

Beyond the glass ceiling

Women and under-represented minorities are earning historically high numbers of science doctorates in the United States. So why aren't they making it to the professorial ranks?

Kendall Powell investigates.



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Aaron Velasco describes himself as the only US-born Latino seismologist in the country. As a faculty member at the University of Texas, El Paso, he is part of a rare group of under-represented minorities who make it into tenure-track academic positions in the United States. His story illustrates part of the reason for the abysmally low numbers of others like him.

"I honestly could not afford to become a postdoctoral fellow," says Velasco, recalling how the enormous debt he had built up during almost ten years of studying beyond high school forced him to seek something better than a postdoc's salary. In search of financial security, Velasco went straight into industry after graduate school, then found his way back to academia. Many other excellent minority graduates cite economic disadvantage as a major reason for why they don't end up in academic positions — even though the number of minority PhDs is on the rise.

If academia is to offer varied role models and perspectives for a diverse population of students, it must become more welcoming to women and ethnic minorities, leaders of diversity efforts say. Industry has already learned the value of diversity. In a 2003 amicus brief in support of the University of Michigan's affirmative-action admissions policies, 65 Fortune 500 firms argued that efforts to increase diversity improve innovation, productivity and global competition.

Women and minorities suffer from the effects of isolation once they enter the upper ranks of academia. Both groups perceive academia as an unfriendly environment, and both suffer from an implicit bias against them in the hiring process.

For women, the clash of their biological clock with the tenure clock, along with the effort of balancing work and family duties, is a huge barrier to advancing up the academic ladder. For minorities, financial and geographical constraints make academia a less attractive choice than industry. Attempts to remove barriers and to mend holes in the pipeline have met with mixed success.

Leaving academia

In 2003, 51% of the US population was female and more than 25% of the population was from a minority group under-represented in science: African Americans, Latinos and Native Americans. Women earned well over one-third of the science and engineering doctorates awarded in 2003–04 and African American and Latino doctorates have steadily increased during the past ten years (see Tables 1 and 2).

But women hold fewer than one-third of all science and engineering faculty posts, and just 18% of full professorships. For minorities, the numbers are below 10% and 6.7%, respectively. When the numbers are dissected at the disciplinary level, many fields find they are doing far worse in hiring talented women and minorities than should be expected, given the numbers of doctorates they award to those groups (see Table 3). Although many 'diversity in science' programmes have been in place for more than 30 years, the faculty in most US academic science departments has remained overwhelmingly white and male.

The numbers show that not only are women having a hard time reaching parity in the hiring process, but that they continue to struggle for parity at all levels of success such as making tenure, advancing to



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administrative positions, and gaining national recognition for scientific achievements. These numbers also send a striking message to the next generation.

“I think young women looking at the PhD-to-faculty transition are being more pragmatic, looking down the road and saying, ‘I don’t want to beat my head against a wall for the next 20 years,’” says Donna Dean, president of the Association for Women in Science (AWIS) in Washington DC. The AWIS began in 1971 to help women succeed at the mid-career stage. Dean says the focus has shifted to earlier stages, to recognize that women fight an uphill battle from the minute they earn their doctorates.

Women and minorities must both deal with implicit bias, a problem that is well-documented in the social-science literature, but one that has garnered little attention from the science sector until recently. Dean describes the problem of implicit bias in these terms: “People are most comfortable with people who think and look like themselves.”

This type of bias cuts across all divides and has been shown to affect everything from basketball refereeing calls to hiring practices. In addition, a strong gender bias has been found in workplace scenarios, with both men and women consistently overrating men and underrating women in job qualifications (see Virginia Valian’s chapter in *Why Aren’t More Women in Science?* (eds S. J. Ceci and W. M. Williams); American Psychological Association Press, 2006).

Bias cuts

“When you have homogenous, privileged groups it is hard for them to see that their decisions are inhibiting their excellence,” says Meg Urry, an astrophysicist and the first woman to chair the physics department at Yale University. Most scientists think they operate in a meritocracy, rewarding excellent research irrespective of colour or gender lines. But the data show that is simply not the case, says Urry. And many scientists, she says, are “unaware of that data and unaware that they have internal biases”.

To change that, several groups have begun highlighting research on bias at workshops for different science disciplines. Chemists are leading the way with the help of the Committee on the Advancement of Women Chemists based in Eugene, Oregon, by holding a workshop last year for 55 chairs from the top



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Women remain under-represented at the higher end of the academic scale.

chemistry departments around the country (see ‘Chemistry case study’).

Programmes to recruit and retain university minority students in science have made steady, if small, improvements. The numbers of science bachelor’s degrees awarded to minority students, about 16% of the total, is now commensurate with the number of minorities enrolled in university. The number of African American and Latino science doctorates have increased about 20% during the past ten years.

“I’m encouraged by the numbers of kids at the beginning of the pipeline,” says Velasco. “But my worry is that these kids will want to go into academia and find their opportunities are limited there.”

For minorities, their small numbers mean that feelings of isolation begin early and are likely to persist throughout a career (see ‘A political hot potato’). Many under-represented minority students come from disadvantaged backgrounds that make both financial concerns and extended family responsibilities rise to the top of the priority list when they consider a career move.

Isiah Warner, a chemist at Louisiana State University in Baton Rouge, has overseen the 15-year transformation of that department into the top producer of African American chemistry PhDs. But, he

CHEMISTRY CASE STUDY

Chemistry as a field has made some progress towards retaining talented women and minority chemists in the academic ranks. Still, although women gain roughly a third of chemistry doctorates, they hold only 13% of chemistry faculty positions.

In January 2006, the National Science Foundation, the Department of Energy, the National Institutes of Health and chemistry leaders sponsored a workshop in which 55 chairs from the top-ranked departments around the country gathered to face the problem and take action to address it. The workshop highlighted research on implicit bias and on issues affecting women’s ability to succeed in academia.

Before the workshop, when participants were asked why women were not being recruited, hired

and retained in their departments, the participants blamed factors largely beyond their control: too few women in the applicant pool, losing females to other departments and no money for recruiting both members of a couple. After the training on implicit bias, participants were more likely to admit to a lack of commitment or downright opposition to hiring female faculty members, says Geraldine Richmond, a chemist at the University of Oregon in Eugene who is evaluating the workshop’s impact.

Participants left with a commitment to implement at least two items within their departments or institutions, such as doubling the number of female applicants in the next faculty search, or advocating subsidized childcare. And the participants agreed to evaluate the

effectiveness of their efforts in the future.

Physics and geosciences have followed suit with their own gender-equity workshops. Chemistry leaders are now planning a workshop to address the lack of minority faculty members, with the goal of encouraging departments to cultivate at least one minority faculty candidate in the next five years.

Biological sciences, which have similar gender imbalances, could learn from other disciplines’ scientific approach and evaluation of the issue, says Donna Dean of the Association for Women in Science in Washington DC. She notes that the funding agencies for biomedical research have “not stepped up to the plate in paying attention to the changing demographics and what’s happening to PhDs as they move into faculty positions”. **K.P.**

A POLITICAL HOT POTATO

One of the obstacles facing minority biomedical scientists could be the way US government funding is distributed through the National Institute of General Medical Sciences (NIGMS) in Bethesda, Maryland. Its Division of Minority Opportunities in Research (MORE) is the largest funder of minority programmes through the National Institutes of Health and has greatly influenced the upward trend of minority PhD numbers. But progress in diversifying faculty has been disappointing or nonexistent, according to Jeremy Berg, director of the NIGMS.

In 2005, MORE was jolted by a working group's report that, although almost 60% of MORE's budget was going to programmes at minority-serving institutions, more than 70% of minority students are receiving their BS

degrees from majority institutions. Even though the topic was a "political hot potato", says working group co-chair Virginia Zakian, a molecular biologist at Princeton University in New Jersey, the group recommended that the MORE budget should more closely reflect the realities of where minority students are educated.

Berg, however, says that it would be a mistake to shift MORE money away from minority-serving institutions towards others that have significantly more resources. Instead, he and the NIGMS are considering how best to restructure MORE programmes so that they not only encourage minority students to take PhDs, but also see them through to faculty positions.

Berg says the best way to do that is to make

changes to programmes at the institutional level, such as the NIGMS' T32 student training grants which stipulate that the receiving department must have a diversity programme in place. Also, says Berg, there should be partnerships between undergraduate universities and top-tier graduate programmes to ensure that minority PhD students aren't starting off at a disadvantage in the academic career track.

Although Berg and Zakian may disagree on how to get there, they agree wholeheartedly that diversifying the biomedical faculty is vital. "This is not an issue of social justice or equal opportunity," says Berg. "The biomedical workforce is much weaker than we need it to be and student diversity is [outstripping] faculty diversity." **K.P.**

notes, financial realities and the unfriendly climate of academia conspire to lure a huge portion of those students directly into industry positions.

"They see me work 8–12 hours a day, seven days a week for a job that pays only two-thirds of your salary, meanwhile you have to hustle the other third of your salary and grant money constantly," says Warner. That's compared with an industry job offering a \$90,000 salary out of graduate school and a 40-hour work week. "Which would you choose?" he asks.

Table 1 | Under-represented groups in the science academic pipeline, 2003–04

Group	General population (%)	BS degree (%)	PhDs (%)*	Postdocs (%)	Assistant professor (%)†	Full professor (%)‡
Women	51	50	37	40	36	18
African American	13	8	3	3	7	4
Latino	14	7	3	4	4	2
Native American	1	0.7	0.2	0.3	0.8	0.7
White	67	65	46	63	71	85

Source: Commission on Professionals in Science and Technology Professional Women and Minorities A Total Human Resources Data Compendium 16th edition (November 2006); www.cpst.org

*US citizens and permanent residents only

†Numbers include faculty members in social sciences, political science and economics, which historically include higher percentages of women and minority PhDs

Table 2 | Science and engineering PhDs granted to under-represented minorities

Group	1996	2005	% change
African American	431	536	24
Latino	529	650	23
Native American	70	48	–31

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Earned Doctorates

Table 3 | Tenure-track faculty in 'Top 50' science departments by discipline, 2001–02

Discipline	Women (%)	African American (%)	Latino (%)	Native American (%)	White (%)
Chemistry	12	1.2	1.8	0.2	90
Physics	6	0.6	1.9	0.1	86
Astronomy	13	1.2	1.2	0.0	91
Mathematics	8	0.9	2.6	0.1	85
Computer Sci.	11	0.3	1.3	0.0	78
Biology	20	1.0	1.9	0.1	89

Source: Commission on Professionals in Science and Technology Professional Women and Minorities A Total Human Resources Data Compendium 16th edition (November 2006); www.cpst.org

At the annual meeting of the National Organization for the advancement of Black Chemists and Chemical Engineers (NOBCChE), recruiters from industry make contacts with promising graduates as early as the third year of graduate school. Students who continue in academia are the rare, passionate few, says Warner.

He and Velasco both say it is imperative that senior academic scientists do a better job of presenting the positive aspects of academia, including intellectual freedom and flexibility, and ultimately higher salaries and stability. The national meetings of NOBCChE and the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) give senior scientists the chance to mentor students across campus borders. They also fend off feelings of isolation and foster networking and professional development.

Diversity leaders say that if members of faculty search committees were to talent spot at these meetings like industry recruiters, they would see that, despite myths to the contrary, there are enough women or minority candidates to go around. NOBCChE meetings attract 600 students and SACNAS 1,000, with ever-increasing numbers of postdocs as well. Urry notes that some departments have been creative in attracting under-represented candidates in the same years that other departments claim there's a shortage.

"Some people understand how to do it by beating the bushes, being very aggressive, and paying attention to these biases," says Urry. "You are sitting on a search committee, not a sit-and-wait-for-it-to-come-over-the-transom committee." Academic departments should recruit at meetings, offer incentives to match industry, and let go of the sacrosanct 'open search' ideology that relies on job ads alone, says Urry. Departments should also consider how they can harness talent by employing the husbands and wives of staff members, catching available talent outside a full-scale search, or by doing broad-based searches and cluster hires of two or three female or minority candidates.

Urry says she often hears search-committee members say that they must hire a particular specialist because the department's students demand that expertise. "If your students are 25% minority and 50% female," she asks, "don't you think they demand professors who look like them?"

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