

MIT Faculty Newsletter

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this issue features a retrospective of his term as Dean for Undergraduate Education by Robert Redwine (page 5); a Teach Talk article on "Why Students Don't Attend Class" (page 6); the announcement of a DOD inquiry into Lincoln Lab misconduct charges (page 9); and an article on "International Students at MIT Post 9/11" (page 10).



Diversification of a University Faculty: Observations on Hiring Women Faculty in the Schools of Science and Engineering at MIT

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Abstract

A BROADLY DIVERSE FACULTY is critical to MIT's educational mission, and significant efforts have been made to achieve a faculty whose diversity reflects that of the students we train. To assess the success of some of these efforts, I examined the percent of women faculty in the Schools of Science and Engineering over time. In Science, the increased number (and %) of women faculty today is the consequence of: pressures associated with the civil rights movement in the early 1970s; unusual efforts between 1996 and 2000 by former Dean of Science Bob Birgeneau in response to the 1996 *Report on Women Faculty in Science*; and efforts that sustained the progress made as a result of these two initiatives. The women faculty hired in the School of Science as a result of these pressures achieved tenure at the same rate as men and have achieved at least the same level of professional success as their male colleagues as measured by election to the prestigious National Academy of Sciences. In the School of Engineering, the number of women faculty rose more steadily with time and with the increasing number of women receiving PhDs. However, as in Science, a recent rapid increase in the number of women faculty resulted from the leadership of its Dean, Tom Magnanti, working collaboratively with then Provost Bob Brown, in response to the *Report on Women Faculty in the School of Engineering*. The data suggest that usual departmental hiring processes do not always identify exceptional female candidates. But, women faculty were readily hired by involvement of the central administration, including the use of novel hiring procedures, collaborations among the Provost, Deans, Department Heads, and women faculty committees, all with the visible support of the President.

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Editorial Squeezing Out the Graduate Students

IN THE EARLY 1980S, MIT was well known as an expensive place to do research. With a high dependence on federal funding, graduate students were very expensive to support. Provost John Deutch made a dramatic improvement in the situation for the faculty by transferring graduate student tuition into the employee benefit pool, but that tactic was eventually disallowed by our federal auditors and costs to research grants and contracts soon escalated. A committee chaired by Professor Robert Weinberg was charged with recommending a long-term solution to the problem, which ultimately led to a tuition remission policy by the Institute.

This policy both removed tuition on graduate students in the summer term and required faculty research grants to cover only 35% of the true cost of tuition, referred to as 65% "tuition remission." To

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I. Introduction

(a) Context

A broadly diverse faculty, including gender, racial, and all other aspects of diversity, has been determined by the faculty and the administration of MIT to be critical to the achievement of the Institute’s educational mission. A diverse faculty is essential in order to offer the best education to all of MIT’s students. It is also essential to serve the nation’s needs for a broadly diverse and highly qualified labor pool, including the academic work force. MIT employs many approaches to recruiting and retaining an exceptional faculty. However, as discussed below, the regular approaches to recruiting and hiring faculty may not be adequate to recruit women. It can be difficult to know how effective particular processes are at recruiting the women and racial minorities needed to achieve the gender and racial diversity essential to our educational mission. As Co-Chair, with Provost Reif, of the Council on Faculty Diversity, I have been interested in assessing the effectiveness of some of these processes. To do so, I looked at overall trends in the hiring of women faculty in the Schools of Science and Engineering.

(b) Percent women faculty and students in Science and Engineering at MIT

Beginning around 1970, the percent of female undergraduates at MIT began to rise sharply: in 1966, fewer than 5% of MIT undergraduates were women, today, 40 years later, 43% percent are women (Figure 1). In the School of Science at MIT today, 51% of undergraduate majors are women, in the School of Engineering,

women comprise 36% of undergraduate majors. The dramatic increase in the number of women in the MIT undergraduate student body was soon accompanied by an increase in the number of women obtaining PhDs in science and engineering at MIT, although increases vary considerably depending on the specific field.

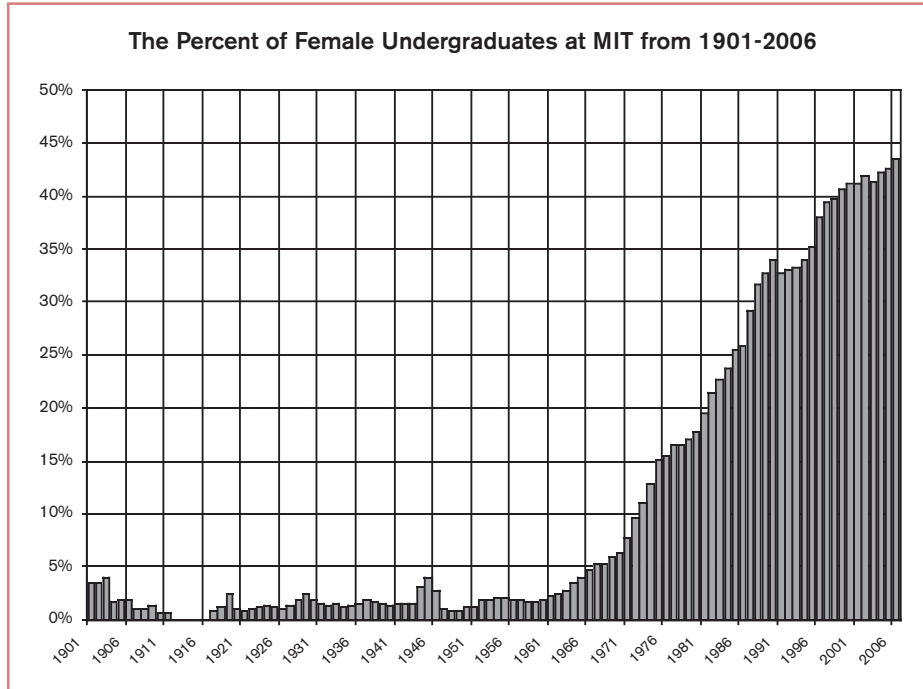
Despite the increases in the number of women in many undergraduate and PhD science and engineering programs over the past 40 years, the percent of women on the science and engineering faculties of research universities, including MIT, remains small: only 13% of the Science faculty and just under 14% of the Engineering faculty at MIT today are women. Table 1 (next page) shows the percent of female PhD students in each Science department at MIT and the percent and number of women faculty in each of these same departments.

In part, the small number of women faculty in Science and Engineering can be explained by (1) the fact that the “pipeline” began to fill only about 40 years ago; and (2) faculty turnover rates are slow, with many faculty who achieve tenure staying at MIT for 30-40 years. Only about 5% of the MIT faculty leave each year due to retirement, failure to achieve tenure, or other factors. At this rate, and assuming a 50% tenure rate, it would take approximately 40 years for a department that had no women faculty to have a faculty that has the same percentage of women as the PhD pool.

Despite this explanation for the small number of women faculty in Science and Engineering, people who study the hiring of women faculty, and also the hiring of under-represented minority faculty, arrive at shared perceptions about the process, namely: that increases in the representation of women and minorities don’t just “happen,” but result from specific pressures, policies, and positive initiatives designed to increase hiring of women or minorities; and that when these pressures abate or expire, hiring progress stops or even reverses.

(c) A brief history of some recent efforts to increase faculty diversity

In 1995, at the request of tenured women faculty in the School of Science, a Committee was appointed by then Dean of Science, Robert Birgeneau (now Chancellor of Berkeley) to study the status of women faculty in Science at MIT. In their 1996 report to the Dean (*The First Report of the Committee on Women Faculty in the School of Science on the Status and Equitable Treatment of Women Faculty*), in addition to identifying factors affecting status, this Committee took note of the very small number of women faculty in Science at that time (22 women and 252 men). They also noted that the number of women



Department	% Female PhD Students	% Female Faculty	# Female Faculty/Total
Biology	52%	21%	11/52
Brain & Cognitive Sciences	43%	24%	8/33
Chemistry	35%	20%	6/30
Earth, Atmospheric & Planetary Sciences	38%	8%	3/38
Mathematics	22%	6%	3/53
Physics	12%	7%	5/70

Table 1. Percent of PhD students and faculty who are women in each of the six departments in the School of Science in 2006. The number of women faculty and the total number of faculty are shown in the third column.

faculty had not changed significantly during the previous decade. Dean Birgeneau concluded that increasing the number of women faculty in the School of Science was a critically important element to remedy the unintended marginalization, undervaluation, and exclusion of senior women faculty documented by the report. As discussed below, he made considerable and successful efforts to hire highly qualified women scientists until his departure from MIT in 2000.

In 1999, a summary of the report on the status of women faculty in the School of Science was published in this *Newsletter*. The summary came to be known as the *MIT Report on Women in Science*. This Report, with validation from then MIT President Vest, had a substantial impact outside MIT, because when news

of it appeared on the front pages of *The Boston Globe* and *The New York Times*, its content resonated with professional women both in the U.S. and abroad. The *MIT Report on Women in Science* provoked similar examinations at many other universities, helped to inform the design of the ADVANCE program at NSF, and resulted in the formation of a network of 9 Universities whose Presidents and women faculty have continued to meet to analyze and discuss this topic and to formulate policies.

Within MIT, the *Report on Women in Science* led to initiatives to try to ensure equity and prevent marginalization of women faculty, to facilitate easier family-work integration, particularly for junior faculty, to increase the number of women faculty in administrative positions, and to increase the number of women and under-represented minority faculty. Major initiatives included: (1) increasing the number of women faculty in academic administration; (2) establishing committees called Gender Equity Committees within each School to report on the status of women faculty and to review equity in working conditions, including salaries, on an ongoing basis with the Deans; (3) establishing a Council on Faculty Diversity, co-chaired by a tenured woman faculty member who sits on the Academic Council and by the Provost, to address Institute policies that impact the quality of life, status, and numbers of women and under-represented minority faculty; and (4) increasing day care facilities (an effort promoted by, among others, Professor Leigh Royden, Dean Birgeneau, and Provost Brown). More recently, under President Hockfield and Provost Reif, and in accordance with a faculty resolution sponsored by former Faculty Chair Rafael Bras, Associate Chair Paola Rizzoli, and Secretary Kenneth Manning, committees have been established to focus on the hiring and retention of under-represented minority faculty. The network of Committees

now under the auspices of the Provost and the Council on Faculty Diversity are shown in Figure 2.

It has been a full decade since *The First Report of the Committee on Women Faculty in the School of Science* was presented to Dean Birgeneau. Given the considerable efforts in response to this report, I decided to examine the impact on the number of women faculty at MIT. Here I present some of the initial findings and discuss what they suggest about ways in which universities can achieve a diverse faculty.

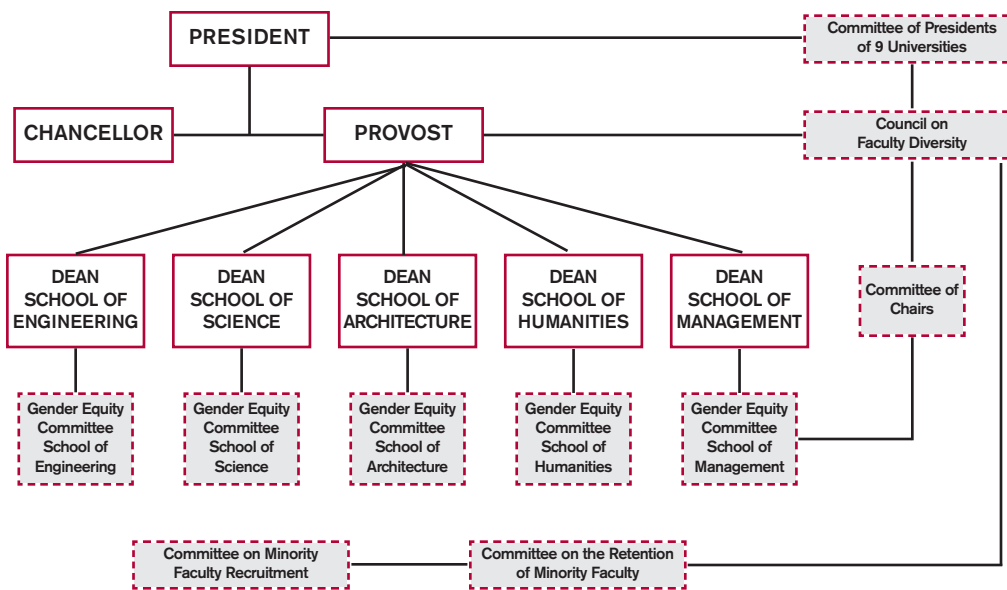


Figure 2. Members of the MIT academic central administration (white boxes) and committees (grey boxes) that have been established to address the under-representation of women and under-represented minorities on the faculty.

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II. Observations on Hiring of Women Faculty in the School of Science

(a) *The Percent of Women Faculty in the School of Science is the consequence of two actions: A response to pressure associated with the Civil Rights Act, and Dean Birgeneau's response to the 1996 Report on the Status of Women Faculty, combined with efforts that sustained the resulting progress*

Figure 3a (next page) shows the total number of tenured and untenured women faculty in all six departments in the School of Science from 1963 (when there was a single woman faculty member) through 2005 (when there were 36 women faculty). The curve rises steeply twice: once between 1972-1976 and once between 1997-2000. These rises do not reflect contemporaneous increases in the size of the faculty during those periods: The number of male faculty at several relevant years is shown in the numbers at the top of the graph. The number of male faculty actually decreased (from 259 to 229) during the rise in female faculty between 1997-2000, due to an early retirement program. As of 2006, there were 36 female faculty and 240 male faculty in the School of Science at MIT.

I deduce that the first sharp rise in the number of women faculty in Science, beginning in 1972, is the result of pressures associated with the Civil Rights Act and of affirmative action regulations. In particular, in 1971 Secretary of Labor George Schultz ordered compliance reviews of hiring policies of women in universities. All institutions receiving federal funding were required to have such plans in effect as of that year. In addition, a group of women faculty and staff worked to persuade MIT to hire more women faculty at this time (M. Potter, personal communication). The second sharp rise, between 1997-2000, directly resulted from Dean Birgeneau's response to the 1996 *Report on Women Faculty*. Despite the small numbers, the increase in women faculty that resulted can be seen in five of the six departments of Science: Table 2 shows the percent of women faculty in each department in 1996 and the percent just four years later, in 2000, the year Birgeneau left MIT. Significant increases in the number and percent of women faculty were achieved in five departments in just four years. They ceased when Birgeneau left, except in Chemistry where they continued under Department Head Steve Lippard.

The data show that significant and rapid increases in the number of women faculty can result from intentional targeted actions and responses to external pressures. However, this alone cannot explain the shape of the curve in Figure 3a. This is because MIT hires primarily junior faculty, not all of whom achieve tenure or choose to stay. Tenure rates vary in different departments, but average roughly 50% in both the Schools of Science and Engineering. The rates of attaining tenure are the same for women as for men in Engineering and the same or slightly higher for women than men in Science. To maintain the

	1996	2000	2006
Biology	15%	22%	21%
Brain & Cognitive Sciences	17%	26%	24%
Chemistry	6%	13%	20%
Mathematics	2%	8%	6%
Physics	4%	7%	7%
Earth, Atmospheric & Planetary Sciences	13%	11%	8%

Table 2. Increases in the percent of women faculty in five of the six departments of Science as a result of Dean Birgeneau's response to the 1996 *Report on Women Faculty in Science*. Note that after 2000 the percent of women faculty continued to increase in only one of the five departments, namely Chemistry.

progress that is achieved in response to unusual hiring pressures requires that additional women be hired.

(b) *Women faculty hired in the School of Science in response to intentional targeted actions and pressures are as scientifically successful as their male colleagues*

A critical question is whether in response to extraordinary pressures universities ever hire, or even worse, tenure individuals of lesser ability or accomplishment. Clearly, at the faculty level it is imperative that the criteria for hiring and tenure remain identical for all individuals. While this necessity should be obvious, opponents of targeted actions to increase gender diversity routinely argue that increases in the number of women on university faculties as a result of external pressures may lower academic standards.

As already noted, overall the tenure rates for men and women are almost identical in both the Schools of Science and Engineering. However, to ask specifically whether standards for hiring and tenure were compromised to achieve rapid increases in the numbers of women faculty, I examined the success of women hired in the School of Science between 1996 and 2000. Fifteen women were hired in this period, and eight are now tenured faculty. Of these eight, three have been elected to the National Academy of Sciences and one (other) has won the Waterman award (for a young United States scientist or engineer of exceptional accomplishment). Since the women are still relatively young, it seems almost certain that others of them will be elected to the National Academy of Sciences. These levels of accomplishment are already comparable to the tenured MIT Science faculty (see below and Table 3 [page 20]).

In 1999 when the *MIT Report on Women in Science* was released, some individuals and several groups outside MIT attempted to discredit the Report's findings by claiming that the women faculty involved in writing it were less successful than

their male colleagues and that this explained or justified their lower status and unequal treatment in previous decades. Judith Kleinfeld (University of Alaska) made particularly negative criticisms of the report (labeling it “junk science”) and of its authors, and she has continued to do so, as have Christina Hoff Summers (Clark University), Cathy Young, and other right wing political writers and organizations such as the Independent Women’s Forum and American Enterprise Institute. To put to rest any concerns such criticisms may have raised, we reviewed the objective academic credentials and achievements of the authors of the Report, as determined by their comparative membership in the prestigious associations and Academies. As Table 3 shows, this group is, on average, at least as accomplished as their male colleagues. Of the 16 tenured women faculty in Science who participated in the study that resulted in the 1996 *Report on Women in Science*, 10 are members of the National Academy of Sciences, two are members of the Institute of Medicine of the National Academy, 11 are members of the American Academy of Arts and Sciences, and two have won the Presidential Medal of Science. As the table shows, these frequencies are higher than the overall tenured Science faculty. Thus, by these criteria, these women faculty are somewhat more successful than their male peers. Moreover, given the scientifically well-documented under-valuation of women’s academic accomplishments, it is likely that these women may, in truth, be still more accomplished than the table indicates. Many of the women who participated in the 1999 study were hired during the first wave of affirmative action in the 1970s, showing that such efforts do not result in lowering standards at elite research universities such as MIT. I conclude that unfounded criticisms of these highly successful women’s accomplishments and of their *Report on Women in Science* were motivated by ignorance, intransigence, a political agenda, or by gender bias itself on the part of these critics: namely, the inability to recognize equal accomplishment in women, despite overwhelming evidence.

In summary, women faculty hired in Science at MIT as a result of unusual pressures and intentional targeted procedures and actions are as scientifically successful as their male colleagues.

Number of Women Faculty in the Schools of Science (1963-2006) and Engineering and Architecture and Planning (1992-2006)

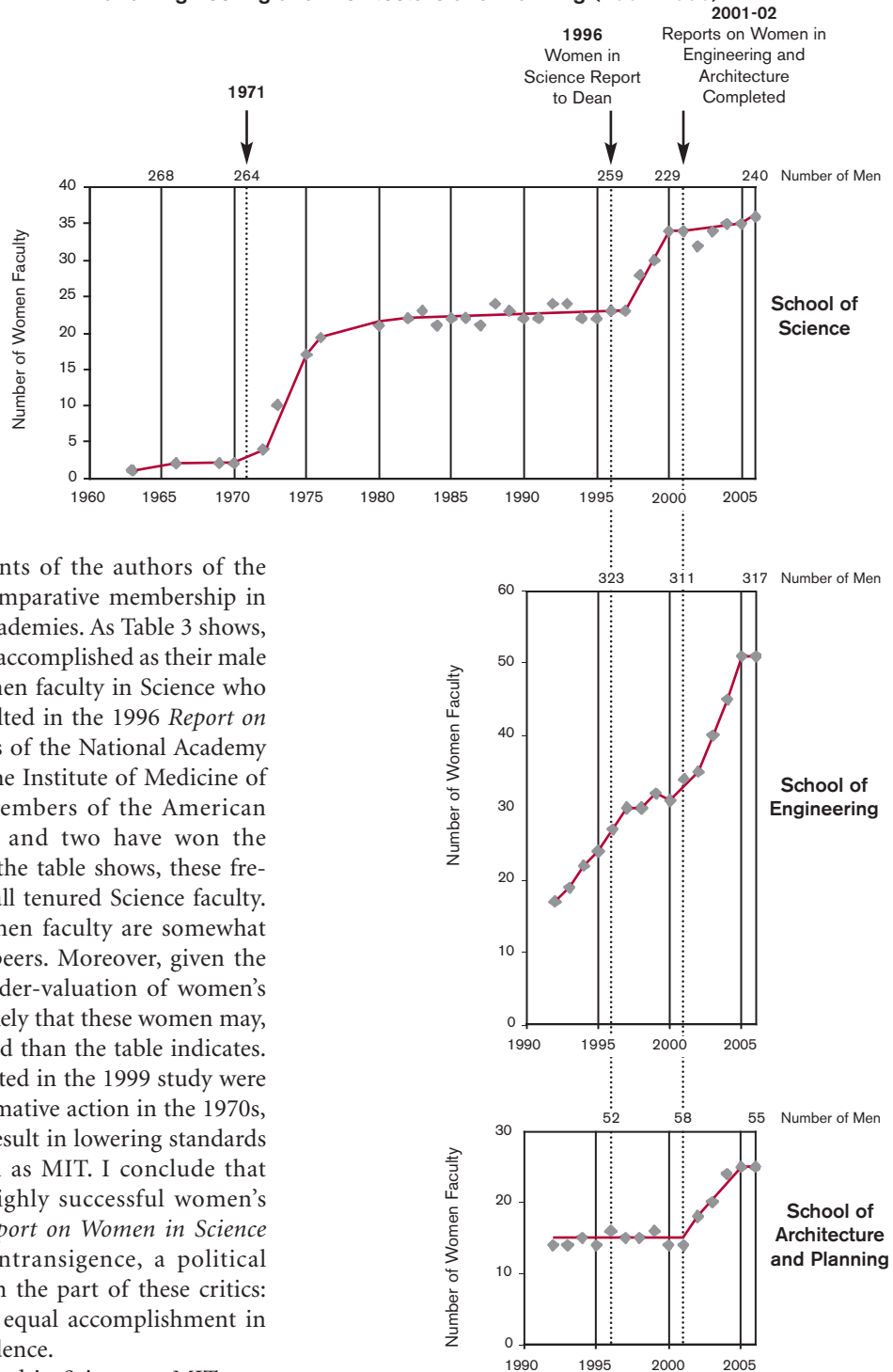


Figure 3. The number of women faculty in the Schools of Science (a), Engineering (b), and Architecture and Planning (c) over time. The number of male faculty in each School is indicated for certain years near the top of each graph. The years of key events that led to rapid increases in the numbers of women faculty are indicated by the dotted vertical lines. Note that the three graphs are positioned so that the calendar years are aligned.

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(c) Relationship between the PhD pipeline of women scientists and the hiring of women faculty in Science at MIT

Hiring women faculty depends upon there being a highly qualified pool of women PhDs to hire from. Could the unusual shape of the curve in Figure 3a reflect the availability of women PhDs in Science? To fully understand the pipeline for this purpose, one would need to know the percent of women receiving PhDs in science over time from the types of universities whose graduates we hire. I did not obtain these data. However, I did look at the percent of PhD students who are women in departments of science at MIT from 1985-2005. MIT is the type of school whose graduates we hire, and its numbers of women PhDs are likely to be similar to those of the other schools we hire from. There is no sharp rise in the percent of women receiving PhDs in Science that correlates with the sharp increase in the number of women faculty in Science between 1997 and 2000. Nonetheless, the pipeline curves (not shown) are informative: As early as 1985, 37% of PhDs in Biology, 28% of those in Chemistry, and 13-15% in Math went to women. These numbers continued to climb over the next decade to 45%, 32%, and 19-20%, respectively. During this period, however, the percent of women faculty in Biology remained flat at 13-15%, the percent in Chemistry did not move from 7% (two women faculty), and the percent in Math remained between 0 and 2%. Only when the Dean intervened did the percent of women faculty in these departments increase. The gap between the percent of women obtaining PhDs and the small percent on the faculty is an example of what is often referred to as the “leaky pipeline” of women – the fact that a higher fraction of women are trained than go on to be faculty. While the leak is most often attributed to women opting out of these careers, the data in Figure 3a and the data just cited for individual departments show that at least part of the leak is due to a failure of search committees to identify and hire exceptional women faculty candidates in the pool.

Physics may present a different situation from Biology, Chemistry, or Math: the percent of women obtaining PhDs in Physics has remained low and the percent hired may be closer to the available pool. Clearly, a much more thorough understanding of the pipeline is important, as it provides a guide to the upper limit of what the faculty could look like, and these studies should be undertaken for each department at MIT.

III. Observations on Hiring of Women Faculty in the School of Engineering

A recent increase in the number of women faculty in Engineering reflects the response of Dean Tom Magnanti to the Report on Women Faculty

I did not obtain data back to the 1960s and '70s for the number of women faculty in the School of Engineering, but obtained it

	# Out of 16 Women Faculty	# Out of All 208 Tenured Faculty in Science
Presidential Medal of Science	2 (13%)	8 (4%)
National Academy of Sciences	10 (63%)	60 (29%)
Institute of Medicine of the National Academy	2 (13%)	23 (11%)
American Academy of Arts and Sciences	11 (69%)	115 (55%)

Table 3. Measures of scientific success of the 16 tenured women faculty in Science who, in 1994, asked the Dean to allow them to study the status of women faculty and who authored the 1996 and 1999 Reports on Women in Science, relative to the same measures of success among all tenured faculty in Science at MIT as of 2006. Currently there are 208 tenured faculty in Science, including 182 men and 26 women.

for the past 25 years. The number of women faculty does not show the 20-year-long plateau seen in Science, but increases much more steadily, presumably reflecting more closely the increasing number of women obtaining PhDs in Engineering, and the fact that individual departments were successful at hiring them. However, the curve does show variation in the rate of hiring. The variation that is useful for the purpose of this article is shown in Figure 3b. Very recently, for a five-year period ('00-'05) the School hired women at the rate of five women faculty/year vs two women faculty/year for the previous 15 years (including in each preceding five-year period). The rates of hiring of men in these same intervals were 11.4 male faculty/year for the past five years and 12/year for the preceding 15 years. The increased rate of hiring of women was primarily due to the efforts of Dean Tom Magnanti following the *Report on Women Faculty in the School of Engineering*. This report, prepared by a Committee appointed by the Dean in 2000, was presented to Magnanti in 2001 and to the MIT faculty in 2002.

Given the impact of the Reports by women faculty committees on the hiring of women faculty in Science and Engineering, I looked at other Schools of MIT as well, since such Reports were made in all five Schools. Figure 3c shows the number of women faculty in the School of Architecture and Planning over the past 14 years. The curve reveals a sharp increase under Dean Mitchell and Associate Dean Knight following the 2001-2002 *Report on Women Faculty* in that School. The number of women faculty in the School of Architecture was 14 for about a decade, then rose quickly to 25 as shown in the figure. In the Sloan School there was a modest rise in the number of women faculty following a *Report on Women Faculty* (data not shown). In the School of Humanities, Arts and Social Sciences there was no rise, and the percent of women faculty remains about the same today as a decade ago (28% in 1997, 29% in 2006). I did not examine overall hiring rates and trends in these Schools.

IV. Different Hiring Processes Yield Different Numbers of Women Faculty but Any Process may Depend on Specific Individuals and Circumstances

(a) *Explaining the shapes of the curves in Figure 3*

In response to external pressures or engagement of their Deans, how did the Schools of Science and more recently Engineering and Architecture succeed in hiring so many highly qualified women faculty in just 3-4 years? And why did many departments fail to increase the percent of women faculty between these bursts, even though many were able to sustain the increased levels of women hired as a result of external pressures? We know quite a lot about the answer to the first question, which informs speculation about the second. Importantly, the processes used to identify and attract women candidates and the hiring processes for faculty are very different during periods of increased hiring of women. Below I use the example of the recent jump in women faculty in Engineering, since, through my role on the Council on Faculty Diversity, I am familiar with many of the administrative procedures that produced it.

On average, as noted above, faculty turnover is about 5% a year at MIT, so the number of hires required to maintain faculty size is small: for example, a department of 40 will hire about two (usually junior) faculty a year, about half of whom will later get tenure. Faculty searches are conducted by a committee appointed within the department, and each search process is independent of any other. Even if the applicant pool were 50% women PhDs, the hiring of a man in any one search would be unremarkable and statistically insignificant. In fact, even to notice that women are not being hired in numbers equal to their availability requires oversight over a period of time, and at a level above, the individual search committee's perspective or mandate. Even today, in some fields of science, only about 10, 20, 30, or 40% of PhDs go to women (see Table 1). For a department of 40, these numbers translate to hiring rates of only 1, 2, 3, or 4 women *every five years*, assuming no leakage from the pipeline. Given that the number of women one might expect to hire is too small to be significant annually, and in some fields too small to be significant over even longer periods of time, one can see how a department might suddenly realize that it had not increased its number of women faculty in a decade. Assuming that a Department Head's term is five years, and that an understanding of this issue takes time to master, one can see how a departmental administration could turn over without knowing if it had significantly increased the hiring of women faculty, or whether a potential increase was sustainable. The data for individual department hires in the School of Science that I examined (not shown) suggest that when the percent of female faculty in a department begins to fall, efforts are made to replace the women who have left, though how and why this occurs is unclear.

The processes that led to a rapid increase in the number of women faculty in the School of Engineering between 2000-2005 were different from those just described for how departments

usually hire faculty. They involved unusual administrative approaches by the Dean of Engineering, Tom Magnanti, with additional administrative actions and support from then Provost Bob Brown. Several key aspects of the processes are revealing: 1) the Dean made it known to department heads that hiring women faculty was a high priority for him, and he reinforced his commitment by returning a chosen male candidate to a department because he concluded that the search committee had failed to interview qualified female applicants. 2) The Dean focused

This raises the profoundly important possibility that exceptional women may not apply for faculty jobs in the same way that has worked for recruiting exceptional male faculty candidates. If true, such women candidates might very well not be found by conventional departmental search committee methods.

particular effort on two departments that had been identified by the *Report on Women Faculty in Engineering* as having particularly poor records of hiring and retaining women faculty. 3) The Dean pooled open faculty slots and made as many slots available for the pool as possible, so that search committees could look for more than one candidate at a time, and the Provost encouraged this practice. 4) When canvassing Department Heads and colleagues at other universities to ask informally for names of potential outstanding candidates (a standard process during job searches), search committees specifically asked for names of outstanding female candidates, which they found were sometimes omitted unless specifically requested. 5) The Dean made it clear that (a) all candidates for a faculty position have to be evaluated under the same criteria, including both academic qualifications and whether the candidate would contribute to high priority needs of MIT, the School and the Department at the time, such as gender and racial diversity and extraordinary excellence in a field (even by MIT standards); (b) for individuals who could make contributions to such needs, in addition to satisfying many other criteria, the Dean made clear that excellence was far more important than their specific field of research. 6) Efforts were made to identify exceptionally talented women candidates who had not applied for the jobs in the conventional manner or whose names did not surface through other standard informal inquiries. These approaches are routinely used for hiring, but possibly used less often or less successfully for women and minority candidates. Importantly, many women who were hired in this period did not think to apply for the job at first. Some have even noted that they would not have thought the department would be interested in them, due to their field of research or

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other reasons. This raises the profoundly important possibility that exceptional women may not apply for faculty jobs in the same way that has worked for recruiting exceptional male faculty candidates. If true, such women candidates might very well not be found by conventional departmental search committee

Nevertheless, no woman heads any unit of seven units of the biological sciences in Science today, and only one woman professor (vs three just a few years ago) occupies a major administrative position within these Departments, Centers, or Institutes.

methods. 7) Finally, the Dean made exceptional personal efforts to work with Department Heads to help them attract outstanding faculty candidates to MIT once offers had been made. The issues that determine acceptance rates for faculty candidates are highly variable, as are acceptance rates over time, and success in recruitment may require a greater knowledge of the system that some Deans may possess.

MIT has long had mechanisms to hire exceptional women and under-represented minority faculty candidates whenever they are found in fields where they are severely under-represented on the faculty. However, these had seldom been used by individual departments in Science and Engineering. But, in the wake of the *Reports on Women Faculty*, these mechanisms as well as those devised by Provost Brown were more heavily used, perhaps because of the involvement of Deans in search processes.

In summary, the data show that the regular processes by which departments hire faculty may be less likely to identify and attract exceptional women candidates than the effort of a School Dean, using innovative approaches in collaboration with Department Heads and the Provost, all in a context in which the Institute has made it clear, through the words and actions of its President, that diversity is a high priority.

(b) Impact of hiring additional women faculty on a department and potential fragility of progress

When will the hiring of women faculty cease to be an issue that requires special attention? Is there some percent of women faculty that constitutes a critical mass, after which the process becomes self-sustaining? In addition, what is the impact of additional women faculty on a department? The biological sciences are the best place to look for answers to these questions

because among the sciences, the number of women undergraduate and PhD students, hence the number of women faculty, has been highest there. Between 1975 and 1995 the percent of women faculty in the Department of Biology remained flat at 13-15%. During this interval no woman served as Department Head, Associate Head, or Head of a Center or Institute within the department. Within a few years of the 1996 *Report on Women in Science*, the percent of women in the department rose to 22%. Furthermore, a woman faculty member became the first female Associate Head of this department, a woman became the Head of the Whitehead Institute, and a woman became Associate Head of the Center for Cancer Research. These appointments changed the professional experience of women in the department. However, such progress is not necessarily permanent.

In recent years the biological sciences in the School of Science, including the two departments, Biology and Brain and Cognitive Sciences (BCS), have expanded to include faculty in several new Centers and Institutes. Nevertheless, no woman heads any unit of seven units of the biological sciences in Science today, and only one woman professor (vs three just a few years ago) occupies a major administrative position within these Departments, Centers, or Institutes. Particularly concerning is that in some new units, where, given many recent hires, one might expect to see more women than in the sections that now contain most of the very senior faculty, the percent of women faculty is extremely low. Overall, as of 2006, 21% of the Biology faculty and 24% of the BCS faculty are women. The Cancer Center, Whitehead Institute, and McGovern Institute have 30, 27, and 23% women faculty, respectively, but the Picower Center for Learning and Memory has only 10%, and the Broad has had a small but entirely male core faculty since its inception, and has an associated faculty (of over 60) that is 15% women. These latter numbers rival those of the 1970s, and show how rapidly gains in diversifying the faculty can be lost. They also demonstrate the need for continued leadership from the Dean, the Provost, and the President, as well as for accountability of the system at some high level.

Conclusion

Achieving faculty diversity, particularly in science and engineering fields, consumes considerable amounts of faculty and administrators' time, effort, and resources, often with frustrating results. It also receives considerable attention at the National Academies, the NSF, other government agencies, and even Congress, because the issue could affect the future technological competitiveness of the United States. As recently documented in *Rising above The Gathering Storm*, the highly influential, congressionally requested report from the National Academies, this country faces ever-stiffer worldwide competition for talent in STEM (Science, Technology, Engineering, and Math) fields. Thus, there is a pressing need to utilize the talents of women and

under-represented minorities at all levels of these professions. Together, women and under-represented minorities comprise nearly 70% of the U.S. labor force. A diverse faculty is not only critical to the best educational experience for all MIT students, it is also seen as critical to our ability to remain competitive as a university and a nation.

While the data here show that the hiring of women faculty under certain circumstances can be successfully overseen and advanced at the level of School Deans, it may be that to increase the number of under-represented minority faculty significantly will require oversight and assistance at a level above the Schools, namely the Provost.

The observations presented here suggest that historical methods of faculty hiring within individual departments are not always as effective as they could be in addressing this problem. The obstacles remain: 1) the continuing small numbers of women applicants in some fields; 2) the lack of awareness and understanding of the problem by most faculty and search committees, despite good will and intentions; 3) the well-documented, but not widely appreciated under-valuation of women of equal or even greater merit, particularly, perhaps, in search processes that seek a single candidate; 4) the slow rate of faculty hiring relative to administrators' terms of office; 5) possibly, the failure to use optimal strategies to identify and to attract the best candidates when they are different from the more typical candidate; and 6) perhaps the misperception that any solution is more likely to be seen as a general institutional and national responsibility, rather than a departmental imperative. The finding that Deans, with the backing of the Provost and the input of highly knowledgeable faculty committees, have been able to significantly increase faculty diversity in a short time and to assist departments to hire exceptional women, shows that solutions exist beyond the more widely known, equally essential efforts by individual departments. Critical to both types of efforts, in order to keep moving ahead, is a system that includes accountability at some level. While all can agree that diversity is an essential goal, this is insufficient to achieve the goal in the absence of 1) concrete plans for how to do so, 2) a method to measure progress, given that the number of individuals being hired is so small, and 3) a system of accountability at the level of Department Heads and School Deans.

While the data here show that the hiring of women faculty under certain circumstances can be successfully overseen and advanced at the level of School Deans, it may be that to increase significantly the number of under-represented minority faculty will require oversight and assistance at a level above the Schools, namely the Provost. The relative scarcity of qualified minorities in the pipeline may mean that yet different innovative search processes will be necessary. Monitoring of progress will be needed at the Institute rather than School level, simply to obtain significant data to ascertain whether progress is being made.

It has been suggested recently that meeting the national need for a diverse STEM workforce, including on university faculties, will require the use of Title IX. This approach has been proposed by Oregon's Senator Wyden, among others. Such approaches would require affirmative action plans to be developed and affirmative actions to be taken in order to remedy any manifest imbalance in the representation of women and minorities in, for example, MIT's workforce in relation to the representation of women and minorities in the available qualified pool of candidates. While this might prove to be an effective means of achieving diversity, it is encouraging that, during certain periods, rapid progress in diversifying a science and engineering faculty in terms of gender has been accomplished at MIT without governmental intrusion, by the use of innovative approaches of the central administration in collaboration with departments and in response to coordinated efforts by women faculty dedicated to faculty diversity.

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