ACS Chemistry for Life™

CPT
Committee on Professional Training

American Chemical Society
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Revitalizing Chemistry Education

Inside This Issue...

Dr. Thomas Lane, President of the American Chemical Society and Senior Research Scientist at Dow Corning Corporation, began the afternoon's symposium by urging everyone to prioritize minority education. With 47% of the U.S. population projected to be of minority origin by the year 2050,[1] those institutions best able to accommodate individual cultural and socioeconomic differences will achieve greater economic success in the 21st century.

Dr. Cora Marrett from the National Science Foundation noted that the United States is the only country among the thirty members of the Organization for Economic Cooperation and Development in which younger adults are less educated than in the previous generation. *A Nation at Risk*,[2] published 26 years ago, warned that competitors throughout the world were overtaking our once-unchallenged preeminence in commerce, industry, science, and technological innovation. The NSF is attempting to bridge the gap through programs focused on improvements at several levels of the educational system.

Dr. Marrett called upon universities to help ensure a steady supply of well-qualified students from the high school and two-year college communities by establishing partnerships with feeder schools, holding summer teacher workshops, and sending out student representatives to act as ambassadors in their communities.

Rigoberto Hernandez from the Georgia Institute of Technology spoke at the Fall 2009 ACS National Meeting.

In his presentation, Dr. Rigoberto Hernandez from Georgia Tech refuted several myths surrounding the lack of underrepresented minorities on U.S. faculties:

Myth:
Institutions lack qualified minority candidates to interview for faculty positions.

Data
Brian Nosek's research on implicit bias has shown how unreliable the senses are in making judgments when experience or expectations limit the field of view.[3]

Myth:
Because there are so few minority candidates for faculty positions, they are highly sought after. Smaller institutions cannot compete.

Data
When blind auditions were instituted for coveted performance spots, the proportion of women hired increased by 30% in eleven major orchestras.[4]

Myth:
Minority candidates prefer positions that are more lucrative.

Meeting Announcement

Come Join CPT at the ACS National Meeting in San Francisco for our open meeting on March 21, 2010 from 4-5 PM. Location to be announced on CPT's webpage.

Data

Racial micro-aggressions are a form of systemic, everyday racism used to keep those at the racial margins in their place.[5] Minority students and faculty experience and respond to the university climate much differently than their majority counterparts. Many of the interactions minority students have with majority group members are not harmless, but constitute "racial micro-aggressions" because they serve to remind out-group members of their place.
As they accumulate, very small differences in treatment can have major consequences in salary, promotion, and prestige, including advancement to leadership positions.

Myth:

Current faculty recruitment and hiring systems correctly identify talented minority candidates.

Data

A study in which applicants with African-American-sounding names had to send fifteen resumes to get a callback, compared to the ten needed by applicants with white-sounding names although the resumes were identical. White-sounding names yielded as many more callbacks as an additional eight years of experience. The higher the resume quality, the larger the gap between callbacks for white-sounding names versus callbacks for African-American-sounding names.[6]

PRESIDENTIAL SYMPOSIUM:

Revitalizing Chemistry Education to Increase Competitiveness and Diversity

Introductory Remarks
Thomas Lane, American Chemical Society

A Learning Society: Can America Get Its Bounce Back?
Cora B. Marrett, National Science Foundation

Increasing Diversity in the Academic Pipeline: A Life-Cycle Analysis
Rigoberto Hernandez, Georgia Institute of Technology

Teaching Scientific Principles from the World View of American Indians and Alaska Natives
Shanadeen Begay, Boston University

Increasing the Participation of African-Americans in Chemistry: What Works?
David R. Kanis, Chicago State University

Tapping into the Powerful Synergy Between Chemistry and Native America
Mary Jo Ondrechan, Northeastern University

Fixing the Leak in the Pipeline
Malika Jeffries-El, Iowa State University

Dr. Hernandez urged the chemical community to discard the pipeline model of the academic lifecycle in search of a broader, more encompassing definition. This model of nurturing a degree target at all costs is the wrong model to use in going forward against this problem. Education needs to be more accommodating of students' personal and family lives.

Those institutions best able to accomodate individual cultural and socioeconomic differences will achieve greater economic success in the 21st century.

Shanadeen Begay, a graduate student at Boston University, pointed out that education professionals can be more accommodating of students' personal lives by simply being aware of the danger of expectations when dealing with students from different cultural backgrounds. "Should" is a dangerous word because it conveys your interpretation of someone else's reality. She urged the academic community to increase their effectiveness by listening to their students and then working with them to tailor strategies to meet their individual needs. Effective conversations between two people must begin as a dialog, with each person taking responsibility to maintain his or her own objectives. Research indicates that these dialogs (also known as mentoring) are the most effective strategy in the recruitment and retention of minority students.

Compassionate personal attention and flexible programming are the hallmarks of success for the Department of Chemistry and Physics at Chicago State University (CSU), where 81 % of the students are African-American. Chicago State University is the largest non-HBCU granter of baccalaureate degrees to African Americans in the nation, but the university itself has one of the lowest six-year graduation rates in the country. The Department of Chemistry and Physics, however, enjoys a six-year graduation rate double that of the university with a year-to-year retention rate of 85% compared with only 55% for the university.

Although systemic change is needed, individuals can produce profound and far-reaching effects.

Dr. David Kanis, the department chair at CSU, recommends the following recruitment strategies:

- Money to live on AFTER tuition and books are paid for is critical. At schools like CSU, academic scholarships do not always improve retention and graduation rates. Family responsibilities often influence students' academic progress: 25% of the students at CSU are single mothers.
- Institutions serving underprivileged areas need to participate in community outreach by promoting school reform, catalyzing economic development within their own communities, promoting environmental justice, and advocating careers in science.

Dr. Kanis also recommended discarding traditional lecture techniques in favor of the collaborative learning methods used in POGIL, PLTL, and other studio classrooms.

Dr. Mary Jo Ondrechen from Northeastern University noted the importance of community and local colleges in her work with Native American students since the majority of these students do not attend tribal colleges. The lack of successful transfer programs from two-year to four-year institutions affects their success in navigating the academic pipeline.[7] She advocated two systemic changes:

- Create a certification program for two-year colleges.
- Establish outreach programs between four-year and two-year institutions.

Dr. Malika Jeffries-El from Iowa State University suggested that the pipeline analogy needs to be replaced and that the chemistry education community must create alternative pathways to encourage more students to pursue an education in chemistry.

Although systemic change is needed, individuals can also produce profound and far-reaching effects. As an example of how one person can make a difference, she noted that Dr. Henry Gilman of Iowa State University published over 1020 papers, and produced a number of African-American PhD graduates. She noted that mentoring and research are still the most effective ways to encourage students.

Cultural changes require visionary thinking. Those institutions best able to accurately identify and implement successful retention and recruitment strategies among diverse student populations will be the most successful in the future.

References

1 U.S. Census Bureau, Census 2000, Table DP-1. www.census.gov/prod/cen2000/dp1/2kh00.pdf (accessed 10/26/2009).

2 A Nation at Risk, http://www.ed.gov/pubs/NatAtRisk/index.html (accessed 10/26/2009).

3 "Workshop on Excellence Empowered by a Diverse Academic Workforce: Achieving Racial & Ethnic Equity in Chemistry" (DOE/NSF/NIH report) http://chemchairs.uoregon.edu (accessed 10/26/2009).

4 "Orchestrating Impartiality: the Impact of Blind Auditions on Female Musicians" Goldin, Claudia and Rouse, Cecelia (2000) The American Economic Review, http://www.faculty.diversity.ucla.edu/search/searchtoolkit/docs/articles/Orchestrating_Impartiality.pdf (accessed 10/26/2009).

5 "Workshop on Excellence Empowered by a Diverse Academic Workforce: Achieving Racial & Ethnic Equity in Chemistry" (DOE/NSF/NIH Report) http://chemchairs.uoregon.edu (accessed 10/26/2009).

6 "Are Emily and Greg More Employable Than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination" Bertrand & Mullainathan (2004) Poverty Action Lab, http://www.economics.harvard.edu/faculty/mullainathan/files/emilygreg.pdf (accessed 10/26/2009).

7 "A National Analysis of Diversity in Science and Engineering Faculties at Research Universities" Nelson, Donna J and Rogers, Dianna C. http://www.now.org/issues/diverse/diversity_report.pdf (accessed 10/26/2009).

Congratulations!

The Committee congratulates the following schools on their newly ACS-approved bachelor's degree program in chemistry:

- **Assumption College**
- **Fairmont State University**

The current number of ACS-approved programs is 655.

ACS has an online bulletin tailored to graduate students!

The ACS Graduate Student Bulletin, sent monthly:

- Features timely news and events of interest to chemistry graduate students
- Highlights grant and fellowship opportunities

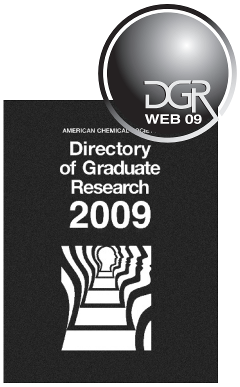
The bulletin is available at www.acs.org\gradbulletin. To subscribe, contact GradEd@acs.org

New Wiki site for educators serving Native American communities

During the 2008 Native American workshop, participants called for the creation of a clearinghouse of materials to assist educators working within these communities. A Wiki site, the Center for Educational Resources for Native Americans in Chemistry, has been initiated to share resources in an open forum.

See: http://www.cernac.org

ACS Directory of Graduate Research 2009 now covers all of North America!



The new edition of the **ACS Directory of Graduate Research (DGR)** is now available. For the first time, the DGR includes research institutions in Mexico, as well as the United States and Canada. Find information on:

- 675 academic departments
- 9,981 faculty members
- 64,331 publication citations

The online searchable database, DGRweb, can be accessed free of charge at **www.acs.org/dgrweb.** The hardcover edition of the 2009 DGR is available for $102 (plus shipping and handling). Call **1-800-227-5558** to order your copy today.

If you have not yet completed the Faculty Status Survey, now is the time!

In 2006, the American Association of University Professors published a report that found a significant decrease in tenure-track faculty in institutions across the United States. CPT is currently conducting a survey of chemistry programs, and the **deadline has been extended until January 11**. If you have already completed this important survey, thank you very much for your input.

The Essential Role of Two-Year College Chemistry Programs in Higher Education

SOCED Task Force on Two-Year College Activities

With changing enrollment patterns in higher education, the number of transfer students is increasing. Their needs and the importance of programs addressing them are explicitly noted in the ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs (Section 5.9). Two-year colleges, with their dual missions of providing postsecondary education and workforce development, are essential partners in the mosaic of higher education, offering programs

and services to students who seek accessible, affordable, and flexible educational opportunities. Because two-year colleges have an impact on students who could not or would not otherwise enroll in a college or university, they are often access points for educational growth.

With their low tuition and open enrollment policies, two-year colleges serve almost half of all undergraduate students. As a result, they have a high proportion of students who are older (average age, 29), female (60%), minority (35%), and from lower income families (23%).[1]

Two-year colleges also play a crucial role in the education and training of the scientific workforce. Over 40% of science and engineering graduates have attended a two-year college at some point along their educational pathway.[2] Since two-year colleges educate a substantial number of underrepresented and first-generation students, they also play a key role in the effort to diversify the scientific enterprise.

Chemistry faculty at two-year colleges are working hard to educate students. Ranging in size from 0.5 to 19 faculty members per campus, they taught chemistry to approximately 180,000 students in the fall of 2001. During that semester, an average of 7.8 chemistry lecture sections were offered per campus.[3]

Chemistry courses in two-year college programs are essential to creating a scientifically-educated community. In order to support faculty, staff, and administrators in strengthening chemistry offerings across the country, the Society Committee on Education has developed the *ACS Guidelines for Chemistry in Two-Year College Programs*.

What is a two-year college?

The term *two-year college* refers to any institution where the highest degree awarded is an associate's degree. Although public comprehensive community colleges represent the majority of two-year institutions, *junior colleges* and *technical colleges* are also included in the *two-year college* mix.

References

1 Phillippe, K.A., & Sullivan, L.G. National profile of community colleges: Trends and statistics (4th ed.). Washington, DC: Community College Press, 2005. (Lower income indicates the percent of public community college students who receive Pell grants.)

2 Tsapogas, J. The Role of Community Colleges in the Education of Recent Science and Engineering Graduates. NSF InfoBrief, April 2004. http://www.nsf.gov/statistics/infbrief/nsf04315/ (accessed Aug 31, 2009).

3 Ryan. M. A.; Neuschatz, M.; Wesemann, J.; Boese, J. J. Chem. Educ. 2003, 80, 129.

Two-Year College Snapshot[1]

Number and Type of Colleges:	
Total:	1195
Public:	987
Independent:	177
Tribal:	31
Enrollment	
Total:	11.5 million
Credit:	6.5 million
Noncredit:	5.0 million
Full-time:	41%
Part-time:	59%
Demographics	
Average age:	29
First-generation:	39%
Single parents:	17%
Community college students constitute the following percentage of undergraduates:	
All undergraduates:	46%
Black:	46%
Hispanic:	55%
Native American:	55%
Asian/Pacific Islander:	46%
First-time freshmen:	41%

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CPT Committee on Professional Training

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Fall 2009

Survey of Master's Degree Programs in Chemistry

Looking for more data on graduate education?

Check out the CPT website at www.acs.org/cpt to find reports from surveys of:

- 2009 ACS Directory of Graduate Research
- PhD Programs in Chemistry Survey Report (2008)
- PhD Recipients in Chemistry Part I (Spring 1999)
- PhD Recipients in Chemistry Part II (Fall 2000)

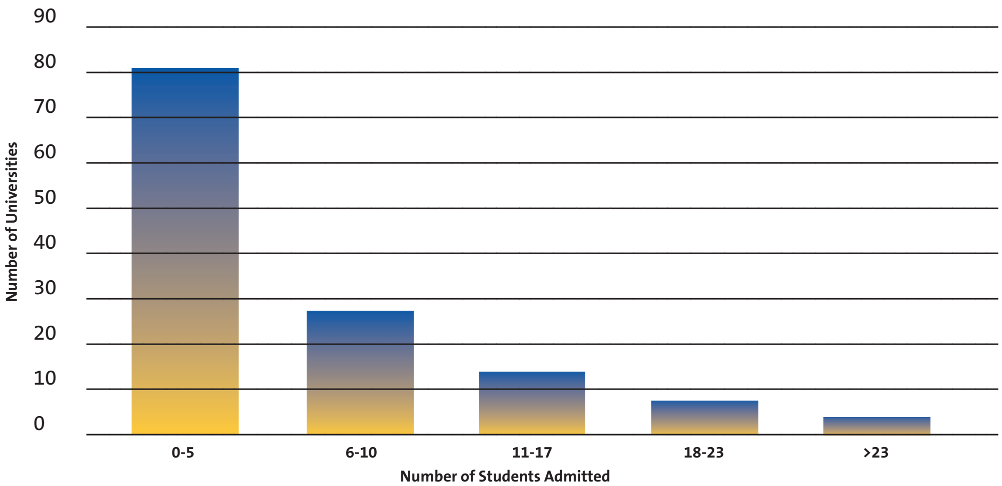
The principal goals of the Committee on Professional Training (CPT) are to promote and assist in the development of excellence in postsecondary chemical education, to collect and disseminate data on trends and developments in modern chemical education, and to cooperate with professional and educational groups having mutual interests and concerns. The ACS approval program for four-year bachelor's degree programs and the *ACS Directory of Graduate Research* (DGR) are perhaps the most obvious activities of the CPT that are germane to these goals. The CPT, however, also conducts periodic studies of graduate education at both the master's and doctoral levels. These studies are conducted via questionnaires completed by graduate departments. In spring 2008, such a report on PhD programs was published by CPT. This report is the companion study on programs that grant master's degrees.

Since master's degrees are granted by departments at both comprehensive and doctoral institutions, both sets of data are included in this report. When there is no significant difference between the data sets, combined data are presented. When the data sets are significantly different, they are presented independently. Data from PhD-granting programs (PGPs) were abstracted from the 2006 survey of 196 schools. These data do not distinguish between students that enter specifically for a master's degree and those who were originally PhD-bound. The 109 master's-granting, but non-PhD-granting programs (NPGPs) known to CPT, were surveyed in June 2008. 139 PGPs and 66 NPGPs provided usable data for this report. Although some overlap occurs, the surveys were not identical. Where appropriate, the findings from the current survey are compared to the recent PhD survey. Comparisons to CPT's 1998 survey of master's programs are made at the end of this document. It should be noted that with the exception of the gender and ethnic diversity data, the information presented in this report is based solely upon interpretable data from the programs that responded to the CPT surveys (~71% of PGPs and ~61% of NPGPs).

Master's degree programs continue to account for almost 50% of the graduate degrees awarded in chemistry.

Types of master's programs. Master's degrees vary in type. Of the responding programs, the most commonly offered degrees are the Master of Science (92%) and the Master of Arts (14%). Also offered are Professional Master's (3%), Master's of Material Science (1%), and miscellaneous degrees (~ 5%) in Education and in Natural or Integrated Sciences, especially catering to in-service teachers. Roughly 17% of master's

Figure 1. Number of Students Admitted Annually to PGPs & NPGPs



programs offered two master's degrees, only 1% offered three or more degrees. In PGPs, 19% of master's programs were interdepartmental such that the degree was not granted by the chemistry department alone. This number rose to 27% for NPGPs.

Admission, duration, and graduation. The total number of students admitted annually for study in the master's program was 1081 (as reported by respondents) of whom 33% were admitted to NPGPs. At NPGPs, the number of students admitted per year varied between 0 and 40 (average = 9.2; Figure 1). Of NPGPs, only 20% have no minimum time to the master's degree; of the vast majority of programs with minima, the distributions are one year (17%), two years (81%), and three years (3%). About 65% of students completed degrees in two years, 30% did so in three years, and only 5% of students finished in four years. At PGPs, the number of students entering the master's program varied from 1 to 20 (average = 5.8; Figure 1). Half of the PGPs indicated that they admit students who specifically target the master's degree only. The annual number of graduates ranged from 1 – 40 (the highest number among NPGPs is 25). Overall, 69% of all programs graduated fewer than 5 students annually and only 3% graduated more than 18 per year. On average, PGPs account for 67% of the 1085 master's graduates annually. The graduation rate at both PGPs and NPGPs is ~ 5.4 students per year.

Requirements: course work, theses, and examinations. At reporting NPGPs, the number of non-research, formal credit hours required for a degree varied from 15 to 33 (average = 27.3; Figure 2), but at reporting PGPS, the number varied greatly from 2 to 64 (average = 20.6; Figure 2). Interestingly, PhD programs require an average of 20 credit hours to earn the degree. Thus, master's and PhD students at PGPs essentially take the same number of credit hours, and this number is less (by roughly two 3-credit courses) than the requirements for a master's degree at NPGPs.

It is possible to earn a master's degree by doing course work only at 30% of NPGPs. At 35%, the degree can be earned by taking course work and performing research, but not by writing a thesis. An equal number (32.5%) of NPGPs allow the option of taking course work and writing a library thesis. At PGPs, the percentages are 32%, 44%, and 24%, respectively. Of NPGPs, 57% offered both thesis and non-thesis options, 41% had only the thesis option, and 2% had only a non-thesis option. About 36% of NPGPs did not require a thesis for graduation; at PGPs, this number rose to 43%. Some form of qualifying (placement or entrance) or comprehensive (exit) exams are required of master's students at 57% of PGPs (for 59% of these the exams are the same as for PhD students). At NPGPs, this number rose to 70%: 28% required qualifying exams only, 30% required comprehensive exams only, and 12% required

Figure 2. Number of Formal Non-Research Credit Hours Required for Degree.

Figure 2a. At NPGPs

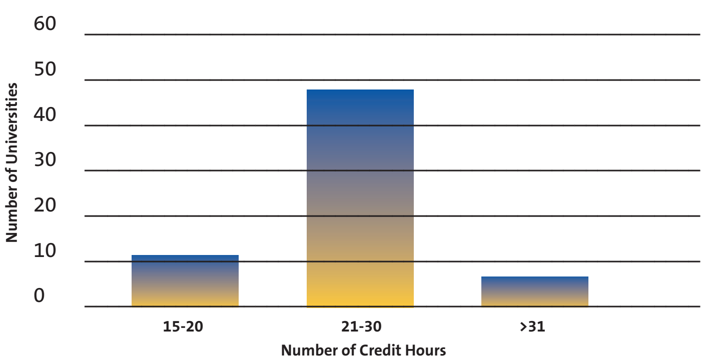


Figure 2b. At PGPs

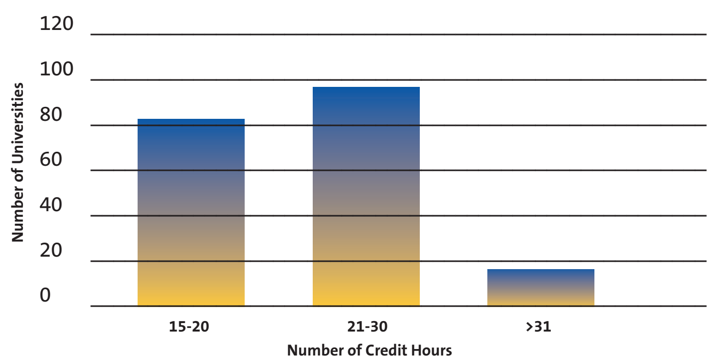
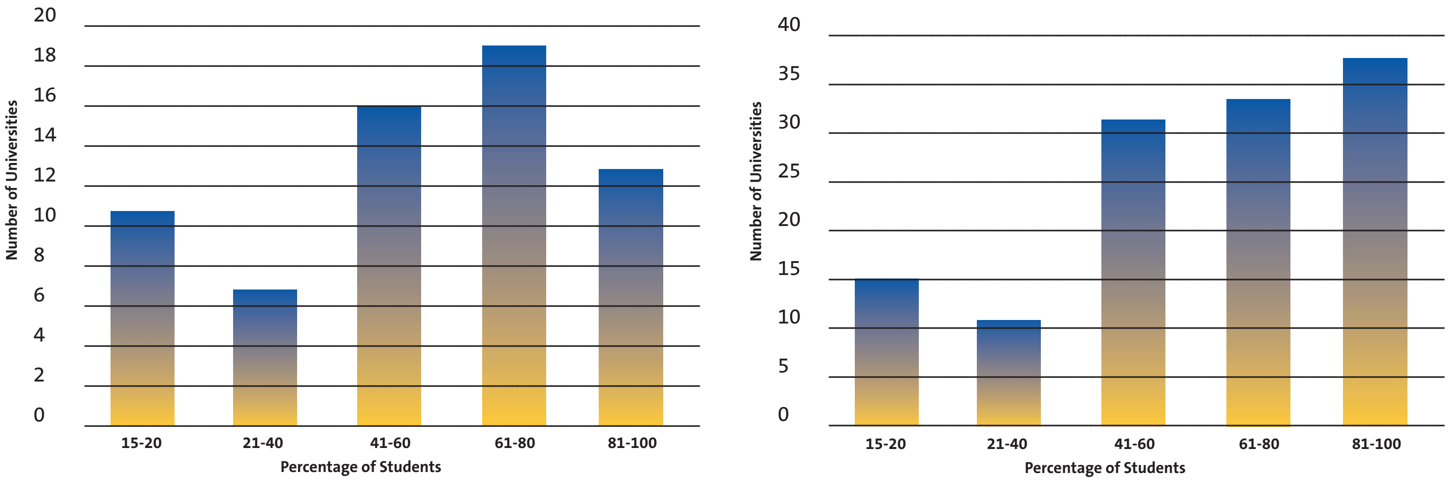


Figure 3. Distribution of Graduates with Domestic B.S. Degrees at NPGPs and Overall

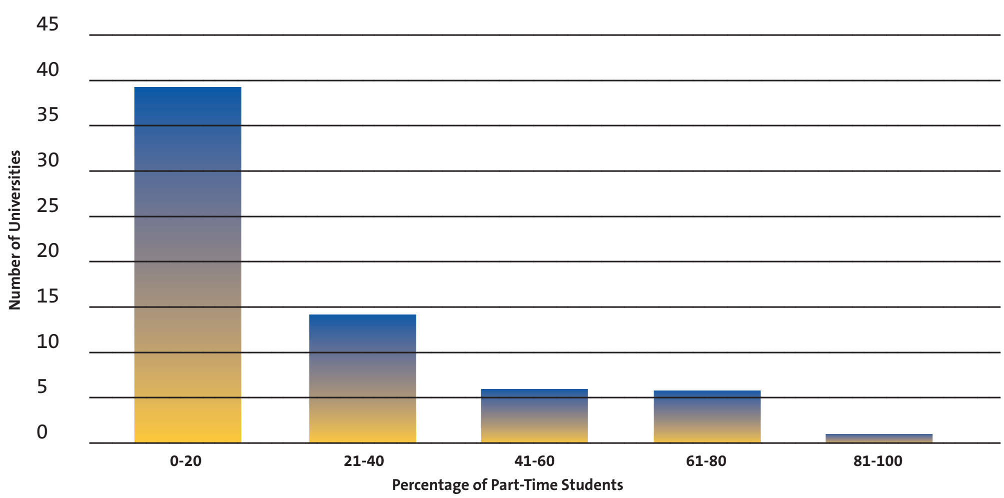


both. By comparison, 71% of PhD programs require qualifying exams, and 31% require comprehensive exams. Only 4% did not require any non-course work exams.

Financial support. An overwhelming 91% of reporting NPGPs provide support to graduate students via teaching assistantships. Another 66% provide support via research assistantships, and 21% provide support by other means including tuition waivers, summer stipends, fellowships, and scholarships. In general, 67% of NPGPs provide multiple means of student support. The situation at the PGPs is unclear, as 79 departments did not report on this statistic. Of the 60 that reported, 98% provided teaching assistantships, 83% provided research assistantships, and 12% provided other means of support. Only 2% did not provide any support for their master's students. These data contrast to findings at PhD programs where 38% of graduate students are on teaching assistantships and 40% are on research assistantships.

Diversity in the student population. The most common metrics of diversity - ethnicity and gender - were not determined in this survey. However, from the most recent NSF survey (2006)[3], 49% of master's degrees in chemistry were awarded to women in that year (compared to 31.4% of PhD degrees). According to the most current NSF data, 67.3% of master's degrees in chemistry were earned by US nationals and permanent residents (59.8% of PhDs)[4]. Asians/Pacific Islanders accounted for 6.2% of chemistry master's (5.7% of PhDs) and underrepresented minorities (Black, Hispanic, American Indian, Alaskan Native) accounted for 7.8% (5.8% of PhDs). It is not possible to extract from the data the number of master's degrees to women or ethnic minorities at PGPs and NPGPs. The diversity indicators examined in the current study were the percentages of domestic and part-time students. On average, 59% of entrants at NPGPs earned their bachelor's degree at a domestic university. This number rose to 69% at PGPs (Figure 3). Interestingly, the recent PhD survey suggested that, in general, the level of diversity rose as program size fell. For example, the percentages of domestic students at large, medium, and small PhD programs were 62.7%, 47.4%, and 47%, respectively. This relationship appears to be echoed in the master's programs as well. Roughly 81% of NPGPs reported that part-time students made up less than 40% of their student body (Figure 4). Of this population of part-time students, about 61% were

Figure 4. Percentage of Part-Time Graduate Students at NPGPs



supported at least 50% by their employers, indicating significant buy-in from these stakeholders in advancing the education and training of their workforce.

Goals of program. Master's-granting programs often carve out specific niches with respect to the training of graduates. At NPGPs, specific program goals were:

- preparation for more advanced study (97%)
- preparation for industry [75% (compared to 78% for PGPs)]
- combined bachelor's/master's degrees (62%), and
- teacher training [43% (compared to 37% for PGPs)].

Of NPGPs specifying industrial preparation as a goal, only 7% were in partnership with a specific employer (compared to 21% among PGPs), while 28% (29% among PGPs) trained students for a particular sector of industry. When teacher preparation was identified as a program goal, 58% of NPGPs matriculated in-service teachers (compared to 57% for PGPs), 36% (48% for PGPs) accepted pre-service teachers, and 31% targeted both pre- and in-service teachers. Only for 19% of NPGPs is a master's degree program specifically designed to prepare students for employment with the master's as the highest earned degree. About 50% of these programs are Professional Master's or forensic science programs.

Departmental budgets at NPGPs. There are tremendous variations in the levels of funding available for research and related activities at NPGPs (Figures 5a-e). The departmental budget for research varied from 0 (11% of programs) to 1 million dollars (average = $86K, median = $20K). More than 53% of programs have a budget of $20K or less, whereas almost 20% have annual research budgets in excess of $100K (Figure 5a). Almost 70% of programs operate on a library budget less than $5K per year (average = $27K; median = $2.5K). A full third of programs have no departmental allocations for library resources. Roughly 12% of programs have annual library budgets greater than $100K (Figure 5b).

With respect to funding to procure instrumentation, more than 9% of departments have no allocations for instrument purchase. Almost half (49%) operate on an annual budget of $20K or less, while only 9% enjoy budgets greater than $100K for purchases. The average departmental allocation is $45.5K while the median is $25K (Figure 5c).

Similarly, for instrument maintenance 9% of departments have no funds, and 76% of departments have an annual budget of $20K or less. No departments have allocations over $100K for instrument maintenance. The average departmental allocation is $17.5K, while the median is $10K (Figure 5d).

Another fiscal issue facing departments is funding for temporary/adjunct faculty: 14% of programs report no allocations to hire such faculty, and 38% had an annual budget of $20K or less. Thirteen percent of departments had annual allocations greater than $100K for this purpose. The average departmental allocation is $49.5K, while the median is $35K (Figure 5e).

It is not clear how much concern should be raised when one considers that a significant fraction of NPGPs do not appear to have "appropriate" budgets. Obviously some fraction of these apparently "underfunded" programs do not conduct or require laboratory research. Therefore, research and instrumentation are not priorities, and funding for these are low or nonexistent. In the larger fraction of programs that do have a research component, it is likely that they are supported, at least in part, by the largesse of their undergraduate programs and/or by direct or indirect funding from faculty grants. Funds may also be provided on an "as needs" basis after petitions to their administration, or by some other fiscal mechanism that may well suit their goals and needs. The level of concern regarding low and nonexistent library budgets is also difficult to gauge. Master's programs in departments with

Figure 5. Budgets at NPGPs

Figure 5a. Research Budget at NPGPs

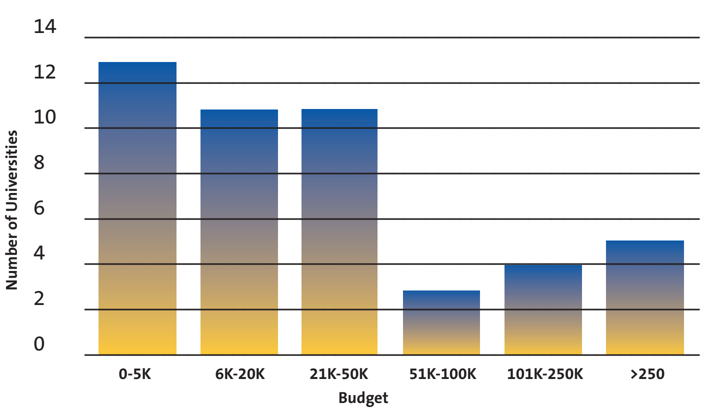


Figure 5b. Library Budget at NPGPs

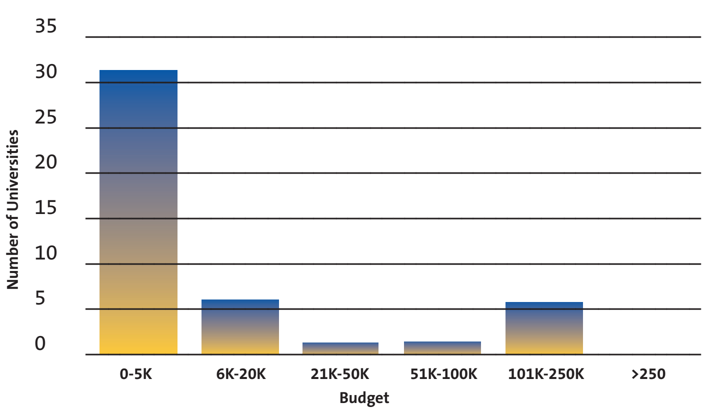


Figure 5. Budgets at NPGPs

Figure 5c. Budgets for Instrumentation Purchases at NPGPs

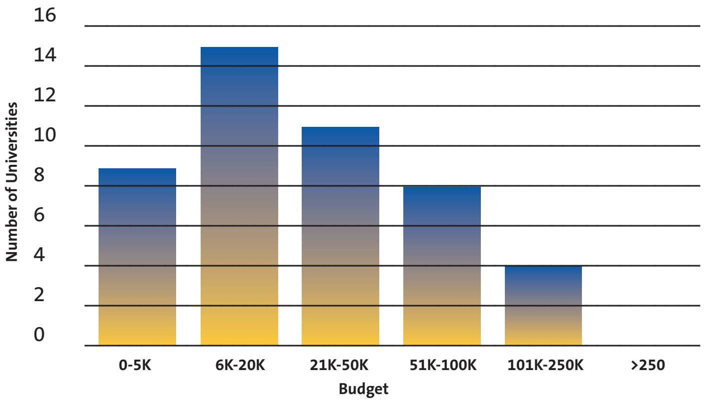
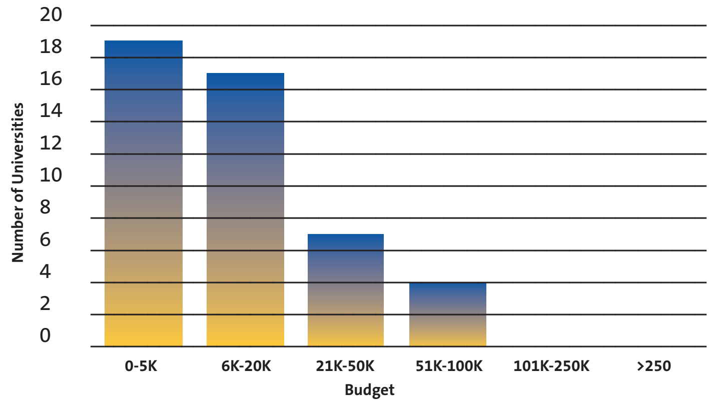


Figure 5d. Budget for Instrumentation Maintenance at NPGPs



an ACS-approved bachelor's degree program may have a well-stocked library that meets and exceeds requirements, but the funding is entirely through the library and not the departmental unit. Additionally, a library may allocate funds for departmental expenditures through the library's budget, but this arrangement would not be measured by the survey instrument. Finally, the funding for temporary/adjunct faculty obviously would be based upon program needs. For programs with a full complement of faculty, an appropriate budget would be zero. For those that have significant turnover, lack full-time expertise in certain subdisciplines, or rely on temporary/adjunct faculty to proctor laboratories or teach courses to non-majors, allocations may be significant.

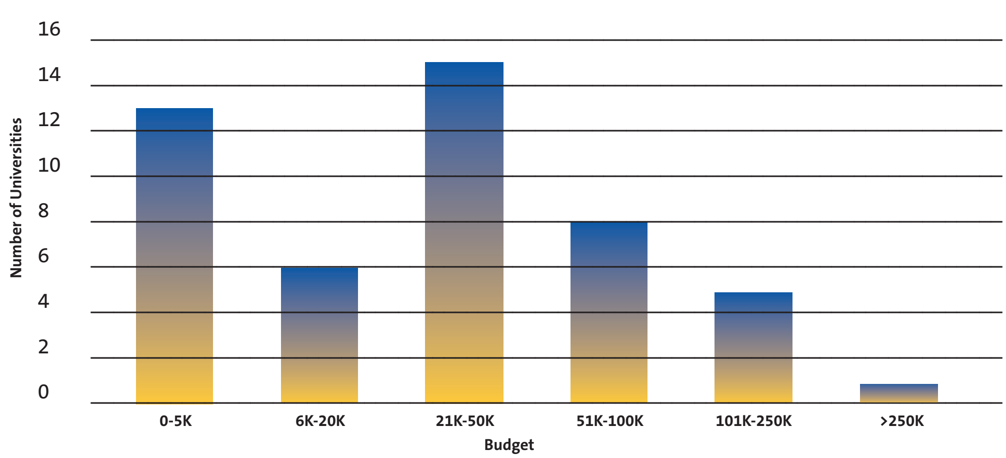
There may be many more scenarios that account for the sizes and variations in departmental allocations. Like beauty, "appropriate" may be in the "eye of the beholder" and may vary between programs to match individual program needs and objectives. One hopes that programs have the resources necessary to effectively train this important segment of the national technological workforce.

In 1998, 49% of master's-seeking students were at NPGPs; in 2008, this number fell to 33%, suggesting a major shift toward matriculation at PGPs. There was also an overall 14% decrease in the number of students admitted for master's degrees. Additionally, there was a 9.2% decline in the total number of graduates with the greater decline apparently occuring at NPGPs. PGPs accounted for 62% of earned masters in 1998; in 2008 they account for 67%. There appears to be a 10% drop in the number of part-time students seeking master's degrees at NPGPs (no comparable data from PGPs). Whether this trend reflects a diminished interest by employees in seeking master's degrees, a decreasing commitment from employers to encourage and support employees pursuing these degrees, or a diminished capacity of master's programs to attract and support students, is unknown.

The percentage of graduate degrees earned by women rose by roughly 3% at both the master's and PhD levels. Except for ~ 2% drop in degrees (both master's and PhD) to Asians/Pacific Islanders, there is little change in the chemistry graduate ethnicity profiles. Interestingly, while

Trends observed over the past decade. Table 1 compares some of the key results of the current survey with the parallel survey in 1998. In comparing results from these two data sets, caution must be taken since the statistics reported for each set depend completely upon the characteristics (size, type, etc.) and numbers of responding institutions in each survey (79% in 1998 vs. 67% in 2008). This caveat does not apply to the NSF data where there was more than a 99% response from programs.

Figure 5e. Budget for Temporary/Adjunct Salaries at NPGPs



the percentage of master's degrees earned by US nationals and permanent residents rose by 0.8%, there was a 7.1% decline in PhDs earned by this group. Although the minimum time to earn a degree appears to have risen, the average time taken to earn the degree seems to have fallen slightly (no data available for PGPs). Interestingly, it appears that the population of master's students with domestic bachelor's degrees has decreased slightly because of a small decrease at NPGPs, but a relatively similar increase at PGPs. The thesis requirement seems to have declined significantly at all institutions, whereas it has become more common to earn a degree by course work only at NPGPs, but less so at PGPs. Many more programs across the spectrum appear to require at least one type of formal examination not related to course work. Evidently, fewer NPGPs prepare students specifically for industry, but the trend is reversed at PGPs. However, teacher training seems to have grown in importance at both types of institutions.

Summary. The master's degree continues to be an important component of graduate education in the chemical sciences accounting for almost 50% of the graduate degrees awarded in this field. The current report provides an analysis of the survey data on master's-granting programs across the United States and is, at best, a snapshot of these programs. It compares statistics between programs where the master's degree is the highest offered by the department and those where the PhD is also offered. The report also highlights the evolution of master's degrees, and the programs offering them, over the past decade.

Table 1. Comparison of Selected Results from the 1998 and 2008 Surveys

Survey Question	1998 Survey Results			2008 Survey Results		
	Combined	NPGPs[1]	PGPs[2]	Combined	NPGPs	PGPs
No. of students admitted	1257	611	646	1081	355	726
No. of graduates	1195	452	743	1085	358	727
% Master's degrees to women[3]	45.9	*	*	48.8 ('06)	*	*
% PhD degrees to women[3]	31.4	*	*	34.3 ('06)	*	*
% Master's degrees to US citizens & permanent residents[4]	66.5	*	*	67.3 ('04)	*	*
% PhD degrees to US citizens & permanent residents[4]	66.9	*	*	59.8 ('04)	*	*
% Master's degrees to underrepresented minorities[4]	8.0	*	*	7.8 ('04)	*	*
% PhD degrees to underrepresented minorities[4]	5.5	*	*	5.8 ('04)	*	*
% Master's degrees to Asians/Pacific Islanders[4]	7.9	*	*	6.2 ('04)	*	*
% PhD degrees to Asians/Pacific Islanders[4]	7.8	*	*	5.7 ('04)	*	*
Minimum time to degree	1.7	1.7	1.7	N/A	2.2 yrs	*
Average time to degree	2.5	2.5	2.5	N/A	2.4 yrs	*
Credit hours	28.6	30.3	27.7	21.9	27.3	20.6
% Domestic Bachelor's	65	60.5	67.3	63.8	58.7	69
% Part-time students	23	33.3	16.7	N/A	23	*
% Requiring Thesis	74	82	70	59	64	57
% Course work only	35	25	42	31.7	30	32
% Requiring specific exams	52	66	44	61	70	57
% Preparation for Industry	76.2	89	59	76.8	75	78
a) Partnership	6.2	3	11	16.8	7	21
b) Sector	3.8	5	2	28.8	28	29
% Teacher training	30.8	32	29	41.9	43	37

* Not surveyed. [1]Non-PhD-granting programs (programs where the master's degree is the highest offered). [2]PhD-granting programs. [3]Data from [NSF 08-321].
[4]Data from nsf.gov-SRS Sci. & Eng., (degrees by citizenship, race/ethnicity of recipients).

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