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FEATURES

From the National Academies

Insights from a Convocation: Integrating Discovery-Based Research into the Undergraduate Curriculum

Sarah C. R. Elgin, Gita Bangera, Sean M. Decatur, Erin L. Dolan, Laura Guertin, Wendy C. Newstetter, Elvyra F. San Juan, Mary A. Smith, Gabriela C. Weaver, Susan R. Wessler, Kerry A. Brenner, and Jay B. Labov

The National Academies of Sciences, Engineering, and Medicine organized a convocation in 2015 to explore and elucidate opportunities, barriers, and realities of course-based undergraduate research experiences, known as CUREs, as a potentially integral component of undergraduate science, technology, engineering, and mathematics education. This paper summarizes the convocation and resulting report.

WWW. Life Sciences Education

Bringing Climate Change into the Life Science Classroom: Essentials, Impacts on Life, and Addressing Misconceptions

Amy J. Hawkins and Louisa A. Stark

Most life science educators are unaware of the scientific consensus regarding climate change. This *Feature* highlights free online resources to teach climate change, including research summaries, materials about the life science impacts of climate change, and resources that address common misconceptions and “skeptical” arguments.

RESEARCH METHODS

A Primer for Developing Measures of Science Content Knowledge for Small-Scale Research and Instructional Use

Kristin M. Bass, Dina Drits-Esser, and Louisa A. Stark

This essay, intended for faculty involved in small-scale projects, courses, or educational research, provides a step-by-step guide to the process of developing, scoring, and validating content knowledge assessments. The authors illustrate their discussion with examples from their measures of high school students’ understanding of cell biology and epigenetics.

ESSAYS

Beyond the Cell: Using Multiscalar Topics to Bring Interdisciplinarity into Undergraduate Cellular Biology Courses

Carolyn F. Weber

This essay discusses bringing interdisciplinarity into undergraduate cellular biology courses through the use of multiscalar topics.

A Conceptual Framework for Graduate Teaching Assistant Professional Development Evaluation and Research

Todd D. Reeves, Gili Marbach-Ad, Kristen R. Miller, Judith Ridgway, Grant E. Gardner, Elisabeth E. Schussler, and E. William Wischusen

This essay proposes a conceptual framework for biology graduate teaching assistant professional development evaluation and research with three overarching variables for consideration: outcome variables, contextual variables, and moderating variables.

ARTICLES

Colleagues as Change Agents: How Department Networks and Opinion Leaders Influence Teaching at a Single Research University

T. C. Andrews, E. P. Conaway, J. Zhao, and E. L. Dolan

This study investigates colleague–colleague relationships within life sciences departments and how they may promote teaching reform. The authors found that discipline-based education researchers are perceived as promoting changes among colleagues in views about teaching and teaching practices. Other faculty may also be leveraged to support change.

Practices and Perspectives of College Instructors on Addressing Religious Beliefs When Teaching Evolution

M. Elizabeth Barnes and Sara E. Brownell

From 32 interviews with college instructors who teach evolution, we found that the majority do not consider student acceptance of evolution as a goal when they teach evolution. Further, instructors cited a number of barriers to addressing the perceived conflict between religion and evolution in their classrooms.

Improved Student Learning through a Faculty Learning Community: How Faculty Collaboration Transformed a Large-Enrollment Course from Lecture to Student Centered

Emily R. Elliott, Robert D. Reason, Clark R. Coffman, Eric J. Gangloff, Jeffrey R. Raker, Jo Anne Powell-Coffman, and Craig A. Ogilvie

The authors describe how a faculty learning community was leveraged to implement active-learning strategies and improve student learning in a large-enrollment introductory course.

Teaching Real Data Interpretation with Models (TRIM): Analysis of Student Dialogue in a Large-Enrollment Cell and Developmental Biology Course

Patricia Zagallo, Shanice Meddleton, and Molly S. Bolger

Data interpretation is an important skill that should be developed within undergraduate biology courses. The authors present instruction in which students collaborate to understand authentic data using biological models. Research in this classroom utilized real-time student dialogues to reveal students' data-interpretation strategies.

Development and Assessment of Modules to Integrate Quantitative Skills in Introductory Biology Courses

Kathleen Hoffman, Sarah Leupen, Kathy Dowell, Kerrie Kephart, and Jeff Leips

Recent reports have called for integrating quantitative reasoning into biology courses to prepare students for careers in research and medicine. This article describes the development, implementation, and assessment of modules designed to incorporate quantitative reasoning and skill development into introductory biology courses.

Development of the Central Dogma Concept Inventory (CDCI) Assessment Tool

Dina L. Newman, Christopher W. Snyder, J. Nick Fisk, and L. Kate Wright

This article describes the development of a research-based assessment tool, the Central Dogma Concept Inventory. The instrument consists of 23 multiple-select questions about information flow in molecular biology and gauges conceptual understanding in depth across the undergraduate curriculum.

Development of a *Lac* Operon Concept Inventory (LOCI)

Katherine M. Stefanski, Grant E. Gardner, and Rebecca L. Seipelt-Thiemann

Gene regulation is an important topic in modern genetics, but learning concepts related to this concept can be difficult. To assess learning of gene regulation, a 12-item *Lac* Operon Concept Inventory (LOCI) was developed. The data gathered were found to be both valid and reliable. In addition, some student misconceptions were identified.

Multilevel Assessment of Middle School Students' Interest in the Health Sciences: Development and Validation of a New Measurement Tool

William L. Romine, Michele E. Miller, Shawn A. Knese, and William R. Folk

The authors utilize the frameworks of multilevel assessment and Rasch modeling to develop and validate the Assessment of Interest in Medicine and Science (AIMS), a three-subscale tool for measuring student interest in science and health careers at the middle school level.

Exploring the MACH Model's Potential as a Metacognitive Tool to Help Undergraduate Students Monitor Their Explanations of Biological Mechanisms

Caleb M. Trujillo, Trevor R. Anderson, and Nancy J. Pelaez

This multiple case study explores a teaching intervention in an introductory undergraduate biology classroom that aimed to guide students to explain biological mechanisms using the MACH model, a previously developed model of the components used by interviewed biologists to explain mechanisms.

Cognitive Difficulty and Format of Exams Predicts Gender and Socioeconomic Gaps in Exam Performance of Students in Introductory Biology Courses

Christian D. Wright, Sarah L. Eddy, Mary Pat Wenderoth, Elizabeth Abshire, Margaret Blankenbiller, and Sara E. Brownell

In a study examining more than 4800 student exams in introductory biology, the authors found that exam characteristics differentially impact students based on gender and socioeconomic status.

Changes in Biology Self-Efficacy during a First-Year University Course

Louise Ainscough, Eden Foulis, Kay Colthorpe, Kirsten Zimbardi, Melanie Robertson-Dean, Prasad Chunduri, and Lesley Lluca

Biology self-efficacy was measured in first-year students. Self-efficacy was lower in females than in males, most noticeably in high-achieving students. High school experience contributed to self-efficacy at the beginning of the semester, and this was replaced by progressive grades at the end of the semester. Self-efficacy did not correlate with exam grades.

Early Engagement in Course-Based Research Increases Graduation Rates and Completion of Science, Engineering, and Mathematics Degrees

Stacia E. Rodenbusch, Paul R. Hernandez, Sarah L. Simmons, and Erin L. Dolan

This study shows that participation in course-based undergraduate research experiences (CUREs) improves students' likelihood of graduating with a STEM degree and graduating within 6 years. These results support offering CUREs in place of standard lab courses as an effective strategy for producing additional college graduates with STEM degrees.

A Social Capital Perspective on the Mentoring of Undergraduate Life Science Researchers: An Empirical Study of Undergraduate-Postgraduate-Faculty Triads

Melissa L. Aikens, Sona Sadselia, Keiana Watkins, Mara Evans, Lillian T. Eby, and Erin L. Dolan

Undergraduate researchers are often mentored by graduate or postdoctoral researchers who are in turn mentored by faculty, creating a "mentoring triad." This study characterizes the prevalence of different mentoring triads at research universities and the relationships between undergraduates' membership in specific triads and their research outcomes.

Development of the Neuron Assessment for Measuring Biology Students' Use of Experimental Design Concepts and Representations

Annwesa P. Dasgupta, Trevor R. Anderson, and Nancy J. Pelaez

An assessment was developed to measure student and expert ability to design experiments in an authentic biology research context. The design process involved providing background knowledge and prompting the use of visuals to discriminate a range of abilities. The process shows potential for informing assessment design in other disciplines.

Scaling Up: Adapting a Phage-Hunting Course to Increase Participation of First-Year Students in Research

Nancy L. Staub, Marianne Poxleitner, Amanda Braley, Helen Smith-Flores, Christine M. Pribbenow, Leslie Jaworski, David Lopatto, and Kirk R. Anders

To offer a research experience to all students taking introductory biology, the authors modified the traditional two-semester Science Education Alliance Phage Hunters Advancing Genomics and Evolutionary Science (SEA-PHAGES) course by streamlining the first semester Phage Discovery lab and integrating research from the second SEA-PHAGES semester into other courses in the biology curriculum.

A Quasi Experiment to Determine the Effectiveness of a “Partially Flipped” versus “Fully Flipped” Undergraduate Class in Genetics and Evolution

Alison E. M. Adams, Jocelyn Garcia, and Tinna Traustadóttir

Two sections of a course on genetics and evolution were taught using active learning. Materials and assessments were identical; the main difference was in the amount of time spent on active learning in the classroom in each section. There was no significant difference in objective student learning outcomes or attitudes toward the course.