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The Minorities Affairs Committee of the American Society for Cell Biology— Fostering the Professional Development of Scientists from Underrepresented Minority Backgrounds

Verónica A. Segarra, Franklin Carrero-Martínez, and Erika Shugart

APPROACHES TO BIOLOGY TEACHING AND LEARNING

Teaching as Brain Changing: Exploring Connections between Neuroscience and Innovative Teaching

Melinda T. Owens and Kimberly D. Tanner

One would hope that of the many ways to conceptualize teaching and learning, scientists would view these processes as driving biological changes in the brain. Here, the authors draw connections between innovative teaching techniques and neuroscience that may support our understanding of why innovative teaching is so effective at promoting learning.

CURRENT INSIGHTS

Reintroducing the Current Insights Feature

Julia Gouvea and Sarah L. Eddy

As the new coeditors of the *Current Insights* feature, we will draw on our different backgrounds, expertise, and scopes of interest beyond biology education to bring a broad range articles to *LSE* readers. In this, our first issue, we have each chosen to highlight two recent articles that have impacted our teaching and/or research.

MEETING REPORTS

Broadening Participation in Biology Education Research: Engaging Community College Students and Faculty

Jeffrey N. Schinske, Virginia L. Balke, M. Gita Bangera, Kevin M. Bonney, Sara E. Brownell, Robert S. Carter, Douglas Curran-Everett, Erin L. Dolan, Samantha L. Elliott, Linnea Fletcher, Beatriz Gonzalez, Joseph J. Gorga, James A. Hewlett, Stacey L. Kiser, Jenny L. McFarland, Anjali Misra, Apryl Nenortas, Smith M. Ngeve, Pamela A. Pape-Lindstrom, Shannon B. Seidel, Matthew C. Tuthill, Yue Yin, and Lisa A. Corwin

Though nearly half of all undergraduates are enrolled at community colleges (CCs), only 3% of papers from a sample of biology education research (BER) journals related to CC contexts. This paper reports the results of a meeting convened to identify affordances and constraints associated with CC BER and describes support strategies for advancing CC BER going forward.

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

A discussion of course-based undergraduate research experiences (CUREs) for nonscience majors (nonmajors) that summarizes the state of knowledge of best practices for nonmajors CUREs, identifies future research priorities, and recommends tools to align research questions with student outcomes.

RESEARCH METHODS

Checking Equity: Why Differential Item Functioning Analysis Should Be a Routine Part of Developing Conceptual Assessments

Patrícia Martinková, Adéla Drabinová, Yuan-Ling Liaw, Elizabeth A. Sanders, Jenny L. McFarland, and Rebecca M. Price

A test may be unfair when students with the same knowledge but from different demographic groups perform differently on its items. Identifying and addressing this differential item functioning (DIF) helps ensure a fair, unbiased test. This *Research Methods* paper will help biology education researchers identify DIF items in their assessments.

ESSAY

Broadening Participation in the Sciences within and from Africa: Purpose, Challenges, and Prospects

Iruka N. Okeke, Chinedum P. Babalola, Denis K. Byarugaba, Abdoulaye Djimde, and Omolaja R. Osoniyi

Women, first-generation literates, and rural inhabitants are underrepresented in African science. Africa also contributes little to the global scientific enterprise. Science in African countries could be enhanced by giving preference to underrepresented groups for increased access, teaching, and research synergies and encouraging purposeful collaborations.

ARTICLES

How Question Types Reveal Student Thinking: An Experimental Comparison of Multiple-True-False and Free-Response Formats

Joanna K. Hubbard, Macy A. Potts, and Brian A. Couch

A comparison of questions posed in multiple true–false and free-response formats reveals how the question type affects diagnosis of the degree to which students hold correct and incorrect understandings.

The Case for Biocalculus: Design, Retention, and Student Performance Carrie Diaz Eaton and Hannah Callender Highlander

Models for developing and implementing biology-oriented Calculus I courses at two institutions are presented. These courses are aligned with *Vision and Change* curriculum recommendations and maintain core calculus concept rigor, but DWF rates meaningfully and significantly decreased.

University Students' Conceptual Knowledge of Randomness and Probability in the Contexts of Evolution and Mathematics

Daniela Fiedler, Steffen Tröbst, and Ute Harms

Two instruments—<u>Randomness</u> and <u>Probability</u> Test in the Context of <u>Evolution</u> (RaProEvo) and <u>Randomness</u> and <u>Probability</u> Test in the Context of <u>Mathematics</u> (RaProMath)—that include both multiple-choice and free-response items were developed. The results indicate that they generate reliable and valid inferences.

ASPECT: A Survey to Assess Student Perspective of Engagement in an Active-Learning Classroom

Benjamin L. Wiggins, Sarah L. Eddy, Leah Wener-Fligner, Karen Freisem, Daniel Z. Grunspan, Elli J. Theobald, Jerry Timbrook, and Alison J. Crowe

This paper describes the development and validation of a survey to measure students' self-reported engagement during a wide variety of in-class active-learning exercises. The survey provides researchers and instructors alike with a tool to rapidly evaluate different active-learning strategies from the perspective of the learner.

Conceptual Elements: A Detailed Framework to Support and Assess Student Learning of Biology Core Concepts

Tawnya Cary and Janet Branchaw

The authors break down the *Vision and Change* core concepts into elements that transcend biological subdisciplines and scales in a new learning framework. The Conceptual Elements Framework can be used to guide the development of core concept learning outcomes, instructional materials, and assessments of student learning.

Development and Validation of the Homeostasis Concept Inventory

Jenny L. McFarland, Rebecca M. Price, Mary Pat Wenderoth, Patrícia Martinková, William Cliff, Joel Michael, Harold Modell, and Ann Wright

The Homeostasis Concept Inventory (HCI) is a 20-item multiple-choice instrument that assesses how undergraduates understand homeostasis. The authors explain how they developed the HCI and collected evidence about its validity and reliability. The process included seeking feedback from students and instructors at all types of undergraduate institutions.

Curriculum Alignment with Vision and Change Improves Student Scientific Literacy Anna Jo Auerbach and Elisabeth E. Schussler

Students who experienced a reformed introductory curriculum designed to align with the *Vision and Change* report recommendations demonstrated higher gains in scientific literacy when compared with students who had experienced the previous curriculum.

Investigating the Relationship between Instructors' Use of Active-Learning Strategies and Students' Conceptual Understanding and Affective Changes in Introductory Biology: A Comparison of Two Active-Learning Environments Lacy M. Cleveland, Jeffrey T. Olimpo, and Sue Ellen DeChenne-Peters

This study examines the impact of different active-learning strategies—graphic organizers and worksheets compared with clicker-based case studies—in an introductory biology course. Data reveal the differential effects of these strategies on students' conceptual understanding, attitudes, and motivation in biology.

Integrating Concepts in Biology Textbook Increases Learning: Assessment Triangulation Using Concept Inventory, Card Sorting, and MCAT Instruments, Followed by Longitudinal Tracking

Douglas B. Luckie, Anne-Marie Hoskinson, Caleigh E. Griffin, Andrea L. Hess, Katrina J. Price, Alex Tawa, and Samantha M. Thacker

This study examined the educational impact of an inquiry-focused textbook, *Inte*grating Concepts in Biology (ICB). Our findings support those of another study that found that performance of an ICB cohort also surpassed that of peers and suggest that the ICB textbook enables learning gains beyond those found using traditional content-focused textbooks.

A Problem-Sorting Task Detects Changes in Undergraduate Biological Expertise over a Single Semester

Anne-Marie Hoskinson, Jessica Middlemis Maher, Cody Bekkering, and Diane Ebert-May

Using a problem-sorting task, this study explored whether students actually develop biological expertise in their introductory courses. Two variables best predicted whether students advanced toward biological expertise: a dosage effect and the availability of a core conceptual framework. This work shows the importance of students connecting facts and ideas.

Effectiveness and Adoption of a Drawing-to-Learn Study Tool for Recall and Problem Solving: Minute Sketches with Folded Lists

Paul D. Heideman, K. Adryan Flores, Lu M. Sevier, and Kelsey E. Trouton

When using a sketching method for studying (minute sketches with folded lists) in comparison with a preferred study method (visual review), college biology students retained 50–80% more content and improved problem solving. Following an intervention experiment, most participants adopted the study method, significantly increasing sketching as a study aid.

How Should I Study for the Exam? Self-Regulated Learning Strategies and Achievement in Introductory Biology

Amanda J. Sebesta and Elena Bray Speth

Within the context of a large-enrollment, introductory biology course, this study identifies which self-regulated learning strategies that students reported using are associated with higher exam grades and with improvement in exam grades early in the course.

Metacognition in Upper-Division Biology Students: Awareness Does Not Always Lead to Control

Kathryn Morris Dye and Julie Dangremond Stanton

The authors used qualitative methods to study the metacognitive skill of evaluation in upper-division biology students. They explored when, why, and how students evaluate their approaches to learning and found that most students adjust their approaches after evaluation, but some choose not to use effective strategies in order to avoid discomfort.

Students' Use of Optional Online Reviews and Its Relationship to Summative Assessment Outcomes in Introductory Biology

Shana K. Carpenter, Shuhebur Rahman, Terry J. S. Lund, Patrick I. Armstrong, Monica H. Lamm, Robert D. Reason, and Clark R. Coffman

This study was designed to measure students' voluntary use of retrieval practice as a review tool. Students who used test-based reviews scored higher on exams than students who used reading-based reviews. Showing students exam performance associated with test- vs. reading-based reviews coincided with a significant increase in use of test-based reviews.

An Analysis of the Perceptions and Resources of Large University Classes Ceilidh Barlow Cash, Jessa Letargo, Steffen P. Graether, and Shoshanah R. Jacobs

This paper presents a mixed-methods analysis of large, medium, and small classes by combining the results of a qualitative survey with a multivariate statistical analysis. The qualitative analysis reveals patterns in student and instructor perception, while the quantitative results reveal how large classes are being modified to accommodate more students.

Evaluating Psychosocial Mechanisms Underlying STEM Persistence in Undergraduates: Evidence of Impact from a Six-Day Pre–College Engagement STEM Academy Program

Danielle Findley-Van Nostrand and Richard S. Pollenz

A cohort of diverse freshman entering a large urban research university showed increased science identity and sense of belonging to STEM and to the university after a short cocurricular STEM Academy (SA). The SA is an example of a cost-effective, scalable experience to enhance undergraduate persistence in STEM that showed 98% first-year retention.

How Do You Like Your Science, Wet or Dry? How Two Lab Experiences Influence Student Understanding of Science Concepts and Perceptions of Authentic Scientific Practice

Maureen Munn, Randy Knuth, Katie Van Horne, Andrew W. Shouse, and Sheldon Levias

This study examines how two kinds of authentic research experiences related to smoking behavior—genotyping human DNA (wet lab) and using a database to test hypotheses about factors that affect smoking behavior (dry lab)—influence students' perceptions and understanding of scientific research and related science concepts.

Race and Gender Differences in Undergraduate Research Mentoring Structures and Research Outcomes

Melissa L. Aikens, Melissa M. Robertson, Sona Sadselia, Keiana Watkins, Mara Evans, Christopher R. Runyon, Lillian T. Eby, and Erin L. Dolan

Undergraduate research with mentorship from faculty may be particularly important for ensuring the persistence of women and minority students in science. This study examines whether undergraduate researchers' outcomes differ in relation to their gender or race/ethnicity and whether the mentoring structures they experience explain the differences.

Examining Summer Laboratory Research Apprenticeships for High School Students as a Factor in Entry to MD/PhD Programs at Matriculation

Robert H. Tai, Xiaoqing Kong, Claire E. Mitchell, Katherine P. Dabney, Daniel M. Read, Donna B. Jeffe, Dorothy A. Andriole, and Heather D. Wathington

Do summer laboratory research apprenticeships during high school have an impact on entry to MD/PhD programs? This quantitative study (n= 236,432) examines the connection between laboratory research apprenticeship experience at the high school level and matriculation into one of the more rigorous educational programs for scientific research training.

Using Next-Generation Sequencing to Explore Genetics and Race in the High School Classroom

Xinmiao Yang, Mark R. Hartman, Kristin T. Harrington, Candice M. Etson, Matthew B. Fierman, Donna K. Slonim, and David R. Walt

Modern genetics relies on cutting-edge sequencing and bioinformatics technologies. A high school experiment that explores current sequencing techniques in the context of race and genetics is described.

Fair Play: A Study of Scientific Workforce Trainers' Experience Playing an Educational Video Game about Racial Bias

Anna Kaatz, Molly Carnes, Belinda Gutierrez, Julia Savoy, Clem Samuel, Amarette Filut, and Christine Maidl Pribbenow

Capitalizing on the potential effectiveness of game-based learning to have a positive impact on persistent subtle race bias in academic science, the authors developed Fair Play, an interactive role-playing educational video game targeting science faculty. Fair Play appears to promote perspective taking and bias literacy, which can reduce race bias.

CORRECTION

Time-to-Credit Gender Inequities of First-Year PhD Students in the Biological Sciences

David F. Feldon, James Peugh, Michelle A. Maher, Josipa Roksa, and Colby Tofel-Grehl

On the Cover

Desmid Micrasterias, a chlorophyceae alga of extraordinary beauty, beginning to divide. Micrasterias have bilateral symmetry, with two mirror image semicells joined by a narrow isthmus containing the nucleus. Image captured using darkfield and polarized light. Antonio Guillén, Honorable Mention, 2010 Olympus BioScapes Digital Imaging Competition[®].