PROJECTS, PROCESS AND PIPELINES:
CHALLENGES TO ENHANCING THE SCIENTIFIC LABOR FORCE

Suzanne Ortega
Vice Provost for Advanced Studies and Dean of the Graduate School
University of Missouri - Columbia

What I really want to talk about today is *change.* We often use the word *institutionalization* to "name" what we consider lasting changes. Ellen Weissinger addressed this question in another context today. What I want to talk about is a broader question. To expand and enhance the scientific work force, I agree with Robert Barnhill that we must promote diversity in higher education. This is fundamentally about social change. In my remarks, I will draw on nearly 25 years of experience observing and developing initiatives designed to foster inclusivity in higher education.

When we talk about policy, it is important to distinguish between programmatic or outcomes-oriented policies and policies that define core processes. In the field of law, there is a distinction between the substantive and the procedural. I want to use this same distinction to talk about policy today. Further, I want to make the claim that policies based in substance are seldom proactive. They are almost always developed and written in response to a problem that has been defined by either a wide group of policy makers and constituents, or by a narrow but powerful and influential group of opinion leaders. Because enactment of policy usually depends on a coalition of interest groups, it is often written at a very general level. Although all parties agree upon the general problem, they may very well disagree about the nature of the problem. Furthermore, implementation of policy is often less public than its enactment; it rests in the hands of administrators and bureaucrats whose typical response is to develop and initiate a series of programs and projects.

The approach of going from policy to program rarely "sticks." When initial funding sources dry up, the programs devised in response to specific policies atrophy or disappear entirely. The question of course is why. The typical response I hear is that it takes a visible, committed leader. While I agree that leadership is extremely important, like funding, leaders also "go away." So what does undermine our capacity to create lasting change? Where are the gaps between the time we first identify the problem, formulate the policy, and implement the programs? I want to make the case (and it really isn't particularly novel) that the primary omission is our lack of attention to core processes.

I think we all can agree that U.S. higher education is characterized by a rather startling lack of diversity, a lack that becomes more pronounced at each succeeding educational level and is particularly striking at a time when demographic changes are literally transforming the face of America. Certainly, in 1954, the U.S. Supreme Court took the first step in dismantling the *il*legal, overtly

discriminatory bases of educational segregation. The 1954 decision has now been followed by almost 50 years of federal, state, and institutional policies and programs designed to foster inclusion. I won't go through the list—you know them well. Nevertheless, despite some truly remarkable and important successes, most of us would have to concede that the problem of access and diversity has proven rather intractable.

Along the way, our understanding has changed. We have moved beyond seeing educational inequality as overt acts of discrimination and now see that inequality is a by-product of institutional structures. Likewise, we have also grown beyond seeing affirmative action as a remedy for past injustice to a view that diversity is a positive educational goal (as in the recent Michigan Supreme Court case). When we don't agree on the fundamental nature of the problem and the goal, this creates additional problems in trying to devise appropriate institutional responses.

Let me give a specific example. As most of you know, in addition to intellectual merit, the National Science Foundation now includes a "broader impact" criterion as part of the graduate predoctoral fellowship awards process. Included under broader impacts are such factors as contributions to diversity and social benefit. In large part, this change was designed to get around legal challenges to earlier targeted fellowship programs for racially and ethnically under-represented groups. The number of applications from members of these groups did go up during the 2002-2003 cycle, but the total applicants—and more importantly, the number of awardees—remains low. Similarly, programs such as the Ronald E. McNair Postbaccalaureate program and GradPortal have increased the pool of applicants from under-represented groups seeking admission to U.S. graduate schools—these programs have great promise. Somehow, though, the number of graduate students and Ph.D. faculty from minority groups remains disappointingly low.

An examination of how the NSF fellowship panels are briefed and make decisions may help to illuminate where the **process** breaks down. NSF fellowship panels are given little clear- cut advice on how they should evaluate the various aspects of the broader impacts criterion. Furthermore, they are given little guidance on just how much weight should be given to this component in the overall evaluation of candidates. Although NSF clearly states the importance of diversity and the broader impacts criterion to the agency and its mission, panel leaders and individual panelists are simply instructed to follow their own personal ideas on the appropriate weight to give. Because it is relatively undefined and under-discussed, the broader impacts criterion, in practice, becomes a secondary selection factor, used only after the traditional intellectual merit criteria are fully and equally satisfied.

In point of fact, I believe this same process occurs time after time on my own campus. Despite an incredibly rich array of diversity programs and a rather

generous institutional investment in graduate fellowships and assistantships for students from racially and ethnically under-represented groups, the progress we are making over the last several years is incremental at best. Why? Because graduate admissions committees often treat diversity in much the same way as NSF fellowship panels do; it is a secondary consideration after standardized test scores and other academic credentials are taken into account. This leads me to believe that the admissions process must be changed so that diversity (along with traditional academic indicators) is one of the core admission criteria. The rationale for including diversity in this way has now been firmly established by the empirical work of Pat Gurin and her associates; they have demonstrated that educational benefits accrue from diverse learning environments. A logical extrapolation of this finding is that a diverse student body is a necessary precondition to a quality education.

What holds at the institutional level should also hold at the level of departments and programs. Interestingly, when I have discussed this issue with the directors of our 90+ graduate programs, I found remarkably wide agreement, across the full range of disciplines; they agreed that diversity should be included as one of the 3-5 core indicators we use institution-wide to evaluate program quality and make related resource decisions. Although we still have some work to do in making this kind of assessment plan a reality, I believe we are within a year or two of doing so. Once we embed diversity in core admissions and resource allocation decision-making processes, I believe we will close the gap between policies and programs. At that point, we will have a real chance of institutionalizing access and diversity as core principles at the University of Missouri.

Now to the question of recruiting and training future scientists. At its heart, I think the fundamental problem is the declining percentage of domestic students in science, technology, engineering and mathematics (STEM) graduate programs, especially at the doctoral level. We fear that if we do not find a way to expand their numbers, the U.S. will lose its competitive edge in an increasingly global and knowledge-based economy.

It would be an interesting experiment to deconstruct, as Debra Stewart did earlier, all of the various stakeholders on this issue, but I want to focus on what faculty (and Vice Provosts for Research) often appear to have in mind. Most worry, I think, about an impending shortage of Ph.D. students capable of independent scientific research. A subtext is a worry that there will not be enough students to fill the labs that support scientific research *as it is currently practiced*. Although there are an increasing number of reasons to believe that science in future generations will not be practiced as it is now, our dialogue about recruiting and retaining a scientific labor force is still largely driven by the needs and structure of existing doctoral programs.

There is a countervailing force, however, that conceptualizes the "problem" of a shrinking scientific labor force differently. This perspective comes from the Sloan Foundation, industry, and other non-academic constituents. They believe that science in the future will require more master's and MBA-prepared scientists, and not necessarily more Ph.D.s. To this end, they are developing funding policies that nurture a different type of educational program. In fact, these policies (and programs) ultimately may change NSF-funding policies to include opportunities for more master's-level students.

If this alternative conceptualization of the "recruiting and retaining scientists problem" gained momentum and produced more programs on our campuses, what would be required to institutionalize these programs? My best guess is that some basic process questions would need to be resolved. Certainly, one critical issue would be the development of mechanisms that would govern/facilitate the movement of students between the two emerging tracks in STEM graduate education—the basic science/doctoral track and the more applied/professional master's track.

Another key element to enhancing the recruitment and retention of the scientific labor force resides in the shifting balance of international and domestic students. Driven by policy changes that lie outside the scientific domain, the [pre]dominant role of international students in graduate education in the STEM fields is under increasing scrutiny. This, in turn, has increased concern about the large segments of U.S. society that are uninterested in and/or under-prepared for advanced scientific education. Of course, any thoughtful exploration of this question, in the end, will lead us back to questions about diversity. The diversity question, in turn, leads us back to an assessment of the programs designed to increase access—GearUp, Talent Search, and Science and Math Upward Bound, for example. Ultimately, we face the conclusion that developing programs in the absence of sustained attention to core processes and systems simply has not, and perhaps cannot, produce sustainable change.

To know what works, we should know more about:

- how people learn science and math;
- what piques their interest as children;
- cultural or economic barriers at key transition points in the science pipeline;
- how graduate students and post-docs are recruited, prepared, and placed;
- which funding mechanisms support young researchers; and
- how scientists move between industry and the academy.

One change is clear; we must do away with the old hierarchies that give greater value to scientists than to science educators. To come full circle, we will need to develop a system of scientific education capable of creating a scientifically and mathematically literate citizenry. These well-informed citizens can then "weigh in" with policymakers on issues of importance to us all.