

## Appendix I

# Graduate Students and Postdoctorates from Phase 3 PFF Disciplines

This appendix places the Phase 3 PFF project in the sciences and mathematics within the larger context of graduate education. In 1998, graduate enrollment in science disciplines (NSF 2002a) was approximately 17 percent of total (NCES 2002). However, about half of all Ph.D. degrees conferred between July 1, 1999 and June 30, 2000 (FY2000) were in the sciences (NSF 2001).

Table I provides data on graduate enrollment and postdoctorates in fall 2000 (NSF 2002a) and Ph.D. degrees awarded in FY 2000 (NSF 2001) for all science disciplines and for each of the PFF phase 3 disciplines. Table I reveals that the PFF phase 3 disciplines enroll almost half of all science graduate students and award nearly two-thirds of science Ph.D. degrees.

Biological sciences enroll more than 56,000 graduate students, computer science over 47,000, and the other fields combined over 45,000. Biological sciences support more postdoctorates and award more Ph.D. degrees than the other PFF phase 3 disciplines combined. According to Robert Beck, a member of the Special Interest Group on Computer Science Education (SIGCSE) of the Association of Computing Machinery (ACM), the small number of Ph.D. degrees awarded in computer science, compared to the sizable graduate enrollment, reflects the robust employment market for computer science master's graduates.

**Table 1. Graduate Enrollment, Ph.D. degrees awarded, and Postdoctoral Appointments, by discipline<sup>1</sup>**

Discipline	Graduate Enrollment	Ph.D. Degrees	Postdoctoral Appointments
All Fields	1,767,557 <sup>2</sup>	41,368	N/A
All Sciences	309,969	20,649	25,745
Biological Sciences	56,494	5,855	16,093
Mathematical Sciences	15,646	1,048	375
Computer Sciences	47,594	861	352
Chemistry	18,188	1,990	3,574
Physics/Astronomy	11,724	1,392	2,176
<b>Totals, PFF3 Disciplines</b>	<b>149,646</b>	<b>13,055</b>	<b>22,570</b>
Among All Sciences	48.3%	63.2%	87.7%
Among All Fields	9.9%	31.6%	N/A
<sup>1</sup> Except where otherwise noted, data are from NSF 2002a (graduate enrollment and postdoctoral appointments, Fall 2000) and NSF 2001 (Ph.D. degrees, 1999-2000)			
<sup>2</sup> NCES 2002 (total graduate enrollment, all fields, Fall 1998)			

The *Biological Sciences* encompass a broad range of distinct disciplines, from entomology to neuroscience, from structural biology to ecology. Doctoral programs may be located in colleges of arts and science, agriculture, or medicine/health. The career paths for biological science graduates vary by specialization: For example, biochemistry Ph.D. graduates may have more opportunities for non-academic positions than those from ecology, because of the large numbers of career opportunities in biotechnology and pharmaceutical industries.

The National Research Council has studied the career paths of biological sciences graduates since the 1970s (NRC 1998). They found that, on average, approximately 60 percent of doctoral graduates in the biological sciences have pursued postdoctoral appointments and that many employers expect this experience. Further, about 40 percent of biological science Ph.D.s in the NRC study ultimately obtained tenure-track academic positions; of these, more than 85 percent were in Ph.D. granting institutions, many in basic science departments in medical schools.

Although many biological science graduate students have opportunities to serve as teaching assistants, those in departments located in a college of medicine or agriculture often are supported solely by research grants and hence have no opportunity to teach or learn about the professoriate, except through PFF programs.

Almost three-quarters of *Chemistry* Ph.D. graduates (1,990 in 2000) take jobs—including postdoctoral positions—in business and industry, according to Jerry Bell of the American Chemical Society. Those who obtain academic positions are broadly distributed among the diverse institutions of higher education. Many chemistry graduate students serve as teaching assistants, often in laboratory courses. Few have the opportunity to gain experience in classroom teaching. Thus, PFF is an important complement to the normal graduate experience of chemistry graduate students.

A total of 861 *Computer Science* degrees were awarded in 2000, about 35 percent to international students. Because of the explosive growth of the discipline and the strong demand from business, most computer science graduates enter the workforce after either an undergraduate or a master's degree. According to Robert Beck (SIGCSE/ACM), among Ph.D. graduates, only about one-third obtain an academic position; as a result, approximately

700 faculty openings annually either remain unfilled or are filled by computer science master's graduates or by master's or Ph.D. graduates from related fields.

Of the 1,048 Ph.D. degrees awarded in *Mathematics* in 2000, about half were earned by international students, 22 percent of whom indicated immediate plans to seek employment outside the U.S. (presumably, many of these planned to return to their home country), and 24 percent had immediate plans to join the U.S. work force—12 percent each in academic positions and in industry (NSF 2001). Among the 1999-2000 Ph.D. mathematics graduates with definite plans for U.S. employment following graduation (63 percent overall; 45 percent of international graduates), 40 percent had academic positions (25 percent of international graduates); 33 percent had post-doctoral positions (45 percent of international graduates); and roughly 20 percent planned to enter industry (26 percent of international graduates). The remainder reported other U.S. employment (NSF 2001).

According to Samuel M. Rankin, III, of the American Mathematical Society, most mathematicians seek employment immediately after the Ph.D., and taking a post-doctoral appointment is a much less common option. Eventually, about 75 percent of doctoral graduates who reside in the United States obtain faculty positions, primarily in four-year colleges.

Most mathematics graduate students serve as teaching assistants for some portion or most of their graduate program. Experienced teaching assistants commonly are given sole responsibility for an entire course. Consequently, many mathematics departments have a teaching assistant training program, and faculty and students tend to be particularly supportive of PFF programs.

*Physics and Astronomy* awarded 1,392 Ph.D. degrees in 2000, about half to international students, only 10 percent of whom indicated immediate

plans to seek employment outside the U.S.; presumably, for many of these, in their home country. Among 1999-2000 Ph.D. physics graduates with definite immediate post-graduation plans for U.S. employment (56 percent of the total), 48 percent had obtained academic positions (3 percent of international graduates); about 60 percent of both U.S. and of international graduates planned to take postdoctoral positions and postpone entry into the workforce; and approximately 33 percent of both groups planned to take employment in industry (NSF 2001).

As a result of a declining production of Ph.D. physicists and increasing retirements among Sputnik-generation faculty, the current academic job market is more favorable than at any time in the last ten years, reports Warren Hein of the American Association of Physics Teachers, making PFF programs in physics especially valuable and timely.

## Appendix II

# PFF3 Faculty Leaders and Partner Institutions

### Biological and Life Sciences

#### Duke University

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Partner Institutions: North Carolina Central University, Guilford College,  
Durham Technical Community College, Elon University, Meredith  
College

#### University of Cincinnati

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Partner Institutions: Raymond Walters College, College of Mount Saint  
Joseph, Northern Kentucky University, Xavier University

#### University of Nebraska, Lincoln

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Partner Institutions: Alcorn State University, Concordia College, Creighton University, Dana College, Doane College, Grambling State University, Metropolitan Community College, Nebraska Wesleyan University, New Mexico Highlands University, University of Nebraska at Omaha

### University of South Carolina

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Partner Institutions: Benedict College, Midlands Technical College, South Carolina Commission on Higher Education, University of South Carolina-Salkehatchie

## Chemistry

### Duquesne University

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Partner Institutions: Chatham College, Seton Hill College, St. Vincent's College, Thiel College, West Liberty State College

### Queens College of the City University of New York

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Partner Institutions: Baruch College, Manhattan College, Queensborough  
Community College

### University of California-Los Angeles

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Partner Institutions: California State University-Fullerton, Mount San  
Antonio College, Mount St. Mary's College, Pierce College, Pomona  
College

### University of Massachusetts-Amherst

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Partner Institutions: Amherst College, Hampshire College, Greenfield  
Community College, Mt. Holyoke College, Smith College, Holyoke  
Community College

### University of Michigan

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Partner Institutions: Baldwin-Wallace College, Calvin College, Eastern Michigan University, Grand Valley State University, Hillsdale College, Hope College, Oakland University, Oberlin College

## Computer Science

### University of Cincinnati

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Partner Institutions: College of Mount Saint Joseph, Northern Kentucky University, Xavier University

### University of Iowa

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Partner Institutions: Central College, Cornell College, Grinnell College, St. Ambrose University

## Mathematics

### Arizona State University

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Partner Institutions: Arizona State University-West, Northern Arizona University, Scottsdale Community College

### Binghamton University

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Partner Institutions: Broome Community College, Ithaca College, King's College, SUNY-Oneonta

### University of Washington

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Partner Institutions: Seattle University, Seattle Central Community College

### Virginia Polytechnic Institute and State University

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Partner Institutions: Bridgewater College, High Point University, Virginia State University, Washington and Lee University

## Physics

### Howard University

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Partner Institutions: Bowie State University, The Catholic University of America, Howard Community College, Marymount University, Virginia Tech-Northern Virginia Campus

### University of Arkansas

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Partner Institutions: Crowder College, Drury University, Northwest Arkansas Community College, University of Arkansas-Ft. Smith, University of Kansas

### University of California, San Diego

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Partner Institutions: Grossmont College, San Diego City College, San Diego State University, University of San Diego



## University of Colorado at Boulder

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Partner Institutions: Adams State College, Colorado College, Colorado School of Mines, Colorado State University, Denver University, Metropolitan State College of Denver, United States Air Force Academy, University of Wyoming