

## TOWARD SYSTEMIC CHANGE: EVOLUTION IN DARTMOUTH'S WOMEN IN SCIENCE PROJECT

Carol B. Muller

Thayer School of Engineering  
Dartmouth College  
Hanover, New Hampshire

### Introduction

Dartmouth's Women in Science Project was initiated in 1990 and was described at WEPAN's 1991 meeting. This progress report will describe the Project and its evolution. The Project currently involves approximately 500 undergraduate women students and 100 faculty and staff members. A constellation of strategies and programs have been implemented to increase retention, including paid research internships for first-year students, a regular electronic newsletter, special seminars, speakers and activities, and a peer mentoring program. The Project's activities and associated budgets were not developed overnight, but rather have seen evolutionary changes, which may be useful to those seeking to develop similar efforts. Long-term plans call for slow but steady change throughout the institution in order to affect the overall climate of support for women in science and engineering.

### Project Activities

The Women in Science Project at Dartmouth was developed in 1990 to address women's underrepresentation in science, and particularly to address retention among women students entering with an interest in science. Because the reasons for women's attrition from science vary from one individual to another, no one retention strategy can be expected to be effective for all. For this reason, the Project deliberately incorporates a number of strategies under one umbrella. This comprehensive approach also works to develop a community of support for women in science, bringing together those with varying needs and interests. All students are invited to participate in the Project, and a special program is extended to first-year women students, inviting them to participate in paid research internships during the winter and spring terms of their first year and/or in a peer mentoring program.

A newsletter, distributed electronically<sup>1</sup> every two weeks, offers information about campus programs and events related to science or otherwise of potential interest to women in science, as well as profiles of women faculty members, graduate students and other news. The newsletter reinforces Project activities and draws attention to the successes of women in science.

Special science seminars feature inspiring scientists who can successfully articulate the values and excitement in the study and pursuit of the sciences, such as astronaut and physician Mae Jemison, Harvard AIDS researcher Phyllis Kanki, and CalTech chemist and MacArthur Award winner Jacqueline Barton. Other on-campus programs include presentations by scientists and engineers in industry, panel discussions focused on topics such as balancing careers and families, discussions with graduate students and faculty, and career development workshops. Industrial site visits to local and regional science engineering firms and laboratories give students the opportunity to see scientists in their work environments.

Research internships offered through the Women in Science Project offer first-year students: 1) an opportunity to work in scientific research during the first year, 2) one-on-one work with a faculty member or researcher, who can serve as a present and future mentor and role model, 3) "hands-on" laboratory work and firsthand experience with scientific inquiry, 4) an important scientific experience complementary to introductory science classes, 5) an experience which de-mystifies and de-mythologizes science, 6) stipends to ensure the full participation of economically disadvantaged students. This is an innovative approach to undergraduate instruction in scientific research, which is usually reserved for upper division science majors, most often seniors, and tends to be focused on preparation for graduate study. Research interns are expected to work 10 hours per week for two academic terms (quarters), and the internships offer the opportunity for substantive, thematic employment in lieu of work-study or other part-time jobs in the dining hall, library, or elsewhere on campus. As a culminating experience, interns participate in a Science Poster Symposium at the conclusion of their internship, developing a poster representing their work, and informally addressing questions from interested students, faculty, and others attending the symposium.

A program of peer mentoring matches prospective women science majors with junior or senior women majoring in science, offering the first-year woman an opportunity to consult with a slightly older peer who has experience similar curricular offerings and choices. The upper division mentor receives training as well as encouragement prior to meeting her "mentee."

### Project Evolution: Participation

The program has grown in each year of its existence, in participation of faculty and students, in activities, and in supporting resources. In the first year, 115 first-year women signed up to participate in the project, and 45 of these worked as research interns. Nearly half of the science faculty offered to supervise interns, many using their own research funds to pay the students. The following year, a similar number of first-year women joined the Project, and again 45 were supported through internships. In the Project's third year, more than 260 first-year women joined the project, 72 are undertaking research internships, and more than 600 students and 100 faculty and staff members are now affiliated with the project.

### Project Evolution: Preliminary Results

Because the Project's efforts begin with first-year women, there is necessarily a four-year delay from the start of the project before it is known whether the Project's first goal — an increase in the number of women majoring in science as measured by graduating statistics — has been achieved. Yet a variety of early indicators, including information obtained directly from participants, can suggest the degree to which the employed strategies will be successful. A reasonably accurate estimate of the number of women majoring in science is available when students declare their majors at the end of the sophomore year.

The first cohort of students to participate in the project is now past the point of having declared majors. Of those who undertook research internships during the Project's first year, 60% have declared a science major. Of those who participated in other activities of the Project, 43% declared a science major. Of those women who initially expressed an interest in a science major but did not participate in the Project, only 22% declared a science major. Among all 260 who originally indicated an interest in majoring in science, 90 (35%) have declared a science major. For the class as a whole, 98 of 449 (22%) women have declared science majors, compared to 156 of 558 (28%) men who have done so. These numbers compare to 65 women (12%) who graduated with science majors in 1992, 70 (17%) in 1991, and 45 (13%) in 1990.

Other analyses of evaluative data indicate that these figures are neither wholly the result of mathematical aptitude or self-selection. Some participants have noted that Project activities were clearly instrumental in affecting student choice of a major. Others note that the mere existence of the Project on campus makes them feel supported and encouraged, whether or not they actively participate in Project activities. Although the Project was designed to address retention of women in science, recent activity suggests that some women are selecting Dartmouth as the college of their choice because of the presence of the Women in Science Project.

Recent findings have reinforced the likely benefit and value of a model project such as the Women in Science Project. A 1991 study<sup>2</sup> which examines efforts made by U.S. institutions to increase the participation of women in science suggests there are too few of these efforts and that the absence of a "nurturing" environment leads many students to feel that no one cares about whether or not they pursue studies in these areas. Another report issued in 1991<sup>3</sup> suggests that institutions must shift attention from recruitment to retention. The National Research Council convened a conference to assess effective programs in retaining women in science and engineering in 1991, and conferees specifically recommended that institutions provide hands-on research experience early, create a network of faculty and student mentors, arrange visits with technical professionals outside academia, and offer financial aid packages that enable students to spend their time on lab work, rather than on part-time jobs outside the institution,<sup>4</sup> all strategies reflected in our project's design.

### Project Evolution: Programs

During the Project's first year, the program of research internships was established: a newsletter compiled and produced by students was published every two weeks; and special seminars, industrial site visits, panels and discussions with visiting scientists were implemented. A program evaluation was undertaken, but resources permitted only limited analysis. In the second year, a director was hired, existing programs were refined and expanded, and a spring science symposium showcasing the work of the Project's research interns was established. In the Project's third year, a peer mentoring program was significantly expanded, student and faculty/staff steering committees were formalized, the student steering committee created a women's science study room, and the research internships program was evaluated by an external consultant.

The Project's fourth year promises further enhancement, enabled by a major grant from the Alfred P. Sloan Foundation to develop new programs of faculty institutes and seminars, curriculum development, enhancing awareness of gender issues among study group leaders, participation of women as study group leaders, and addressing the needs of women graduate students. Additional future plans involve the development of an external advisory committee for the Project, industrial mentoring programs and new programs to address peer gender dynamics among students.

### Project Evolution: Systemic Change

Many efforts designed to encourage greater participation of women and minorities in science and engineering in education and in the workplace are primarily "band-aid" efforts which address the symptoms, but not the roots of the problem. Until we begin to restructure the organizations most involved – schools, universities, corporations, and other institutions – to change organizational culture, beliefs and behaviors, incentive and reward systems, we will not be creating long-lasting change.<sup>5</sup>

In contemplating institutional change in an institution of higher education, it is essential to involve the faculty as well as others. Though colleges and universities are loosely-coupled organizations, with great organizational ambiguity in structure and governance,<sup>6</sup> it is still clear that the faculty has the opportunity to create change, both in policy and in the actual delivery of education, and also the ability to thwart and actively resist change. By enlisting faculty members directly in the provision of retention efforts, through supervision of students involved in research internships and other activities, they are likely to learn more about and appreciate more fully the experiences of women students.<sup>7</sup> In addition, like most sensible professionals, faculty members "do not replace strongly-held views and behavior patterns in response to fiat or the latest vogue; instead, they respond to developing sentiment among respected colleagues to incentives that reward serious efforts to explore new possibilities, and to the positive feedback that may come from trying out new ideas from time to time."<sup>8</sup> We have already found that some science faculty members who were initially skeptical that first-year students could be involved in any meaningful way in research projects have, through talking with their own colleagues and

observing their behavior, found ways to involve first-year students in research. A few others have confessed to us their surprise at finding the Women in Science Project's success in encouraging women students in science corroborated through direct conversation with students.

### Project Evolution: Resources

In 1991, when I indicated our estimated annual budget for this project, fully implemented, would be approximately \$210,000, I heard gasps of dismissal suggesting an interpretation that somehow Dartmouth must have very deep pockets indeed, and the experience of this endeavor would therefore not translate to other campuses. To the contrary, the Project initially began with no funding. The resources available to support it have grown over time through careful development of internal and external support. Although many worthwhile retention efforts may not require a high level of direct costs, there will always be a need for some resources – human, financial, time and effort. On our campus, as noted above, we felt the best results could be achieved through a *comprehensive* project, and so we set about to develop the needed resources.

Internal and external financial support for the Project has been gratifying, particularly given the high cost of supporting a program of paid research internships. In its first year, the deans of engineering and arts and sciences made available some internal budgetary allocations to support internships; individual faculty members supplied funds from their own research grants to support first-year interns working in their labs; we were successful in acquiring an internal grant to support Project activities from Dartmouth's president's discretionary funds to support undergraduate education; the provost's office and other organizations and departments at Dartmouth contributed funds to support special events, such as the visit of astronaut and physician Mae C. Jemison. Later in the year, the Project also received some corporate contributions.

In its second year, the Project was successful in obtaining a major grant from the National Science Foundation, enabling us to hire a sorely-needed project director and fund sufficient first-year research internship experiences to satisfy student demand. This grant, coupled with some additional corporate support, not only provided the substantial base of support required, at least for one year, but also offered important leverage for a request for long-term base budgetary support from Dartmouth. Despite the current financial constraints on the university budget, this request was granted, effective for the Project's third year.

The National Science Foundation awarded a second \$100,000 grant for the Project's third year. Halfway through the year, the Project won a five-year, \$300,000 grant from the Sloan Foundation both in support of existing Project activities and continued development of systemic change as noted above. External funding for the Project has grown from \$6,000 in the first year to \$183,400 to support activities during the third year.

### Conclusion

The Women in Science Project at Dartmouth represents an important initiative in higher education, and already is serving as a model for other institutions. It addresses a significant problem — the underrepresentation of women in the pursuit of science — and seeks to improve opportunities and access for these students. Initial results indicate a very positive change in the numbers of women participating in science. Through careful orchestration, including initial research and education, coalition building, collaboration across departments and schools, and other project development work, the Women in Science Project has garnered significant resources and support, financial and non-financial, to undergird and enable its ambitious goals: increasing the numbers of women in science and engineering by creating an institutional environment in which women in science are truly encouraged and supported at every step.

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- <sup>1</sup> Dartmouth requires all students to have a personal computer, and electronic mail is students' communications medium of choice. Electronic distribution is also more cost-effective, more timely and more conservative of natural resources.
  - <sup>2</sup> Marsha Lakes Matyas and Shirley M. Malcom, eds. *Investing in Human Potential: Science and Engineering at the Crossroads*. AAAS, Washington, D.C., 1991.
  - <sup>3</sup> "Women in Science and Engineering: Increasing their Numbers in the 1990s," National Academy Press, Washington, D.C., 1991.
  - <sup>4</sup> See "Continuing Shortage of Women in Science Decried; Many Drop Out," *The Chronicle of Higher Education*, December 11, 1991, pp. A31-32.
  - <sup>5</sup> Change also will be required in arenas other than institutions, such as social and family belief systems, communications media, and so forth, but these are beyond the focus and scope of this project. In addition, it is clear that even with institutional change in higher education, systemic change is also required in pre-college education to ensure full participation of women in science. Our project is thus limited to a still-ambitious program of institutional change within one university, and an effort to influence other institutions of higher education toward similar change.
  - <sup>6</sup> For a great deal more on these concepts, see, for example, Michael D. Cohen and James G. March, *Leadership and Ambiguity*, 1974. They note that universities can be termed "organized anarchies."
  - <sup>7</sup> An analogy may be made to the results of research on youth tutoring youth, which has found that tutors actually gain more than the tutees. If we extrapolate from these results, it is reasonable to assume that by involving faculty directly in this project, their behaviors will change as well. Another example is provided by unanticipated results of a family science project in the schools. In this project, teachers were trained to conduct a series of 6 afterschool programs for parents and their children, focusing on math and science enhancement, with the expectation that parents would have a good experience and then be more likely to work with their children on these skills at home. Evaluation results showed that while the parents did have a good experience, behavior in the home rarely changed. Instead, the biggest change found was in teachers' behavior. Teachers began doing more "hands on" science and math projects with children in their classrooms, were also more apt to pay attention to gender issues, and were more likely to report that the number of things they do to encourage girls' participation in math and science increased. (Source: Patricia Campbell, Campbell-Kidder Associates, telephone conversation 12/28/92.)
  - <sup>8</sup> This wording, which seems most appropriate, is taken directly from Chapter 14, "Reforming Education," in *Science for All Americans*, Washington: AAAS, 1989, p. 154.