

Program Description

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Introduction

Introductory science courses at large universities in the United States serve as the portals that connect undergraduates to frontiers in research and scientific ways of thinking. An introductory undergraduate biology class might be the only exposure many students have to the life sciences, or to any of the sciences. It often serves as the best opportunity to interest students in a biomedical research or other life science career. However, according to the 2003 NRC report, *BIO2010: Transforming Undergraduate Education for Future Research Biologists*, teaching practices have not kept pace with advances in scientific research. Consequently, the gateway through which most students pass is antiquated, misrepresents the interdisciplinary, collaborative, evidence-based culture of science, and fails to implement current knowledge about how people learn. *Bio2010* identified faculty development as a crucial component in improving undergraduate biology education and suggested the creation of a Summer Institute during which life sciences faculty would work to improve their educational skills by integrating current scientific research with new pedagogical approaches and to create courses that actively engage students in the ways that scientists think.

The Summer Institutes

One substantive result of this recommendation has been the development of the annual National Academies Summer Institutes for Undergraduate Education in Biology. These unique Institutes are designed to model the scientific teaching principles on which they are founded and draw on the expertise of both participants and presenters. The Summer Institutes have provided a venue since 2004 for teams of faculty from primarily research-intensive universities to meet



The 2011 Madison Summer Institute.

for five days of in-depth discussions, demonstrations, and working sessions on research-based approaches to undergraduate biology education. The idea is to generate the same atmosphere as a Cold Spring Harbor research course, but with the topic being issues in education rather than, for instance, phage genetics. Current research in effective practices in undergraduate science education, active learning, assessment, and diversity are woven through the week, creating a forum for participants to share ideas with each

other and develop innovative instructional materials that they are expected to implement when they return to their own campuses. The current target audiences have been faculty and academic leaders from universities where large classes, especially at the beginners' level for both life sciences majors and for students with other career goals, provide

significant impediments to reform. Some universities have sent a team of two to three people to one Institute. Others have sent multiple teams (consisting of different people each year) over two or more years. There is a particular emphasis on including pre-tenured as well as more senior faculty as members of the team.

The Institutes also train a cadre of mentor/facilitators who work with participating teams each summer. Many of these facilitators are alumni from Summer Institutes in previous years, selected for this honor based upon observations of their performance during the Institute they attended. Each annual session consists of a series of plenary sessions in the mornings and facilitated small group activities during the afternoons. All plenary sessions model the kinds of evidence-based active teaching and learning that the Institutes stress for improving undergraduate education. Topics include subjects such as active teaching, how people learn, formative and summative assessment, teaching to diverse student populations, mentoring, and working with colleagues to improve teaching and learning.

Each small group consists of participants from two or three university teams and focuses on producing a “teachable tidbit” within some broad area of biology or interconnected disciplines (e.g. biology/chemistry, biology/mathematics). A tidbit is an integrated module that combines aspects of classroom, laboratory or field experiences, assessment, and techniques to help diverse student populations learn more effectively. Small groups are given time to interact with each other during the week to critique each other’s tidbits as they are developed. Each team then presents its “tidbit” on the next-to-last day. Each tidbit is peer-reviewed by other participants, facilitators, and members of the organizing committee. All resources and products of each Institute are collected on a portal and made available to all participants, current and previous.

At the 2012 Summer Institutes, 213 individuals from 74 universities participated. Over the course of the Institutes (2004-2012), 710 people have participated from 167 institutions in 46 states and the District of Columbia. Because so many of these participants serve as instructors in large lecture-style courses, collectively they have taught more than 250,000 undergraduates.

The National Academies recognizes the commitment of these participants by naming each as an “Education Fellow in the Life Sciences” for the year following their attendance at the Summer Institutes and by notifying key academic leaders on their campuses about this honor. From its inception, the Summer Institutes have been a research project. Data from participants are collected and analyzed regularly to determine the impact of this initiative. In addition, HHMI sponsors a mid-year meeting for one representative from each university team approximately six months after their participation in an Institute to measure success, challenges, and new activities that have emerged from their participation.

Because of their success to date, HHMI has provided a new award to the Summer Institutes that will enable their expansion to several Institutes each year in various regions across the United States. Four of these regional institutes were organized in 2011, seven in 2012. Seven regional institutes will be held each year over the next four years of the grant.

The 2013 Summer Institutes are scheduled as follows:

- Southeast, May 13-17, 2013, University of Georgia, Athens
- West Virginia, June 2-7, 2013, West Virginia University
- Midwest, July 8-13, 2013, University of Minnesota-Twin Cities
- Mountain West, July 22-26, 2013, University of Colorado-Boulder
- Gulf Coast, July 22-26, 2013, Louisiana State University
- West Coast, July 22-27, 2013, University of Hawaii-Manoa
- Northeast, Aug. 4-9, 2013, Stony Brook University

Links to the individual regional institutes in 2013 and in the future are available at www.academiessummerinstitute.org/.

These institutes adhere to the structure and emphasis of the Madison Institute but also will expand the pool of educators beyond faculty in research-intensive universities. Data about the participants in these institutes and how they change their approaches to teaching and student learning will continue to be collected and analyzed.

Research and evaluation

Robust evaluation provides essential feedback for program development and decision-making. The current and evolving evaluation plan for the Summer Institutes, 2011-2015, incorporates the major program activities, evaluation questions, participants or data sources, evaluation measures, evaluation design, approach to analysis, and the current reporting process. The evaluation plan guides the complex array of activities associated with assessing the institutes. It will adapt as the circumstances of program implementation require and is not intended to be rigid and inflexible.

The primary purpose of the Summer Institute (SI) evaluation is to identify and assess scientific teaching faculty outcomes (active learning, assessment, diversity) at their home institutions as a direct result of attending the National Academies Summer Institutes on Undergraduate Education in Biology, both from 2004-2011 as the Madison SI as well as from 2011-2015 for the regional SIs. A secondary purpose of the evaluation is to assess whether the scientific teaching curriculum was successfully implemented from 2004-2011 (the Madison SI) as well as to assess whether the Madison SI model can be successfully implemented at seven regional institutes each summer from 2011 through 2015. Aspects include past, present, and future SI curriculum structure and instructional materials.

As regional SI implementation progresses, how the SIs and the principles of scientific teaching (active learning, assessment, and diversity) are implemented nationwide by trained faculty is of central interest. Historical data will establish baselines for comparison at the regional level. Moving forward, there are three specific evaluation questions for 2011-2012:

1. To what extent do SI participants demonstrate knowledge, skill, and attitudes concerning the core principles of scientific teaching (active learning, assessment, and diversity)?
2. How do individual regional site leaders perceive and implement the SI? (What do they see as the key objectives? What implementation choices do they make? What are their reasons for these decisions?)
3. To what extent do SI participants indicate satisfaction with their SI experience? Does this vary substantially across regions?

The measures currently in use or development for the present evaluation period (2011-2012) include an SI “teachable tidbit” observation checklist, ongoing participant reflections, daily facilitator debriefings, a post-SI interview protocol for each regional leader, and ongoing refinement of the SI self-report exit survey.