Resources from the Preparing Faculty Group:
Vision and Change Conference

1. STEM Teaching Certification Program

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Proposal

Offer a certification program in STEM teaching for graduate students who are pursuing the PhD. The program would prepare students for careers that include undergraduate teaching, and would be structured so that it can be completed in the equivalent of one semester. Much or most of the work could be done in the context of an intensive seminar course.

Sponsoring agencies

Perhaps NSF, AAAS, NAS/NAE, or HHMI would be interested agencies

Proposed requirements

1. General exam given by a supervisory committee member who specializes in scholarship of teaching.

Written questions on classic papers in scholarship of teaching;

Oral exam assessing a) mastery of recent research in teaching the student's discipline, and b) familiarity with effective teaching strategies and technologies (concept mapping, think/pair/share and peer teaching, case/problem-based learning in groups, clickers, tablet pcs, etc.). This requirement could be met by satisfactory completion of a graduate-level course on techniques in STEM teaching, given at the student's home institution.

2. Research experience

Participate in a study on student learning that results in a published paper, poster, or conference presentation. Alternatively, write a grant proposal for a study related to scholarship of teaching in your discipline.

3. Practicum, directed by a supervisory committee member whose research interests include the scholarship of teaching

Create, test/assess, and revise an exercise or teachable unit that is implemented in a course related to your discipline. Submit the revised exercise, along with data documented its impact on student learning, to a national "teaching bank" administered by the sponsoring agencies, so the material is available for others to use.

Create, test, and revise 3 exam questions given in a course related to your discipline. Each question should be ranked on Bloom's taxonomy of learning, identified by topic area, and accompanied by data quantifying student answers. Submit the revised questions to a national "teaching bank" administered by the sponsoring agencies, so the material is available for others to use.

Create a laboratory or tutorial exercise—or revise an existing exercise—given in a course related to your discipline. After testing and revision, submit it to a national "teaching bank" administered by the sponsoring agencies, so the material is available for others to use.

Design a proposed course in your discipline, including a list of learning goals, an outline of assessments, and a detailed description of how class/lab/discussion section components will be organized.

Certification process
The candidate's request for certification would be approved pending review of six deliverables: 1) the written component of the general exam, along with a letter from the supervisory committee member attesting to satisfactory completion of the oral portion; 2) the course exercise or teachable unit, 3) the exam questions, 4) lab/tutorial exercise, 5) proposed course design, and 6) the research paper, poster, presentation, and/or grant proposal.
Philosophy and motivation
The overall goals of this program are to 1) train PhDs in the basics of good STEM teaching practice, 2) cultivate a commitment to evidence-based teaching among newly minted PhDs, and 3) improve the quality of college-level STEM teaching, as measured by recruitment and retention rates and performance on standardized tests or other indices of achievement. STEM teaching certification should be seen as something that significantly enhances a new PhD's job-hunting prospects.
2. STEM Teaching Certification Program
David Lynn, Emory University
Bridging the Gap: A Research-Based Approach for Teaching Interdisciplinary Science to Undergraduate Freshman Students. Jessica Sales, Dawn Comeau, Kathleen Liddle, Nikki Khanna, Lisa Perrone, Katrina Palmer, and David Lynn. Journal of College Science Teaching May/June 2006 pg. 36-41.
3. STEM Teaching Certification Program
David Lynn, Emory University
The American Science Pipeline: Sustaining Innovation in a Time of Economic Crisis. Gillian Hue, Jessica Sales, Dawn Comeau, David G. Lynn and Arri Eisenl. Submission to the Chronicle of Higher Education
4. Examples of Successful Strategies (Question 2)
Lillian Tong, University of Wisconsin, Madison
Delta (http://www.delta.wisc.edu/), the UW Madison version of CIRTL (Center for the Integration of Research, Teaching, and Learning), stresses Learning Community. There are a number of activities- roundtables, expeditionary learning, etc. that are across all levels from graduate student through faculty.
Instructional Materials Development class, part of Delta (see poster #50, p. 55). The class has graduate students and faculty working together in teams on materials for STEM classes (or in one semester, all teams were from the Intro Bio course). This addresses the integration as well as culture because students see that teaching improvement is iterative and worthy of time even by senior faculty.
National Academies Summer Institute (SI) on Undergraduate Education in Biology is a strategy for overcoming a number of limitations. Note that junior faculty attending SI while in Madison have an opportunity to give a research talk in their disciplinary community and I try to choose hosts who are appropriate to further the research part of the career. The institution encourages

junior faculty to talk to the hosts about why they are at the SI (integration of research and teaching).
In an NSF funded program, BIGS (Biology Interest Groups), we assessed the student outcomes, and also the faculty. Our questions had to do with why they decided to participate and what they thought they got out of it. They learned how to teach using effective small groups and how to teach with cases. One goal was promoting student ownership of their learning, and students themselves integrating what they learn in chemistry and calculus around biology cases. Participation (no money was given to faculty) was motivated by a worthy goal (in this case, getting students to remember the chemistry and math and be motivated to think like a scientist). Important features are learning community- faculty did this together, and support, as well as something new to learn, but about a familiar content area of their choice- sense of autonomy.

5. Examples of Successful Strategies (Question 2)

Ann C. Smith, University of Maryland, College Park MD (asmith@umd.edu)
Milt Cox defines a successful **learning community** as a community where faculty share ideas and receive constructive feedback in an atmosphere of trust and respect. (Cox, M.D., 2004. in Building Faculty Learning Communities: New Directions for Teaching and Learning, No. 97, edited by M. D. Cox and L. Richlin Jossey-Bass, San Francisco. 2004: 5–23)
Two examples of learning communities from the University of Maryland:
1. The Marquee faculty, who have been working on teaching science classes for non- science majors: http://www.marqueecourses.umd.edu/marqueefaculty.html. This group includes faculty from 3 colleges at the University of Maryland and has met monthly for two years to develop the curriculum of the Marquee courses. An article about the group: http://cte.umd.edu/teaching/newsletter/2008-09/Nov-Dec08.pdf
2. The Host Pathogen Interaction Teaching Community (http://www.clfs.umd.edu/hpi/) who are a set of faculty whose research is in the area of Host Pathogen Interactions. This group has a shared research interest in host pathogen interactions but the conversation is about teaching concepts of host pathogen interactions in eight microbiology courses. The group has been meeting monthly since 2004. An article about the group: Marbach-Ad, G., V. Briken, et al. 2007. Cell Biol. Educ. 6:155–162 http://www.lifescied.org/cgi/reprint/6/2/155?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=1&author1=marbach&andorexacttitle=and&andorexacttitleabs=and&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec=relevance&resourcetype=HWCIT,HWELTR%29. The HPI teaching community has developed a concept inventory (Marbach-Ad, G. Briken, V., et al., 2009. J. Microbiol and Biol Ed http://www.microbelibrary.org/Edzine/Journal/PDFs/2009/pp43-50Marbach-Ad.pdf) to assess students learning of Host Pathogen Interaction concepts and is presently working on the development of research oriented activities that will be used to engage students in learning science in the context of the scientific process. This work is funded by an NSF CCLI grant.
Studies that indicate the **importance of involving faculty in curriculum reform**:

1. Brigham, S. E. 1996. Change, 28(6): 28-39

2. Silverthorn. D.U., Thorn, P.M., et al. 2006. Advances in Physiology Education, 30: 204-214