Employment of Recent Doctoral Graduates in S&E: Results of Professional Society Surveys

August 6, 1998

Commission on Professionals in Science and Technology
A Participating Organization of the American Association for the Advancement of Science

1200 New York Avenue, N.W., Suite 390
Washington, DC 20005
202-326-7080
Web site: www.cpst.org

Acknowledgments

We gratefully acknowledge the support provided by

Alfred P. Sloan Foundation, Michael Teitelbaum, Program Officer

Burroughs Wellcome Fund, Martin Ionescu-Pioggia, Program Officer

National Science Foundation, Larry Suter, Program Official to the Commission on Professionals in Science and Technology

with

1997-1998 Participants

Mary Jordan – American Chemical Society
John Siegfried, Wendy Stock – American Economic Association/Vanderbilt University
Nicholas Claudy – American Geological Institute
Eugene Bierly, Jennifer Giesler – American Geophysical Union
Roman Czujko, Patrick Mulvey – American Institute of Physics
James Maxwell – American Mathematical Society
Martin Frank, Marsha Matyas – American Physiological Society
Sheilah Mann – American Political Science Association
Jessica Kohout, Marlene Wicherski – American Psychological Association
Peter Farnham – American Society for Biochemistry and Molecular Biology
Mitchell Bostelman – American Society for Engineering Education
Heather Garvey, Janet Shoemaker – American Society for Microbiology
Roberta Spalter-Roth – American Sociological Association
Herbert Maisel – CPST Commissioner for the Association for Computing Machinery

"Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation."

(Disclaimer required by NSF Grant General Conditions GC-1, 12/97)

Contents

- **EMPLOYMENT AND UNEMPLOYMENT**

The number of recent PhD respondents who were still seeking employment (or a postdoc) as of mid-October 1997 ranged from 0.6% (10 people) in psychology to 7.0% (also 10 people) in political science, with most fields reporting relatively small numbers of individuals who were still looking for a position.

For the six fields for which comparable data are available from last year, the percent of those unemployed and seeking remained about the same or decreased slightly. One should bear in mind that it is a relatively small number of individuals in each of these fields who are still seeking, and the percentages are influenced in part by the numbers of PhDs who responded to the survey (see Technical Note).

Employment and Unemployment (for 1996-1997 PhDs as of mid-October 1997)

	# of survey respondents to item on employment status	# unemployed and seeking	% unemployed and seeking	For those working, average months it took to find job	For those seeking, average months spent looking
Biochemistry & molecular biology[1]	202	8	4.0	3	3
Chemistry	888	41	4.6	6	8

Chemical engineering	188	6	3.2	6	7
Computer science	251	6	2.4	3	3
Earth & space sciences	257	10	3.9	5	9
Economics	441	10	2.3	5	4
Engineering	1,286	35	2.7	4	6
Mathematics	675	16	2.4	5	6
Microbiology	371	8	2.2	4	6
Physics[2]	438	8	1.8	4	6
Physiology[3]	183	5	2.7	3	7
Political science[4]	142	10	7.0	9	9
Psychology	1,666	10	0.6	4	
Sociology[5]	309	6	1.9	6	8

[1] Biochemistry and molecular biology data are preliminary.
[2] Physics data are for those with domestic addresses only.
[3] Physiology data are for 1995-1996 graduates; more recent data are forthcoming.

[4] Political science sample size is relatively small, so percentages should be interpreted with caution.
[5] Sociology data are preliminary; ASA is attempting to increase response rate to 70%.

Still, we find that when the professional societies ask about employment for the same reference week, we do not see the wide variation in the percentages of those unemployed and seeking across fields that we saw when they were asking about different times of the year.

For those who were still looking for a position, a range from three months to 9 months of "actively looking" was reported. It is interesting to compare the time spent looking for a job for those still seeking, with the time it took those who had already landed a job. In some cases, e.g., computer science and biochemistry/molecular biology, respondents who were job hunting had spent about the same amount of time on average looking as was reported for those who had gotten positions. So these new PhDs may well have been on the brink of obtaining a position. In other fields, however, the gap is wider with respondents who were job hunting having looked twice as long as it took for those who landed jobs, so new docs in these fields may be having a somewhat more difficult time.

- **EMPLOYMENT CHARACTERISTICS**

	% employed part time	% employed in temporary position	% in temporary position involuntarily	% in temporary position that is a postdoc	% employed & currently actively looking for another job
Biochemistry & molecular biology	2	79	17	94	29
Chemistry	2	58	57	88	43

Chemical engineering	0.5	26	65	88	28
Computer science	1	17	36	49	20
Earth & space sciences	8	53	65	76	45
Economics	5	19	76	28	25
Engineering	2	24	44	75	28
Mathematics	5	46	59	58	29
Microbiology	1	81	42	94	35
Physics	3	57	53	85	31
Physiology	2	75	46	91	33
Political science	14	41	92	21	40

Psychology	24	25	61	68	23
Sociology	7	35	Data not available	44	33

Relatively few recent PhDs reported that they were working part-time with the exceptions of 24% in psychology, 14% in political science, and 8% in earth and space sciences. In the case of psychology, so many recipients hold two or more part-time jobs, that the APA survey asks a double set of questions about one's primary and secondary positions. In some cases, this is a new PhD who is working at a university and in a practice setting simultaneously.

For other fields, the percentage of recipients working part time may be either an indication of similar diversity in employment or an indication of some weakness in the job market. The societies did ask if the part time position was taken because "a suitable full-time work week job was not available," and these data are (or will be) reported at their individual web sites with elaboration of the unique circumstances for their fields.

As might be expected, fields with a high percentage of postdocs reported high percentages of those in temporary positions (operationally defined as having an end date), although not all temporary positions were postdocs. The range for those who reported they were involuntarily in a temporary position ("because a suitable permanent job was not available") was 17% to 92%, so perceptions of the acceptability of a temporary position varied widely across the fields. As we can imagine, there is a large difference between taking a potentially lucrative fixed-term contract position in business/industry versus taking one's primary employment as an adjunct instructor.

When asked if they were currently actively looking for another job even though they already had one, the range varied from 20-45% by field. These job incumbents are still expending energy despite the fact that, in most cases at least, they have just recently gotten a position.

For these new docs, and especially those in postdoctoral appointments, the need for job/career assistance is ongoing. For these new professionals, the services of campus career centers may not be available/applicable (although this is changing at some universities). In these cases, career services offered by professional associations/societies such as www.nextwave.org (see also the list of web sites for field-specific societies) may be especially helpful and appreciated.

- **SALARIES**

Salaries in business/industry are greater, not surprisingly, than those in other sectors, but what may surprise some is the discrepancy among sectors in some of the fields. Within specific sectors, there is great variability by field (for these data postdocs were excluded). For example, in educational institutions, new PhDs in some fields received 11-12 month salaries that were nearly twice as much as those in other fields. Salaries (for Those Employed in the U.S.)

Note: Postdocs are excluded except for the column specifically labeled postdocs.

	Sector of employment				
Median salaries ($)	Education 9-10 mos	Education 11-12 mos	Postdoc	Business industry	Government
Biochemistry & molecular biology[1]	Overall educ 35,750	26,500	25,250	53,000	n too small
Chemistry	35,525	34,000	25,000	58,000	45,000

Chemical engineering	49,500	64,000	33,000	61,200	n too small
Computer science	47,000	56,500	44,000	72,500	67,500
Earth & space sciences	33,000	40,000	34,000	58,600	47,500
Economics	48,000	51,000	42,800	73,500	54,815
Engineering	50,000	55,000	35,250	63,600	60,000
Mathematics	36,000	49,700	37,500	60,000	57,255
Microbiology[2]	33,000	26,000	26,000	44,250	47,500
Physics	33,000	45,000	36,000	62,000	63,000
Physiology	33,500	27,250	24,000	45,000	52,437
Political science	37,200	36,950	30,000	38,940	42,747
Psychology	31,091	38,000	22,500	54,000	43,500
Sociology	37,000	39,800	31,666	n too small	53,500

[1] $ 35,500 for clinical/medical
[2] $ 34,500 for clinical/medical

Salaries for postdocs vary widely by field, due in part to the availability of industrial or government lab postdocs in some fields, although these are still relatively few in comparison to the large percentages of academic postdocs. Additional retrospective data on postdocs (including data on benefits) are available from a one-time set of survey questions in the 1995 Survey of Doctorate Recipients (the SDR is sent to a representative sample of all those who have received PhDs in the U.S.) via the NSF's SESTAT system at www.nsf.gov/sbe/srs/stats.htm .

- **JOB SEARCH METHODS**

The top four job search methods as selected by respondents in each field showed that informal channels for finding a job appear to be most effective. For most fields, faculty advisors were ranked as the second most effective, PhDs in a growing number of fields reported electronic resources as valuable. Society newsletters or magazines were rated as highly effective for some other fields.

Job Search Methods (top four ranked methods within field)

Most effective method	Bio-chem	Chem	ChE	Comp Sci	Earth	Econ	Eng	Math	Micro	Phy-sics	Phy-sio	Poli Sci	Psyc	Soc
Faculty advisor(s)	2	1	3	3	2	2	2		3	2	1	3	4	4
Informal channel, e.g., colleague or friend	1	2	1	1	1	1	1		1	1	2	2	1	2
Newspaper advertisement													3	
Newsletter, magazine, or journal		3		4	3	4*	3		4	3	4	1	2	1
Placement service, e.g., campus, conference			2											3
Employment agency														
Met employer through former job or position			4		4							4		
Sent unsolicited vita	3	4							2		3			
Received unsolicited offer														
Electronic resource	4			2		3*	4			4				

* Note that it is an electronic version of a newsletter that led to the print version of the same newsletter being ranked fourth. When the print and web versions are combined, "Job Openings for Economists" ranked number 1 overall.

While some of the variance in job search methods chosen might be attributed to the content of the field itself or the likely sector of employment, e.g., mathematicians rated electronic resources first and computer scientists ranked it second, there is

undoubtedly variance based on the services provided by the professional societies. In fact, in some cases its is the society newsletter that is now provided on line that has led to the shift to the web. For the fields for which we have comparable data from last year, there was an increase in the rankings for electronic resources in just one year. In fact, half of actual surveys returned by the engineering PhDs for this project were web-based and half were paper copies.

- **MAJOR SECTORS OF EMPLOYMENT**

The employment destination for most graduates in some fields is academia – the historically traditional path for PhDs. However, the field-specific variability is great, with fields one might expect to be industry oriented, e.g., computer science and engineering, having more new docs head into the business world.

% employed in broad sector	Educational institutions	Business/ industry	Gov't.	Other	Clinical/ Medical[1]
Biochemistry & molecular biology	73	9	8	4	6
Chemistry	57	29	9	4	

Chemical engineering	25	65	5	6	
Computer science	43	48	6	3	
Earth & space sciences	53	24	16	7	
Economics	59	16	15	10	
Engineering	32	52	13	3	
Mathematics	70	21	5	4	
Microbiology	70	11	12		7
Physics	45	31	21[2]	3	
Physiology	82	4	3	11	
Political science	78	5	6	11	
Psychology	37	2	2	11	48
Sociology	87	5	3	5	

[1] Category not included in core set of questions.
[2] Includes those employed in national labs.

The life science fields saw more new PhDs head back into academe, but once again, a large proportion of these positions was temporary postdocs. The large proportion of psychology doctorates heading into clinical/medical settings stands out in the data.

As one considers what one wants to be as a "grown-up," the idea of being a professor probably conjures up notions in the general public of teaching, with perhaps a lab on the side for demonstrations and some research. When one looks at the percentage of those new PhDs who actually spend most of their time teaching in the first year out, the proportions vary quite widely across the fields. Again, postdocs account for much of

this variability since they are largely research oriented. However, in the Survey of Doctorate Recipients, 40% of academically employed scientists and engineers at all levels of experience still reported R&D as their primary work activity, while 44% reported teaching received most of their time.

- **PRIMARY WORK ACTIVITIES BY BROAD SECTORS OF EMPLOYMENT**

In business, it is interesting to note the different primary work activities across fields as some scientists and engineers spend more or less time in research versus development or design versus professional services.

% indicating primary work activity	Educational institutions			Business/industry		
	Teaching	Research	Professional services	Research	Development or design	Professional services
Biochemistry & molecular biology	6	92	0	64	18	0
Chemistry	22	75	1	66	19	2
Chemical engineering	29	67	0	43	39	6
Computer science	54	40	1	45	44	5
Earth & space sciences	28	70	0	33	22	33
Economics[1]	32	33	1	26	15	43
Engineering	40	50	1	28	51	13
Mathematics	57	35	1	26	47	18
Microbiology	8	90	1	82	4	7
Physics	23	65	2	29	55	7
Physiology	10	88	3	n too small		
Political sci.	66	28	0	n too small		
Psychology	40	20	24	21	14	32
Sociology	65	33	0	67	0	0

[1] 31% of those employed in academia indicated teaching and research equally; this was not a response option in the core set of questions. *Note: Rows within sector do not total to 100% because of small percentages reporting diverse other categories, the "other" category itself, and individuals who chose multiple primary work activities when asked to choose one.*

Again, the popular concept of scientist in lab coat with microscope nearby does not apply to many of these scientists.

- **OPINIONS**

When new docs rated (1) the extent to which their jobs were related to their fields, (2) the extent to which the job was commensurate with their education, and (3) the professional challenge involved in their jobs, the average ratings for all fields tended toward strongly agree (although the range did span the rating options from 1 to 5).

Using the scale below:

Strongly Agree 5 4 3 2 1 Strongly Disagree

Mean response	The position is related to my field.	The position is commensurate with my education and training.	The position is similar to what I expected to be doing when I began my doctoral program.	The position is professionally challenging.
Biochemistry & molecular biology	4.4	4.2	3.7	4.2
Chemistry	4.5	4.3	3.6	4.3

Chemical engineering	4.3	4.1	3.4	4.3
Computer science	4.5	4.3	3.7	4.2
Earth & space sciences	4.6	4.4	3.8	4.3
Economics	4.3	4.3	3.6	4.2
Engineering	4.3	4.1	3.5	4.1
Mathematics	4.3	4.2	3.6	4.1
Microbiology	4.3	4.2	3.7	4.3
Physics	3.9	4.1	3.2	4.2
Physiology	4.3	4.2	3.7	4.3
Political science	4.4	4.2	3.5	4.1
Psychology	4.5	4.1	3.4	4.2
Sociology	4.3	4.3	3.6	4.1

Ratings for the fourth opinion item that asked if the position was similar to what they expected to be doing when they began the doctoral program were lower on average indicating some unexpected outcomes. However, it should be noted that we do not know how positive or negative these unexpected outcomes were. For some, perhaps a faculty position was the intended destination, but the competition for these positions has heated up so much lately that fewer new PhDs have been able to join the ranks. For others,

perhaps an industrial internship redirected career interests. We can speculate about other reasons, but it is interesting to note that across fields, PhDs consistently rated this opinion question differently than the other three. While not all unexpected outcomes are negative, this result might indicate the needs for enhanced career advising and better data on employment outcomes (such as this report) for those with PhDs in science and engineering.

• METHODS

In most cases, department chairs for the science fields and deans of engineering were asked to provide the names and addresses of recent doctoral graduates in their departments. Recent was defined as **July 1, 1996 through June 30, 1997** to be consistent with most federally funded national data collection efforts. Professional societies have up-to-date mailing lists of the Chairs'/Deans' names and addresses, which made this task easier. In addition, the good relationships between the societies and departments/schools in their respective fields undoubtedly improved response rates.

To have comparable results across science and engineering fields, professional societies asked the same core set of employment and related questions in a consistent format. **Comparable data** are more easily explained and understood, and therefore are more useful to students, faculty, policy makers, and others.

For example, if societies report unemployment rates for recent graduates as measured in the summer after graduation versus the following spring, rates will be different across fields. If on the other hand, societies present data collected in the same time frame and for the same reference week, the data will be comparable across fields. For this reason, the original project team funded by the Alfred P. Sloan Foundation developed a core set of questions. These questions were pilot tested during the 1996-1997 academic year (for 1995-1996 graduates) and were revised for the 1997-1998 surveys.

The core questions tap such variables as education, employment, and other background information, for timely assessments of the job market. Other variables were excluded intentionally since federal data collection programs provide these data.

Professional societies added additional field-specific or other questions such as area of specialty or dissertation. To support this desire, the set of core questions was intentionally kept to a minimum so that the questionnaire did not become too long. These additional data are (or will be) presented on the web pages of the respective societies and in various related publications (see separate list of web addresses).

Some societies also expanded on the response choices for some survey questions, for example, asking more detail on employment sectors and destinations. When this was done, care was taken so that the results could still be aggregated into the same more general categories provided in the core set of questions. In this way, CPST was able to compile results for analyses across fields.

- **RESPONSE RATES**

	Number of recent doctorates who returned surveys	As percent of those who received surveys (response rate)
Biochemistry & molecular biology	203	47
Chemistry	888	63

Chemical engineering	188	60
Computer science	255	46
Earth & space sciences	259	53
Economics	441	66
Engineering	1,296	34
Mathematics	675	60
Microbiology	372	45
Physics	438	46
Physiology	185	73[1]
Political science	152	42
Psychology	1,686	51
Sociology	309	62

1 With monetary incentive of $15

- **TECHNICAL NOTES**

Response rates in these surveys are in the range of 34-73 percent of contacted new doctorates (see Response Rates) from about 60-90 percent of contacted graduate departments. It is reasonable to assume that there is some nonresponse bias in these data. However, it is equally reasonable to assume that bias operates in about the same direction in these different fields. Therefore, these data are useful to suggest where opportunities and problems might exist, and the relative differences among fields. The data are unlikely to serve as highly reliable estimates of the levels of the different variables.

While these data address some of the same variables as in other databases (e.g., NSF's Survey of Doctorate Recipients), their unique contribution is in providing a timely set of measures for the range of employment conditions new doctorates have encountered after leaving graduate school. To obtain data this quickly necessarily involves some tradeoffs on such things as response rates. Efforts are ongoing to monitor and increase the response rates and to determine the representativeness of the resulting samples for those fields who plan to continue data collection in the coming years.

More detailed data are collected—with more rigorous response rate requirements, consequently involving more time and resources to collect and disseminate—by the National Science Foundation (NSF) in the biennial Survey of Doctorate Recipients (SDR) (www.nsf.gov/sbe/srs/stats.htm). It is important to note that the SDR includes about eight percent of all those who have received doctorates in the United States, so sample sizes for particular cohorts or classes, and for particular fields, may be too small for generalization. For this reason, the professional societies were intentionally redundant with some of the SDR questions they thought to be important. Also, since the federal surveys are conducted based on federal mandates for selected data of direct national interest and also require Office of Management and Budget approval, societies have some additional freedom to experiment with questions that may be of interest to them.

For additional information on the methodology used, including a copy of a sample survey instrument, see the report, *Road Map for Conducting Employment Surveys of Doctoral Graduates in S&E* (available by calling 202-326-7080).

- **RELATED RESOURCES**

Commission on Professionals in Science and Technology. (1998, May). *Road map for conducting employment surveys of doctoral graduates in S&E*. Washington, DC: Author. (Available by calling 202-326-7080)

Commission on Professionals in Science and Technology. (1998, June). *Employment outcomes of doctorates in science and engineering: Results of a CPST workshop.* Washington, DC: Author. (Available at www.cpst.org or by calling 202-326-7080)

Fowler, F.J., Jr. (1984). *Survey research methods.* Beverly Hills, CA: Sage.

Henderson, P. H., Clarke, J. E., & Woods, C. (1998). *Summary report 1996: Doctorate recipients from United States universities.* Washington, DC: National Academy Press.

National Science Foundation (NSF). (1997). S*cience and engineering doctorate awards: 1996* (NSF 97-329). Arlington, VA: Author. (Available at www.nsf.gov/sbe/srs/stats.htm)

National Science Foundation **(**NSF). (1997). *Characteristics of doctoral scientists and engineers in the United States: 1995* (NSF 97-319). Arlington, VA: Author. (Available at www.nsf.gov/sbe/srs/stats.htm)

Salant, P., & Dillman, D. A. (1994). *How to conduct your own survey*. New York, NY: John Wiley. (Available for $17.95 from John Wiley at 1-800-225-5945)

The Section on Survey Research Methods of the American Statistical Association (1429 Duke Street; Alexandria, VA 22314-3402; 703-684-1221; www.amstat.org) has a collection of 12-page pamphlets in its “What Is a Survey?” series.

Web sites that contain data/information on the job market for recent doctorates are listed below. Please keep in mind that web site addresses change relatively frequently, so you may need to visit the associated home page for an updated link.

Data from multiple disciplines/fields:

- American Association for the Advancement of Science, *Science* magazine's NextWave web site has CPST/professional societies data: www.nextwave.org/survey1.htm

- Links to other periodic national, state, and institutional studies as well as one-time studies: www.cpst.org

Data and related careers/employment information for specific disciplines/fields:

1. American Chemical Society: www.chemcenter.org
2. American Economic Association: www.vanderbilt.edu/AEA
3. American Geological Institute: www.agiweb.org
4. American Geophysical Union: www.agu.org
5. American Institute of Physics: www.aip.org/statistics
6. American Mathematical Society: www.ams.org
7. American Physiological Society: www.faseb.org/aps
8. American Political Science Association: www.apsanet.org
9. American Psychological Association: www.apa.org
10. American Society for Biochemistry and Molecular Biology: www.faseb.org/asbmb
11. American Society for Engineering Education: www.asee.org
12. American Society for Microbiology: www.asmusa.org
13. American Sociological Association: www.asanet.org
14. Commission on Professionals in Science and Technology: www.cpst.org