

ASU researcher leads national effort to transform undergraduate biology education

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Arizona State University undergraduate students study biology in an 'active learning' classroom. Credit: Sandra Leander

During the past few decades, the field of biology has dramatically expanded, incorporating many diverse sub-disciplines and specialty areas such as microbiology and evolutionary biology. However, teaching biology to undergraduate students has not kept pace with the changes, and core biology curriculum varies widely from university to university, and classroom to classroom.

In an effort to both capture the diversity of biology and condense what is taught, an Arizona State University researcher is leading a grassroots effort to improve [biology education](#) throughout the United States.

Working with a team from the University of Washington to collect feedback from more than 240 biologists nationwide, ASU assistant professor Sara Brownell has developed a new, detailed core concept template called BioCore Guide. The guide is intended to provide an updated blueprint for educators to help them clarify the learning outcomes for [undergraduate students](#) majoring in general biology.

"What we really wanted to articulate was, at the end of four years, what do we want a graduating general biology major to know about the core concepts of biology?" asked Brownell, an education researcher with ASU's School of Life Sciences in the College of Liberal Arts and Sciences. "Even if they end up specializing in neuroscience or microbiology, there are some fundamental concepts in ecology and molecular biology that we want them to know. We especially want students to understand that these core concepts extend across sub-disciplines of biology."

The complete guide appears today in the online journal *Cell Biology Education—Life Sciences Education*, a quarterly journal frequently read by researchers and biology educators.



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BioCore Guide builds on previous reform efforts

Brownell's research builds on initial efforts in 2011 by the National Science Foundation (NSF) and the American Association for the Advancement in Science (AAAS) to reform undergraduate biology education. Through conversations with more than 500 biologists and biology educators, NSF and AAAS developed a set of recommendations and five core concepts outlined in the paper "Vision and Change in Undergraduate Biology Education: A Call to Action."

The five core concepts include evolution, information flow, structure function, transformations of energy and matter, and systems.

"Vision and Change provides just a paragraph or two, not a lot of specificity," said Brownell. "It's hard for educators to read, take back to class, and figure out how they should teach a particular subject in biology. So, we decided to more clearly communicate what the core concepts of Vision and Change actually mean for general biology majors. Other sub-disciplines of biology have already done this for students in their sub-discipline specific courses, but no one has done it for general biology majors."



Arizona State University undergraduate students study biology with associate

professor Valerie Stout. Credit: Sandra Leander

The BioCore Guide provides overarching principles for each core concept, as well as 40 statements that illustrate the concepts within each major subdivision of biology including molecular, cellular and developmental biology; physiology; and ecology and [evolutionary biology](#). The statements and principles have already been nationally validated by hundreds of biologists and biology educators.

Brownell added, "Looking at biology education from a broader perspective, we need to stop lecturing to students in a large lecture hall about the tiny details of biology. One solution is to teach through active learning environments. Another is to start tracking our students' progress through the major."

Brownell and her colleagues plan to use the BioCore Guide as the basis for developing a curriculum assessment that can track how well biology majors understand the core concepts throughout their undergraduate studies. She adds that the BioCore Guide is not meant to dictate when a subject should be taught, or what to teach, but rather to serve as a resource for both faculty and biology departments to generate conversations that lead to a plan for improvements in [biology](#) education.

Provided by Arizona State University

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