

## Table of Contents

### GENERAL ESSAYS AND ARTICLES

#### CURRENT INSIGHTS

##### **Addressing Racism in Human Genetics and Genomics Education**

*Julia Svoboda Gouvea*

This installment of *Current Insights* reviews recent work addressing racism in human genetics and genomics education.

#### ESSAYS

##### **A Vision for University Biology Education for Non-science Majors**

*Cara Gormally and Austin Heil*

College biology education must prepare future college graduates to be engaged, science-literate citizens. This is especially important, because the vast majority of college students (82%) are non-science majors. This essay identifies aspects of science education critical for preparing science-literate non-science majors.

##### **An Instructor's Guide to Including Traditional Ecological Knowledge in the Undergraduate Biology Classroom**

*Rebeka F. Greenall and Elizabeth G. Bailey*

Indigenous students are underrepresented in science, and researchers have called for integration of TEK into Western science. We summarize practical suggestions and caution from the literature for undergraduate biology instructors who want to make their course more equitable for Indigenous students.

#### ARTICLES

##### **"It's completely erasure": A Qualitative Exploration of Experiences of Transgender, Nonbinary, Gender Nonconforming, and Questioning Students in Biology Courses**

*A. M. Aramati Casper, Nico Rebolledo, A. Kelly Lane, Luke Jude, and Sarah L. Eddy*

Students with queer genders describe exclusionary narratives about sex and gender in biology courses. These narratives harm students by lowering sense of belonging, career preparation, and interest in biology. Students employ resilience strategies and recognize the currently unrealized potential for biology to validate queer identities.

##### **Evidence for Professional Conceptualization in Science as an Important Component of Science Identity**

*Ariana S. Huffmyer, Tara O'Neill, and Judith D. Lemus*

Science identity development is critical for persistence in STEM. An examination of the experiences of five women in science found that participation in research influenced performance/competence beliefs and exploration of research interests. Conceptualization of self as a science professional was identified as an important component of science identity.

### **Demographics Matter: Non-white and White Life Science Graduate Students Perceive and Use Resources Differently**

*Maryrose Weatherton and Elisabeth E. Schussler*

We employed a national survey of life science graduate students ( $N = 534$ ) to describe student resource use outcomes and how these outcomes may be related to student demographic characteristics. ANOVA modeling indicated that student characteristics impacted resource use outcomes, with the greatest differentials between white and nonwhite students.

### **Faculty Experiences of the Impostor Phenomenon in STEM Fields**

*Devasmita Chakraverty*

Using a qualitative analysis of 56 faculty interviews, this U.S.-based study found that participants were predominantly White and female, experiencing moderate, high, or intense impostor phenomenon because of peer comparison, faculty evaluation, public recognition, the fear of not knowing, and a perceived lack of competency.

### **Probing Internal Assumptions of the Revised Bloom's Taxonomy**

*Tori M. Larsen, Bianca H. Endo, Alexander T. Yee, Tony Do, and Stanley M. Lo*

Bloom's taxonomy is a widely used classification of learning objectives and assessments in biology education. It is important to understand the underlying assumptions of the taxonomy. This paper empirically examines the independence of the knowledge-type and cognitive-process dimensions and the use of action verbs as proxies for cognitive processes.

### **Learning Introductory Biology: Students' Concept-Building Approaches Predict Transfer on Biology Exams**

*Mark A. McDaniel, Michael J. Cahill, Regina F. Frey, Lisa B. Limeri, and Paula P. Lemons*

This study identifies students who tend to be "abstraction learners" (extract the principles underlying related examples) versus those who tend to be "exemplar learners" (focus on memorizing the training exemplars and responses). This distinction predicts performance in general biology courses on exams constructed to contain transfer and retention questions.

### **Initial Development and Validation of the Plant Awareness Disparity Index**

*Kathryn M. Parsley, Bernie J. Daigle, and Jaime L. Sabel*

An outline of the development and validation of the Plant Awareness Disparity Index (PAD-I), which is designed to measure plant awareness disparity (PAD, formerly plant blindness) in undergraduate biology students, is presented.

### **Access to Online Formative Assessments in Lower-Division Undergraduate Biology Courses: Investigating Barriers to Student Engagement**

*Allison M. Upchurch, Dana L. Kirkwood-Watts, Kathleen R. Brazeal, Lorey A. Wheeler, Brian A. Couch, Gabrielle B. Johnson, and Sarah K. Spier*

Students in introductory biology courses at 2-year and 4-year institutions were surveyed to determine their degree of access with respect to completing online formative assessments. This study reports on five different areas in which students may face challenges and includes student recommendations for how instructors might help alleviate these barriers.

### **Comparing the Outcomes of Face-to-Face and Synchronous Online Research Mentor Training Using Propensity Score Matching**

*Jenna Rogers, Xue Gong, Angela Byars-Winston, Melissa McDaniels, Nancy Thayer-Hart, Philip Cheng, Kelly Diggs-Andrews, Kermin J. Martínez-Hernández, and Christine Pfund*

Mentors' perceived mentoring skill gains and overall quality of mentoring are comparable regardless of the training modality used—online versus face-to-face. As such, online mentoring training should be considered a viable option.

### **Student Motivations and Barriers toward Online and In-Person Office Hours in STEM Courses**

*Jeremy L. Hsu, Melissa Rowland-Goldsmith, and Elaine Benaksas Schwartz*

Office hours are one of the most common support mechanisms found in STEM courses. Despite their prevalence, little work has examined student motivations and barriers toward attending office hours. This article explores these student perceptions at a primarily undergraduate institution and also compares student and instructor views of office hours.

### **Faculty Experiences during the Implementation of an Introductory Biology Course-Based Undergraduate Research Experience (CURE)**

*S. E. DeChenne-Peters and N. L. Scheuermann*

Faculty experiences while implementing a course-based undergraduate research experience (CURE) are explored by interviewing faculty from four diverse institutions. Results indicate that resources, benefits, challenges, and feelings differ before and after CURE implementation and between different institutional types.

### **Experience with Scientific Teaching in Face-to-Face Settings Promoted Usage of Evidence-Based Practices during Emergency Remote Teaching**

*Mary Durham, Blake Colclasure, and Tessa Durham Brooks*

Changes in the use of evidence-based teaching practices during the transition to emergency remote teaching in the Spring of 2020 were measured. Usage of all practices declined, and active learning was the most impacted. Follow-up interviews helped shed light on what drove specific changes. Recommendations based on these data are provided.

### **The Influence of Instructor Behaviors and the Perceived Motivational Climate on Undergraduate Students' Experiences in College STEM Laboratories**

*Troy O. Wineinger, Mary D. Fry, and E. Whitney G. Moore*

This article breaks new ground in understanding biology teaching and learning by bringing an established theory applied to other educational fields to the college biology laboratory setting. The results of this study identify instructor behaviors that can facilitate creating an optimal motivational climate resulting in positive student outcomes.

### **Current Status and Implementation of Science Practices in Course-Based Undergraduate Research Experiences (CUREs): A Systematic Literature Review**

*Alaina J. Buchanan and Ginger R. Fisher*

This systematic literature review of CUREs published within the years 2000 through 2020 assesses each CURE curriculum for inclusion of the five primary components of CUREs as well as four specific science practices key to scientific reasoning. CUREs are compared according to their STEM discipline, subdiscipline in biology, and course level.

### **Motivating and Shaping Scientific Argumentation in Lab Reports**

*Julia Gouvea, Lara Appleby, Liren Fu, and Aditi Wagh*

This study evaluates an iterative design experiment in an introductory lab course in which instruction was restructured and uncertainty in lab activities was increased. It is proposed that these changes to the rhetorical context helped motivate and shape more authentic engagement in scientific argumentation.

### **External Collaboration Results in Student Learning Gains and Positive STEM Attitudes in CUREs**

*Kevin P. Callahan, Celeste N. Peterson, Betsy M. Martinez-Vaz, Kathryn L. Huisinga, Nicole Galport, Courtney Koletar, Rebecca M. Eddy, Joseph J. Provost, Jessica K. Bell, and Ellis Bell*

This study examines how the inclusion of structured external collaborations in course-based undergraduate research experiences (CUREs) affects learning outcomes. Students worked with faculty from an external institution to refine their hypotheses and discuss their data. In the collaborative CURE cohort, students had greater gains in learning outcomes compared with students in standard CUREs and no-CURE controls.

**“Bed bugs live in dirty places”—How Using Live Animals in Teaching Contributes to Reducing Stigma, Disgust, Psychological Stigma, and Misinformation in Students**

*Roman Asshoff, Benedikt Heuckmann, Mike Ryl, and Klaus Reinhardt*

Bed bugs are increasingly perceived as harmful parasites and represent an important public health and environmental justice concern and thus a health education issue. This article examines how stigma, disgust, psychological distance, and myths about bed bugs change over time in response to two forms of teaching intervention using live animals and pictures.

**What College Biology Students Know about How Vaccines Work**

*Gavina Kahlon, Fareshta Waheed, and Melinda T. Owens*

A sample of more than 600 college biology students were asked: “How does a vaccine work?” A rubric was created to score the presence of basic knowledge about vaccines and the accuracy of students’ knowledge and documented inaccurate ideas. The prompt and rubric provide a new way to gauge college student understanding of how a vaccine works and what college students know about this process.

**Putting the Pieces Together: Student Thinking about Transformations of Energy and Matter**

*Kush S. Bhatia, Austin Stack, Cheryl A. Sensibaugh, and Paula P. Lemons*

Research on student thinking from the pieces perspective reveals students’ independent, fluctuating ideas about metabolism.

**A Longitudinal Study Identifying the Characteristics and Content Knowledge of Those Seeking Certification to Teach Secondary Biology in the United States**

*Kimberly Linenberger Cortes, Joshua W. Reid, Rebekah Fallin, Jie Hao, Lisa Shah, Herman E. Ray, and Gregory T. Rushton*

Demographic and performance data from examinees who took the Praxis® Biology Subject Assessment exam from 2006 to 2015 were compared. Findings revealed substantial differences in average performance and pass rates between examinees of different genders, races, undergraduate majors, undergraduate grade point averages, and census regions.

**Collaborative Teaching plus (CT+): A Timely, Flexible, and Dynamic Course Design Implemented during Emergency Remote Teaching in an Introductory Biology Course**

*Kamal S. Dulai, Petra Kranzfelder, Adriana Signorini, Téa S. Pusey, Andrea Presas Valencia, Christian Urbina, and Néstor J. Oviedo*

This case study presents a flexible and dynamic course design administered by multiple instructors simultaneously. The integration of multiple instructors allowed for knowledge exchange in blending complementary behaviors and discourse practices during class sessions. This course design could be adapted to STEM courses in higher education.

**Peer-Modeled Mindsets: An Approach to Customizing Life Sciences Studying Interventions**

*Cameron A. Hecht, Anita G. Latham, Ruth E. Buskirk, Debra R. Hansen, and David S. Yeager*

Mindset interventions can promote diversity in STEM but require customization. A customization protocol was developed and used to create a “peer-modeled” mindset intervention for introductory biology. Underrepresented students randomly assigned to receive the intervention reported better psychological experiences and earned more “As” in the class than those assigned to a control condition.

## **SPECIAL ISSUE ON COMMUNITY COLLEGE BIOLOGY EDUCATION RESEARCH**

### **Increased Pass Rates in Introductory Biology: Benefits and Potential Costs of Implementing a Mathematics Prerequisite in a Community College Setting**

*Stacey L. Kiser, Christine M. Andrews, Shannon B. Seidel, Matthew R. Fisher, Natalie A. Wright, and Elli J. Theobald*

An 11 year retrospective assessment of pass rates, course grades, and student demographics before and after implementing a math prerequisite for an introductory biology course. Probability of passing increased with prereq. Enrollment proportion of persons excluded due to ethnicity or race (PEERs) increased more than comparison groups.

### **Evaluating the Representation of Community Colleges in Biology Education Research Publications following a Call to Action**

*Catherine Creech, Jan Just, Sarah Hammarlund, Cleo E. Rolle, Ngawang Y. Gonsar, Alyssa Olson, Nikaila Campbell, Karissa Mennes, Cecilia Adoradio, Paula Soneral, Sharday Ewell, Clay Mazur, A. Kelly Lane, James Hewlett, and Sehoya Cotner*

This paper examines the extent to which community college biology education research (CC BER) has progressed since initial calls for broadening participation by comparing the number of CC BER publications, identifies barriers to and opportunities for community college faculty BER participation, and highlights the importance of institutional networks as a driver for incorporating CC faculty in BER.

## **CORRECTION**

### **Moving the Needle: Evidence of an Effective Study Strategy Intervention in a Community College Biology Course**

*Sheela Vemu, Kameryn Denaro, Brian K. Sato, Matthew R. Fisher, and Adrienne E. Williams*

### *On the Cover*

Cell Bio 2021 Image and Video Contest, American Society for Cell Biology. Dividing HeLaM cell, by Nadja Hümpfer, Freie Universität Berlin.