

Feature From the National Science Foundation

The Vision Is Set, Now Help Chronicle the Change

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The Vision and Change effort to explore and implement needed changes in undergraduate biology education has been ongoing since 2006. It is now time to take stock of changes that have occurred at the faculty and single-course levels, and to consider how to accomplish the larger-scale changes needed at departmental and institutional levels. This article is a continuation of our efforts to keep people informed about the next steps for Vision and Change, in particular ongoing activities that need community (your) input, and what resources are available to support the Vision stated in 2009: “the biology we teach should reflect the biology we do” (American Association for the Advancement of Science [AAAS], 2011).

BACKGROUND

From the beginning, Vision and Change has been an effort supported by three funding agencies (the Howard Hughes Medical Institute [HHMI], the National Institutes of Health [NIH], and the biological sciences and the education and human resources directorates of the National Science Foundation [NSF]), the AAAS BiosciEdNet project (representing the many biological professional societies), and the National Research Council (NRC).

The journey to the Vision began as a small conversation convened in July 2007. Bruce Alberts graciously cut short a vacation to preside at that first Vision and Change event.

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Before he did so, he asked whether this would be just another one of “those discussion” meetings or would there be follow-through. We answered that we were determined to follow through, and not only to engage the biology community in needed dialogue but also to find ways to help the community realize the vision once it was crafted. We felt that the time had come to commit to such an effort. NRC reports such as *BIO2010* (NRC, 2003a) and *Improving Undergraduate Education in Science, Technology, Engineering, and Mathematics* (NRC, 2003b) had informed the community of the existence and value of new understandings of how students learn and new technologies to facilitate learning. More recently, overviews of the state of biology, such as the NRC reports *A New Biology for the 21st Century* (NRC, 2009), *The New Science of Metagenomics* (NRC, 2007), *The Role of Theory in Advancing 21st-Century Biology: Catalyzing Transformative Research* (NRC, 2008), *Discipline Based Education Research* (NRC, 2012) and the exciting research reports being published and presented at professional society meetings make it obvious that biology is a changed science. The courses of 20 yr ago do not serve the students or the biology community well in terms of what students learn and how we challenge them to think (President’s Council of Advisors on Science and Technology, 2012).

INITIAL REACTIONS

The number of citations referencing *Vision and Change* is a demonstrable outcome that the seeds sown fell on rich soil, and the ideas were heard by open ears. In December 2011, examination of Web citations referencing *Vision and Change in Undergraduate Biology Education* resulted in 192 nonduplicated URLs. In August 2012, a partial search resulted in more than 250 unique URLs. The nature of the content appears to be changing from simple citations of the material to in-depth discussion and advocacy for *Vision and Change* recommendations. Discipline-based professional societies, such as the American Society for Microbiology, the American Society of Plant Biologists, the Genetics Society, and the American Institute for Biological Sciences, are posting updates regarding such Vision and Change topics as educational tools and curriculum changes, while also promoting such developments in their communities. Academic professional societies, such

as the American Association of Universities (AAU, 2012), the American Association of Community Colleges, and the American Association of State Colleges and Universities, also have noted the message of *Vision and Change* in reports or citations within their websites. An increasing number of journal articles from *CBE—Life Sciences Education* and the *Journal of Molecular & Biochemical Education* reference *Vision and Change*. More universities are hosting seminars and workshops to discuss questions about their curricula and new aspects of learning. In addition, postings of citations and interest in *Vision and Change* have increased. For example, as of December 2011, individual assessment of unique URLs yielded 15 citations of *Vision and Change* at academic institutions' websites. Conversely, a similar assessment since December 2011 disclosed 30 such citations at academic institutions. As of September 14, 2012, there was also a total of 8508 unique hits to the *Vision and Change* website and 3465 downloads of the *Vision and Change* final report (a conservative indication of total readership, considering more than 6000 print versions have been distributed and the existence of other sites that provide access to the report). Projects such as Penn State Lehigh Valley University's Connecting Humans and Nature through Conservation Experiences program are introducing inquiry-based learning through an extensive network of participants across the globe, with the call of *Vision and Change* referenced (www.lv.psu.edu/Academics/ugradresearch.htm). The fact that references to *Vision and Change* are increasing, rather than decreasing, 3 yr after the meeting is encouraging! Clearly the ideas generated are percolating through the community.

Perhaps an even more tangible and important outcome of the 2009 meeting and resultant report is the start-up of the Partners in Undergraduate Life Science Education (PULSE) initiative (www.pulsecommunity.org), organized by the three funding agencies and the American Institute for Biological Sciences. PULSE is providing a website for community building and exchange of ideas and is leading the way to produce *An Implementation Framework for Change*.

The material below highlights: 1) what is happening now and will happen in the near future; 2) opportunities existing for you, the reader, to help us move forward; and 3) resources to support your efforts.

WHAT'S HAPPENING AND YOUR PLACE IN THESE EVENTS

Many of these events were previewed in the Fall issue of *CBE-LSE* (Dolan, 2012). Events needing feedback from the community (you) are preceded by an asterisk (*).

PULSE Actions: They Are Designed for You

The names of the 40 Vision and Change Leadership Fellows were announced September 7, 2012. The Fellows met in October and crafted a preliminary version of *An Implementation Framework for Change* posted on the PULSE website in November 2012. The *Framework* will be available for comment through mid-May 2013. It is an important document and will be well worth reading. Your comments on the *Framework* are an important component of the next steps for bringing biology undergraduate education into the 21st century. **Please go to the site* (www.pulsecommunity.org), *click, read, and comment*.

PULSE Discussion Forums

The PULSE Forum (www.pulsecommunity.org/forum) is designed to encourage conversations on specific issues in undergraduate biology education; there is a wide array of topics listed, and the list is growing. Topics range from a discussion of stereotype threats in the classroom to how to engage one's colleagues in advancing pedagogical change.

PULSE Community Groups

These are essentially birds-of-a-feather groups that form as people discover that they share interests and confront similar challenges. Some groups have formed around institutional types (from community colleges to research-intensive institutions), others around specific pedagogical interests ("math across the curriculum" or "transforming the traditional lecture").

Vision and Change: Chronicling the Changes

Reports such as *Vision and Change* tend to appear, cause a stir, and recede into the background. They are rarely followed by a coordinated effort to chronicle outcomes of the report that answer the question "What does the report inspire?" At the 2009 Vision and Change meeting, a commitment was made to try to follow the precepts of scientific teaching (Handelsman *et al.*, 2006) by documenting and reporting on the trajectory of change following the meeting. The three activities listed below (the call for abstracts, the online survey, and the August 2013 Change meeting) represent an attempt to capture a substantive sample of postconference activities. They will add to, and enrich, the materials currently on the Vision and Change website (<http://visionandchange.org>).

Call for Abstracts

There is now an online call from the AAAS for abstracts chronicling your responses to *Vision and Change*. Brief abstracts should contain the following information: the change(s) you made, outcomes of the changes instituted, and how those outcomes were determined and documented, as well as information about any changes that your efforts have inspired at a departmental or larger institutional unit level, and how these more global efforts were achieved. A representative sample of those submitting abstracts (about 150 people) will be invited to attend the Change meeting (see below) and to bring a colleague with them—a faculty member contemplating but not yet engaged in the change effort, a change-enabling administrator, or a student who can give insight into the change process and outcomes. This is an important activity. Your input is needed for the contemplated online Change document to be as useful as the Vision document has been. **Please go to the Vision and Change website and submit an abstract, even if you will be unable to attend the meeting. All abstracts will be included on the site.*

Online Survey

This survey is currently being prepared. It will specifically ask for information concerning what people have done as a result of having participated in some way in the Vision and Change process. It will go online in the Spring of 2013 and will be available to all Vision and Change conference participants and all individuals who requested a copy of the *Vision and Change* report.

The Change Meeting

An important component of the Vision and Change effort is the use of well-documented evidence as a means of establishing the effectiveness of any actions recommended. In this spirit, an invitational meeting in Washington, DC, is scheduled for August 27–29, 2013, to discuss well-documented cases illustrating how people have effected change in their own teaching efforts and at their institutions. Topics of discussion will be drawn from the rich information gathered from the submitted abstracts, the results of the AAAS Spring 2013 Change survey, and the working version of the implementation framework to be posted by the PULSE initiative in June of 2013. Conferees will discuss the changes they have effected in terms of outcomes, both at the level of courses and at more systemic levels. The result from these efforts will be a website that documents how change has been accomplished, the outcomes of the changes instituted, and how people are documenting these outcomes.

In sum: *An Implementation Framework for Change* will provide the structure of how change occurs; the document emerging from the August 2013 meeting will provide specific examples from the field of how change has been accomplished. Each product will complement the other.

NSF Programs to Fund Change

While many of the changes needed to bring undergraduate biology education into the 21st century can be introduced without infusion of external funds, there are times when external support is needed to buy the time or expertise or to acquire unique equipment needed to catalyze change. NSF has five programs that can potentially provide that financial support: Science, Technology, Engineering, and Mathematics Talent Expansion Program; Transforming Undergraduate Education in Science (TUES); Research Experiences for Undergraduates; Research Coordination Networks–Undergraduate Biology Education (RCN-UBE); and Faculty Early Career Development. We are surprised that two of these programs (TUES and RCN-UBE) have been underutilized by the community. The TUES program was put in place to support changes in undergraduate education in a variety of science, technology, engineering, and mathematics disciplines. The RCN-UBE program is specifically crafted to catalyze formation of networks of people engaged in addressing specific issues in undergraduate biology education. Funding rates for these two programs currently average about 25% for biology projects submitted to TUES and 40% for RCN-UBE proposals. Within both of these programs, the reasons why proposals are declined for support center around the need for the submitters to be more explicit about both the subject matter and the teaching approaches to be instituted, as well as the need to have a clear plan for determining outcomes as the proposed project progresses. Some proposers also neglect to put their ideas into the context of what others are doing, and what their work might add to the community's wisdom about undergraduate education. Examples of recently funded projects within these programs that cite and incorporate precepts from *Vision and Change* are given below. Additional information on these funding mechanisms and the application process can be found at the NSF website (www.nsf.gov).

TUES. Type 2 proposals (up to \$600,000 total for up to 4 yr) are due January 14, 2013; Type 1 proposals (up to \$200,000 total for up to 3 yr) are due May 2013 (date to be announced in February 2013).

- Example of a funded project in materials development: 1122616, Graham Walker, Massachusetts Institute of Technology: Producing StarCellBio, a set of in silico simulations of cell biology experiments for use in generating realistic problems for undergraduate student lecture and laboratory classes (<http://star.mit.edu/index.html>).
- Example of a funded project in curricular approaches: 1044453, Elizabeth Dinsdale, San Diego State University: Implementing a series of multidisciplinary courses in ecosystem genomics that teach next-generation DNA sequencing technology to undergraduate students, enabling them to analyze the resultant data and interpret the effects of genomic changes in the context of ecosystem health and function (<http://sealiongenome.org>).

RCN-UBE. Both full-project proposals (up to \$500,000 for 5 yr) and incubator-track proposals (up to \$50,000 for 1 yr) will have a due date in June 2013 (exact date to be announced).

Example of a funded project: 1154681, Erin Dolan, University of Georgia: CUREnet, a network of people funded to introduce authentic research into their courses. Its aim is to bring these people together to discuss mutual challenges and successes. The first meeting in the Spring of 2012 attracted 32 attendees representing 23 projects, some funded by NSF, some by HHMI (www.curenet.franklin.uga.edu).

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