.

### **Despite Similar Perceptions and Attitudes, Postbaccalaureate Students Outperform in Introductory Biology and Chemistry Courses**

*Erin E. Shortlidge, Liz Rain-Griffith, Chloe Shelby, Gwendolyn P. Shusterman, and Jack Barbera*

This study explores student perceptions of what influences their learning and interest, as well as their attitude toward active learning. Student perceptions and attitudes are similar, yet course performance varies significantly among student groups, namely, postbaccalaureate students outperform undergraduates.

### **Closing the Achievement Gap in a Large Introductory Course by Balancing Reduced In-Person Contact with Increased Course Structure**

*Sat Gavassa, Rocio Benabentos, Marcy Kravec, Timothy Collins, and Sarah Eddy*

Student performances in sections of an introductory biology course delivered in face-to-face, hybrid, and fully online formats were compared. It was found that performance of all students improved as course structure increased, even when contact time was decreased. Hispanic and Black students had higher scores in the hybrid format than in the online and face-to-face formats.

### **Laboratory Courses with Guided-Inquiry Modules Improve Scientific Reasoning and Experimental Design Skills for the Least-Prepared Undergraduate Students**

*Lawrence S. Blumer and Christopher W. Beck*

Across diverse institutions, student scientific reasoning skills and experimental design skills did not improve pretest to posttest in labs with guided-inquiry modules. However, when broken into quartiles based on pretest score within each course, students in the lowest quartile experienced significant gains not seen in the other quartiles.

### **Computer-Based and Bench-Based Undergraduate Research Experiences Produce Similar Attitudinal Outcomes**

*Catherine Kirkpatrick, Anita Schuchardt, Daniel Baltz, and Sehoya Cotner*

Student responses to three different course-based undergraduate research experiences (CUREs) offered within the same course are compared. Both computer- and bench-based CUREs are found to have positive impacts on students' attitudes. Development of more computer-based CUREs might allow larger numbers of students to benefit from participating in a research experience.

### **FAIL Is Not a Four-Letter Word: A Theoretical Framework for Exploring Undergraduate Students' Approaches to Academic Challenge and Responses to Failure in STEM Learning Environments**

*Meredith A. Henry, Shayla Shorter, Louise Charkoudian, Jennifer M. Heemstra, and Lisa A. Corwin*

The ability to navigate scientific challenges and failures is the hallmark of a successful scientist. To guide research aimed at understanding how, STEM undergraduates develop this ability, a model representing hypotheses of how students might approach challenges and respond to failures in STEM learning contexts is presented.

### **The Impact of a Pedagogy Course on the Teaching Beliefs of Inexperienced Graduate Teaching Assistants**

*Star W. Lee*

Inexperienced graduate teaching assistants (GTAs) completed a science-specific pedagogy course that emphasized student learning and how to support this process. This study used concept maps and presentations to investigate the impact of the course on the teaching beliefs of inexperienced GTAs.

#### *On the Cover*

Epithelial ovarian cancer single cell spreading its fibers to attach to the surface of a multicellular aggregate, a tumor cluster that promotes metastasis (false-colored scanning electron micrograph, 15,000× magnification). Image credit: Yuliya Klymenko, University of Notre Dame, Harper Cancer Research Institute.