

Executive Summary
Educating Future Science Faculty for Careers at Predominately
Undergraduate Institutions
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Introduction

During his address to the National Academy of Sciences during its 146th Annual Meeting on April 27, 2009, President Obama presented a compelling case for improving science education in the United States of America. He stated that “the nation that out-educates us today will out-compete us tomorrow.” The President added that of the developed nations in the world, our K-12 students rank in the middle of the pack with respect to science and math achievement. His charge to the NAS was that we must improve science education if we are to remain the leading nation in the world economy. I believe that this improvement begins with those who teach future K-12 science educators, that is faculty in higher education. Pursuant to the goal of improving the teaching and mentoring skills of future science faculty, a roundtable discussion was held at the Trust on Tuesday, March 16, 2010 focused on the idea of envisioning a graduate training program for science Ph.D. students who wish to pursue a career at a predominately undergraduate institution (PUI). The target group that would benefit from such a program would be made up of graduate students who know from the outset that they are interested in pursuing a career at a PUI. The program would be designed to train graduate students to excel as teachers and scholars in the environment of a PUI. In the end, a program would be considered successful if it produced effective teachers and research mentors at PUIs. To this end, we began by examining successful programs at major research institutions that were designed to train future science faculty and considered how the environment at a PUI might necessitate a different approach. One model emerged as being immediately viable as a pilot program. This model could be implemented as a regional, competitive grant program where each region would be funded by a separate organization.

An Emerging Model

An emerging model would be a 25 week program (10 weeks during the summer plus a 15 week semester) that could be called *Educating Future Faculty in Undergraduate Teaching and Research* or EFFURT.

EFFURT Program Structure

A PUI would apply to be a host site for up to 3 graduate students from across the STEM disciplines, in which they will provide:

- (a) residency for the Ph.D. student in an active research group, where the student will serve as a senior scientist in the research program of the PUI-PI, including mentoring undergraduate research students;
- (b) opportunity for the Ph.D. student to carry out research that is aligned with, or complementary to, the student’s thesis work, as determined by a matching process between applicants and host labs;

- (c) opportunity to teach an introductory course in the student's discipline under the continuing guidance of a faculty mentor;
- (d) opportunity to shadow a faculty mentor in the preparation and teaching of an upper-division course in the student's sub-discipline;
- (e) opportunity for the Ph.D. student to interact closely with the PUI host department and institution in order to better understand the PUI environment as a professional home, including a series of regular activities for the visiting students to introduce them to various aspects of life as a faculty member at a PUI.

Cost of Supporting an EFFURT Student

- (1) stipend, health care and fringe benefits for the participants that matches the appointment level that the student would have had at the DRU (up to \$12,000);
- (2) reimbursement for travel (up to \$500);
- (3) a \$5,000 bursary, to an account managed by the PUI-PI, to cover research-related expenses; this should be flexible enough, for instance, to help hire an additional undergraduate research student because of the extra mentoring capacity in the research group, or to pay for normal research expenses;
- (4) an allotment of up to \$500 per student per month, paid to the institution, to cover expenses incurred in carrying out this program (budget required)*.

*Given the short time duration, we strongly recommend that housing be provided by the institution in either a dormitory or institution-owned house. The grant will cover the customary housing costs for the entire 25 week program.

The total cost of supporting one EFFURT student would be \$20,000 - \$25,000/student for 25 weeks (the current NSF REU budget guideline is \$800-1000/week/student, so this appears to be a reasonable cost estimate for this program).

The Regional Support Strategy

The M. J. Murdock Charitable Trust has long supported innovation in science education in the Pacific Northwest. The EFFURT program could be the next step for the institutions involved in the Murdock College Science Research Program. Since its inception, the MCSRP has had a dramatic impact on the state of undergraduate research in the PNW. A significant number of our students now compete successfully for positions in the best graduate and professional programs in the world. The anecdotal evidence from PIs and admissions personnel suggests that meaningful experiences conducting cutting-edge research under the close mentorship of a faculty member is a necessary component of a successful application for post-baccalaureate study. The EFFURT program would be a way to enhance the teaching and mentoring abilities of the future faculty members at PUIs. In addition to the long-term advantage to the graduate students who engage in this program, there are several immediate advantages to the PUI. The undergraduate research partners would enjoy increased contact with a senior scientist in the lab and the PI would enjoy greater productivity with the extra help as well as fostering a much stronger collaboration with a colleague at the DRU. Furthermore, the institution would be able to

accommodate a larger number of undergraduate research students during the summer and fall semester.

The Pilot Program

I envision that the pilot program in the PNW could be three years in duration awarded to several institutions with up to three students per institution per year. The total number of graduate students impacted would depend upon the level of funding available but the number of undergraduate students impacted would likely be two to three times the number of EFFURT students. The following table shows the cost of supporting this program as a function of number of EFFURT students for a three-year duration.

Table 1: Program cost as a function of number of students for a three-year duration.

Students	Year 1/\$	Year 2/\$	Year 3/\$	Total Cost/\$
1	20500	20500	20500	61500
2	41000	41000	41000	123000
3	61500	61500	61500	184500
4	82000	82000	82000	246000
5	102500	102500	102500	307500
6	123000	123000	123000	369000
7	143500	143500	143500	430500
8	164000	164000	164000	492000
9	184500	184500	184500	553500
10	205000	205000	205000	615000
11	225500	225500	225500	676500
12	246000	246000	246000	738000

Other Models for Consideration or Further Study

- Graduate student in-residence at a PUI

A Ph.D. student who desires a career at a PUI would seek a research advisor who has established a long-term collaboration with an investigator at a PUI with the goal of creating a research project that would satisfy the following criteria.

1. The results would be publishable and the scope of the project would be suitable for a Ph.D. thesis.
2. A significant component of the work could be performed on-site at the PUI.
3. Undergraduate research partners could be meaningfully involved in the work.

The relationship between the Ph.D. student and the research groups at the PUI and research institutions must be made clear in order for this to work. While the specific details of each arrangement would be unique (e.g. research project, equipment/facilities, teaching schedule, etc.), there should be a standard set of guidelines to ensure that the student progresses toward the

degree at an acceptable rate. The teaching component of the program would come in the form of a one-on-one interaction with the mentor at the PUI. The Ph.D. student would have the opportunity to observe lecture and laboratory instruction while working with the mentor to develop syllabi and instructional materials.

- Separate 10 week research and 15 week teaching programs

This program would contain all of the elements of the 25 week EFFURT program except that it would be divided into separate research and teaching experiences. The advantage of this program over the 25 week EFFURT program would be more flexibility when planning the leave time from the home institution.

- A 10 week research experience at a PUI with a teaching experience at the home institution

This program would contain the research mentoring elements of the 25 week EFFURT program but the teaching experience would occur at the student's home institution. The advantage to this program is that the graduate student would have the experience of working with undergraduate research partners at the PUI while the classroom experience would occur where they are conducting their thesis research; thereby, causing less disruption of the work that will move them toward degree completion.

- A 15 week teaching experience at a PUI

This program would contain the teaching and mentoring elements of the 25 week EFFURT program without the 10 week summer experience. There would still be some component of conducting research with undergraduates but the focus would remain on the teaching aspect of the program.

- The 25 week EFFURT program for post-doctoral fellows

This program would contain all of the elements of the 25 week EFFURT program but it would be open to those who have already earned their Ph.D. degrees. This is not a separate program per se, but it does change the dynamics of candidate selection and it reduces the probability of collaboration between the PUI-PI and DRU-PI. The advantage of this scenario is that it reduces the potential for conflict between the interested graduate student and the thesis advisor. That said, by structuring a program so as to avoid pushback from PIs at DRUs, we would miss an opportunity to affect a culture shift in making pedagogical training part of the graduate education.