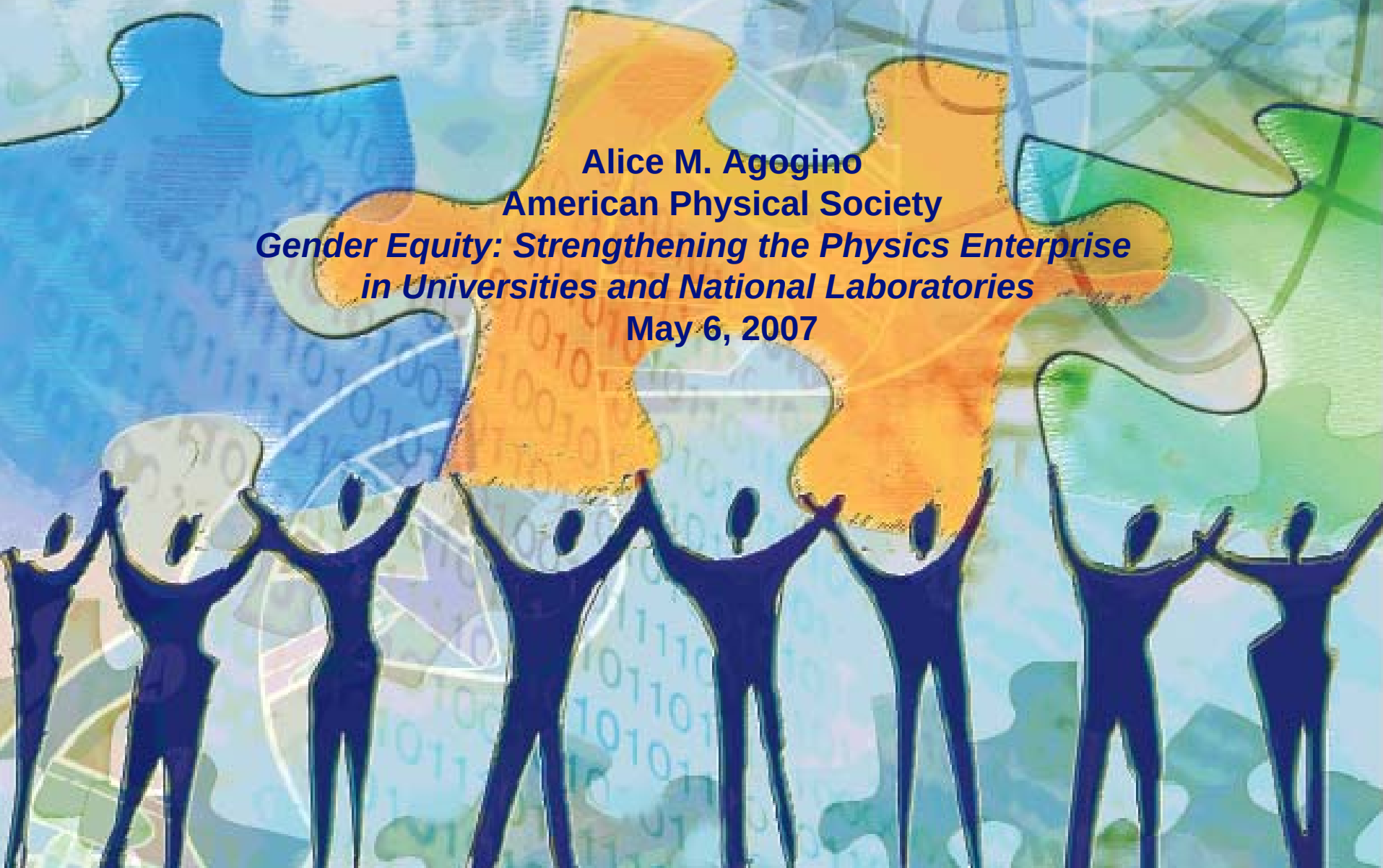
Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering



Alice M. Agogino
American Physical Society

Gender Equity: Strengthening the Physics Enterprise in Universities and National Laboratories

May 6, 2007

DONNA E. SHALALA [IOM] *(Chair),* President, University of Miami, Miami, Florida

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LOTTE BAILYN, Professor of Management, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, Massachusetts

ROBERT J. BIRGENEAU [NAS], Chancellor, University of California, Berkeley, California

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CATHERINE D. DEANGELIS [IOM], Editor-in-Chief, Journal of the American Medical Association, Chicago, Illinois

DENICE DENTON*, Chancellor, University of California, Santa Cruz, California

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JO HANDELSMAN, Howard Hughes Medical Institute Professor, Department of Plant Pathology, University of Wisconsin, Madison, Wisconsin

NAN KEOHANE, President Emerita, Duke University, Durham, North Carolina

SHIRLEY MALCOM [NAS], Head, Directorate for Education and Human Resources Programs, American Association for the Advancement of Science, Washington, DC

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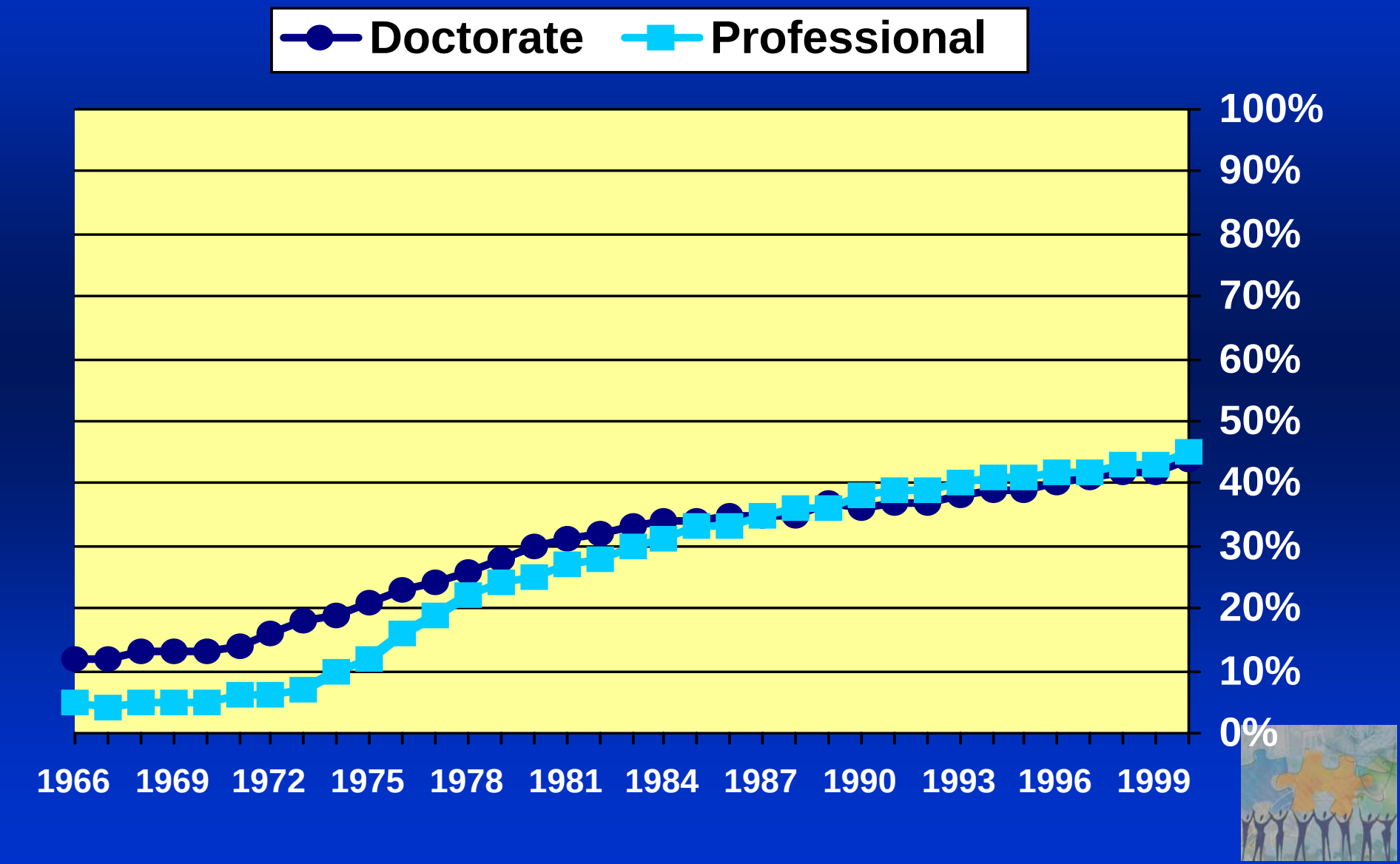
ELAINE WEYUKER [NAE], Fellow, AT&T Laboratories, Florham Park, New Jersey

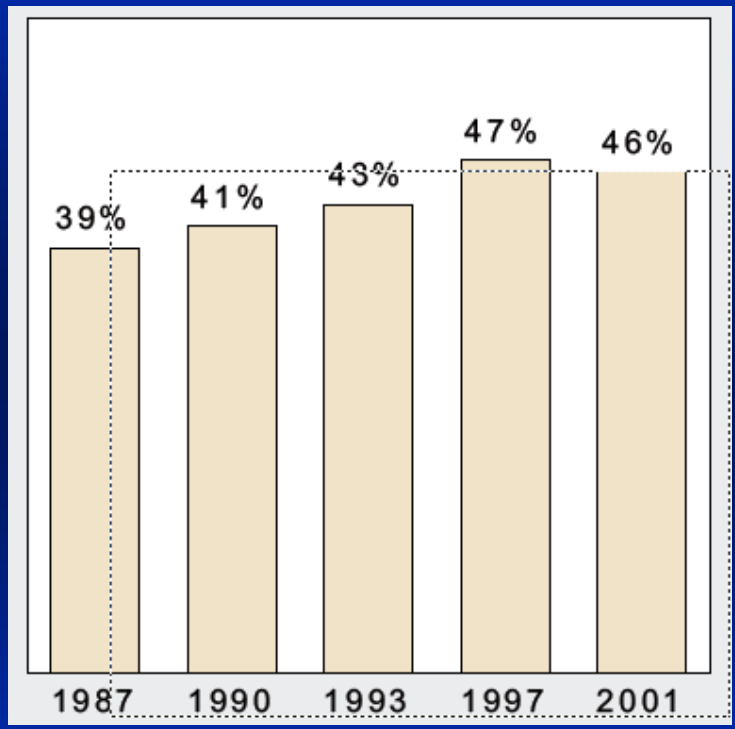
MARIA T. ZUBER [NAS], E. A. Griswold Professor of Geophysics, Massachusetts Institute of Technology, Cambridge, Massachusetts

Women As a Percentage of Doctoral and Professional Degree Recipients in the US, 1966-2000



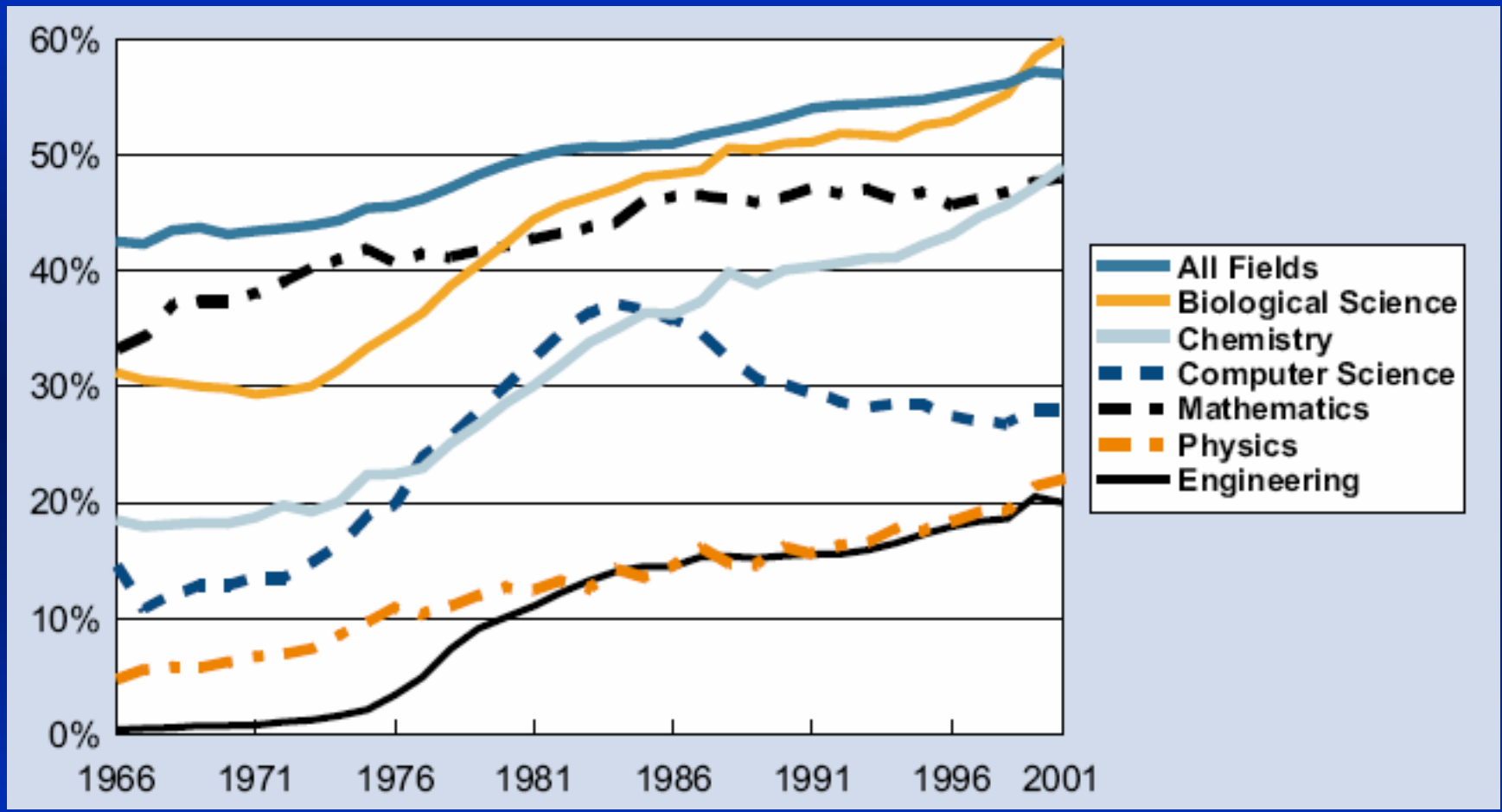
Source: National Center for Education Statistics, "IPEDS Completions Survey," taken from WebCaspar (IPEDS includes Doctorate Records File Data).

Girls Enrollment in HS Physics



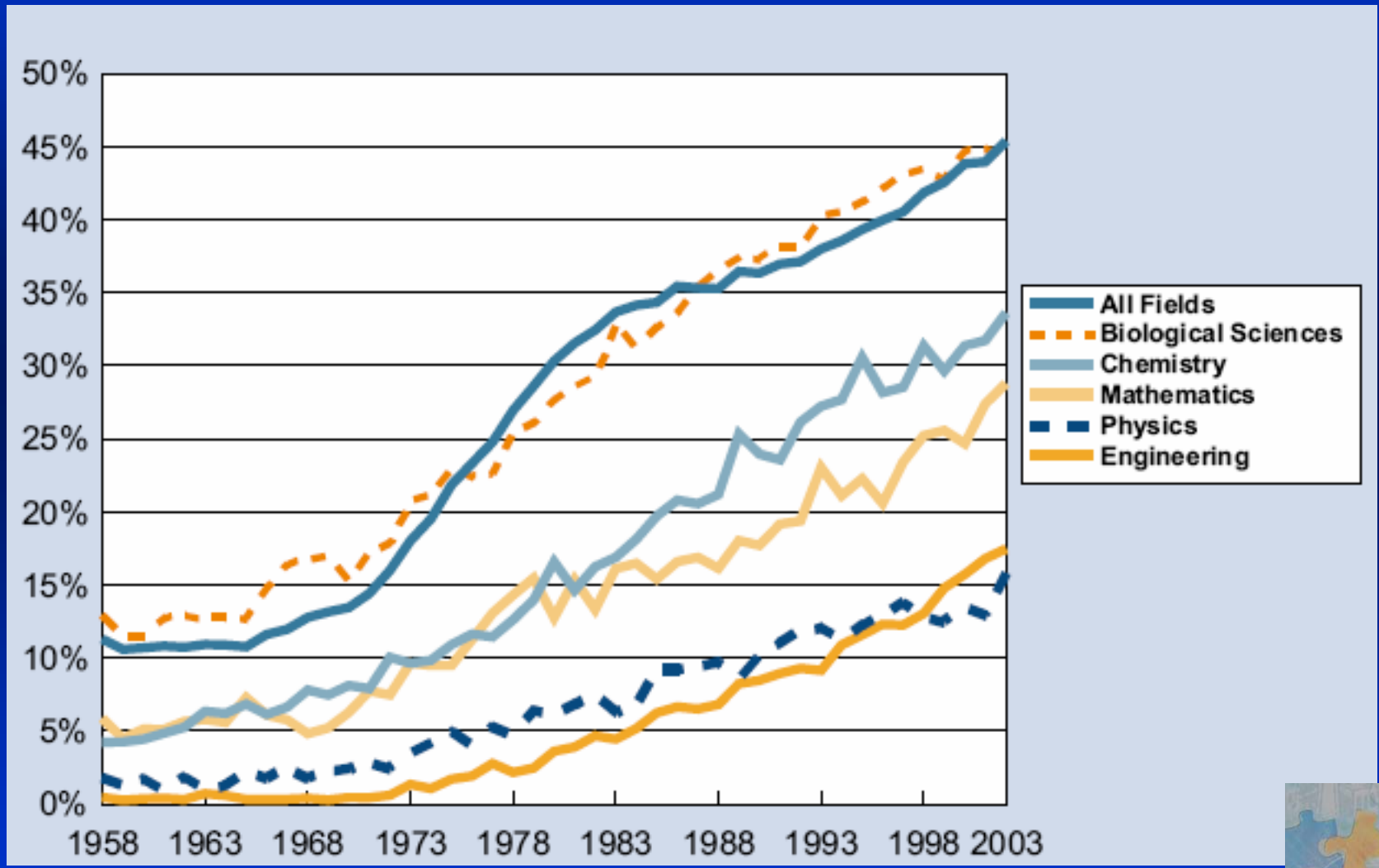
AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97 & 2000-01 High School Teacher Surveys.

Percentage of BS Degrees for Women



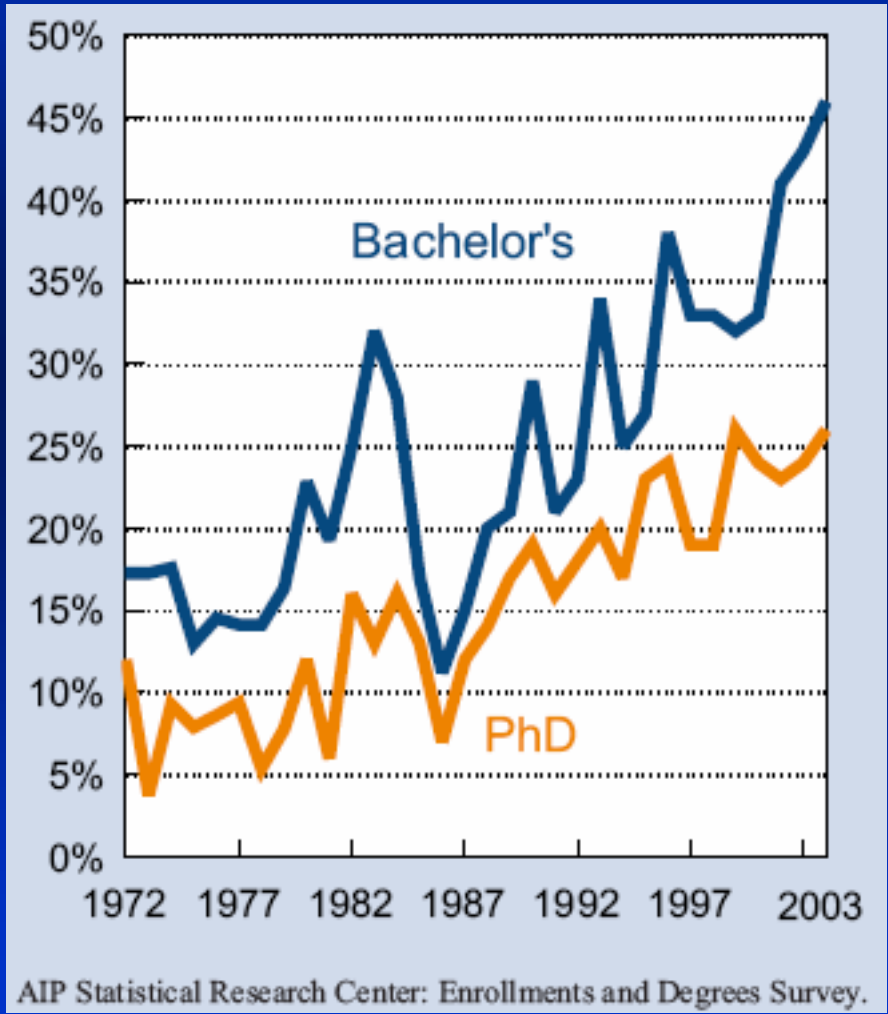
National Center for Education Statistics. Data for academic year 1999 not available. Compiled by AIP Statistical Research Center.

Percentage of PhDs Earned by Women



National Science Foundation. Compiled by AIP Statistical Research Center.

Percentage of Degrees Earned by Women in Astronomy



But women are not entering or are disproportionately leaving academic careers

Increasing the number of women earning science and engineering doctorates will have little effect on the number of women in academic positions, unless attention is paid to recruiting women to these positions and retaining them once hired.

Percentage of Faculty Positions Held by Women

Physics

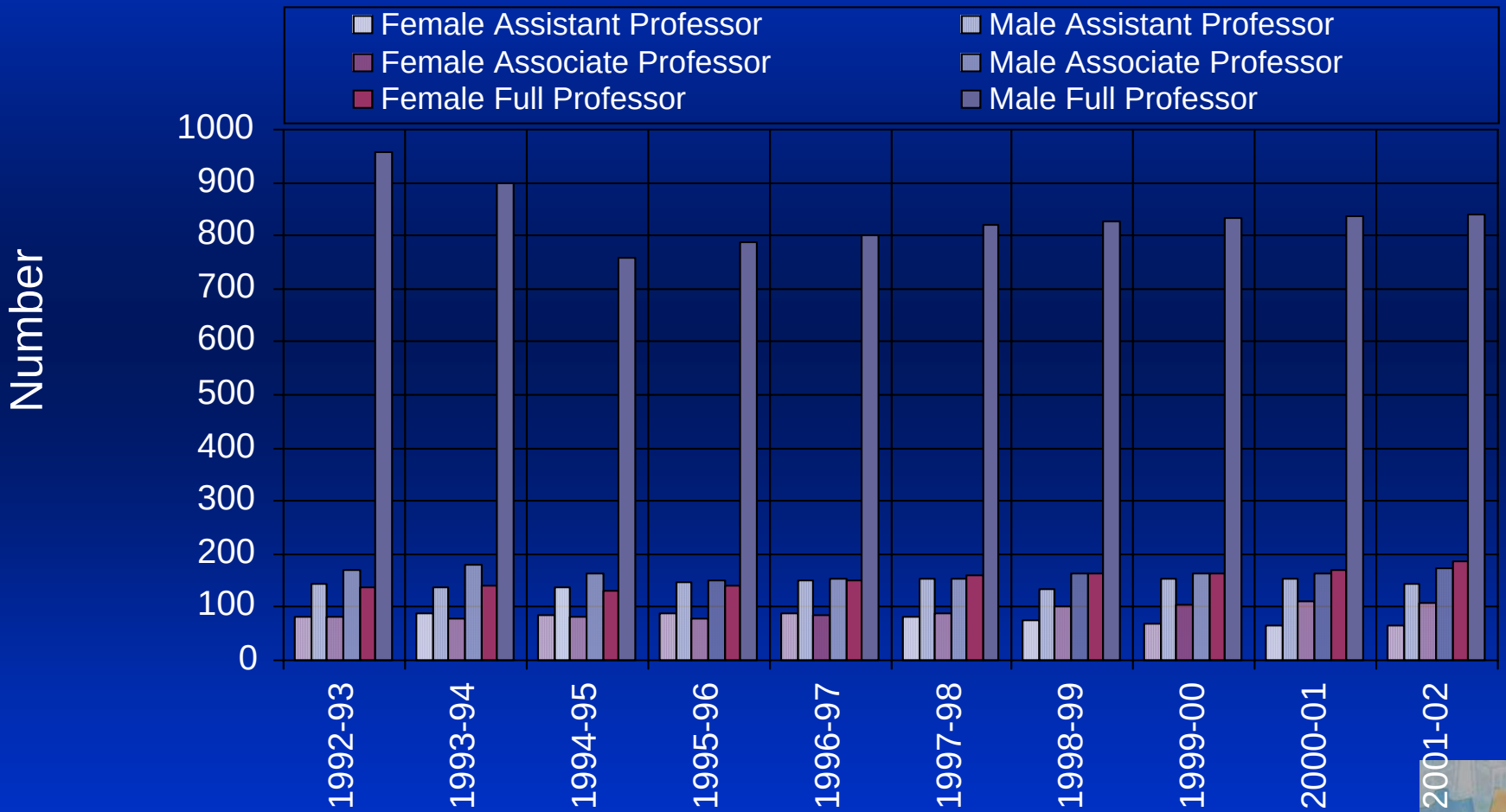
	1994 %	1998 %	2002 %
Academic Rank			
Full professor	3	3	5
Associate professor	8	10	11
Assistant professor	12	17	16
Instructor / Adjunct	N/A	N/A	16
Other ranks	8	13	15
Type of Department			
PhD	5	6	7
Master's	7	9	13
Bachelor's	7	11	14
Overall	6	8	10

Astronomy

Academic Rank	Percent
Full professor	10
Associate professor	23
Assistant professor	23
Instructor / Adjunct	15
Other ranks	15
Overall	14

AIP Statistical Research Center

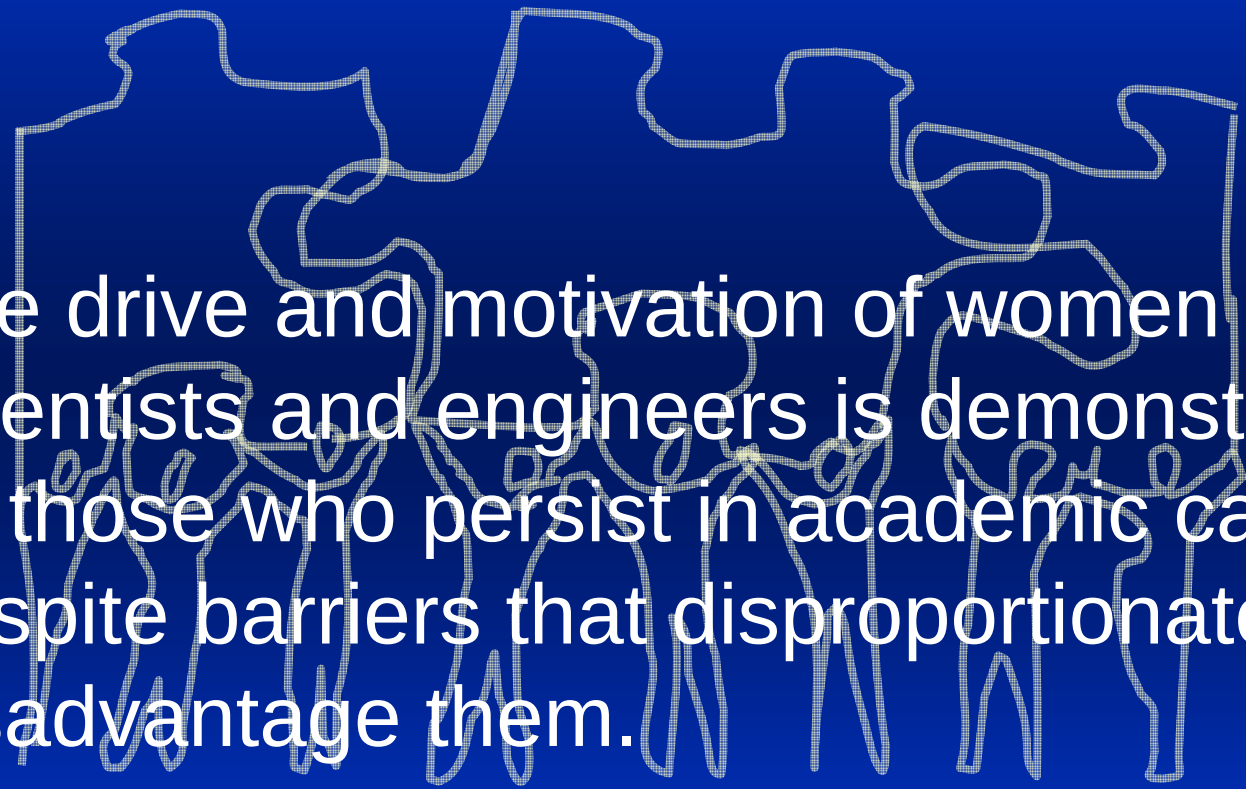
Faculty Headcount by Gender and Rank



Women have the capability to succeed in Science & Engineering

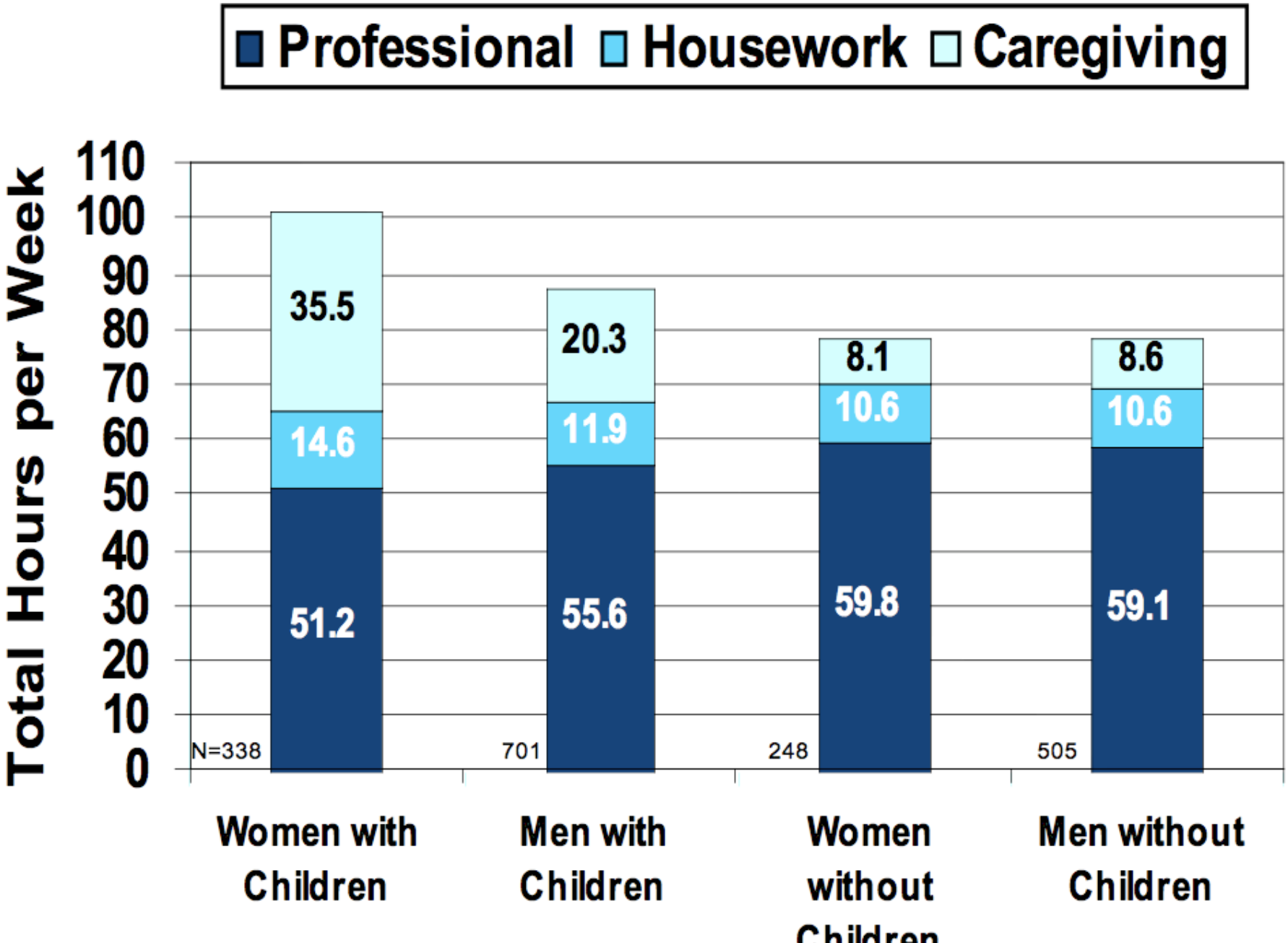
- Studies of brain structure and function, of hormonal modulation of performance, of human cognitive development, and of human evolution have not found any significant biological differences between men and women in performing science and mathematics that can account for the lower representation of women in academic faculty and scientific leadership positions in these fields.

Women have the drive to succeed in Science & Engineering



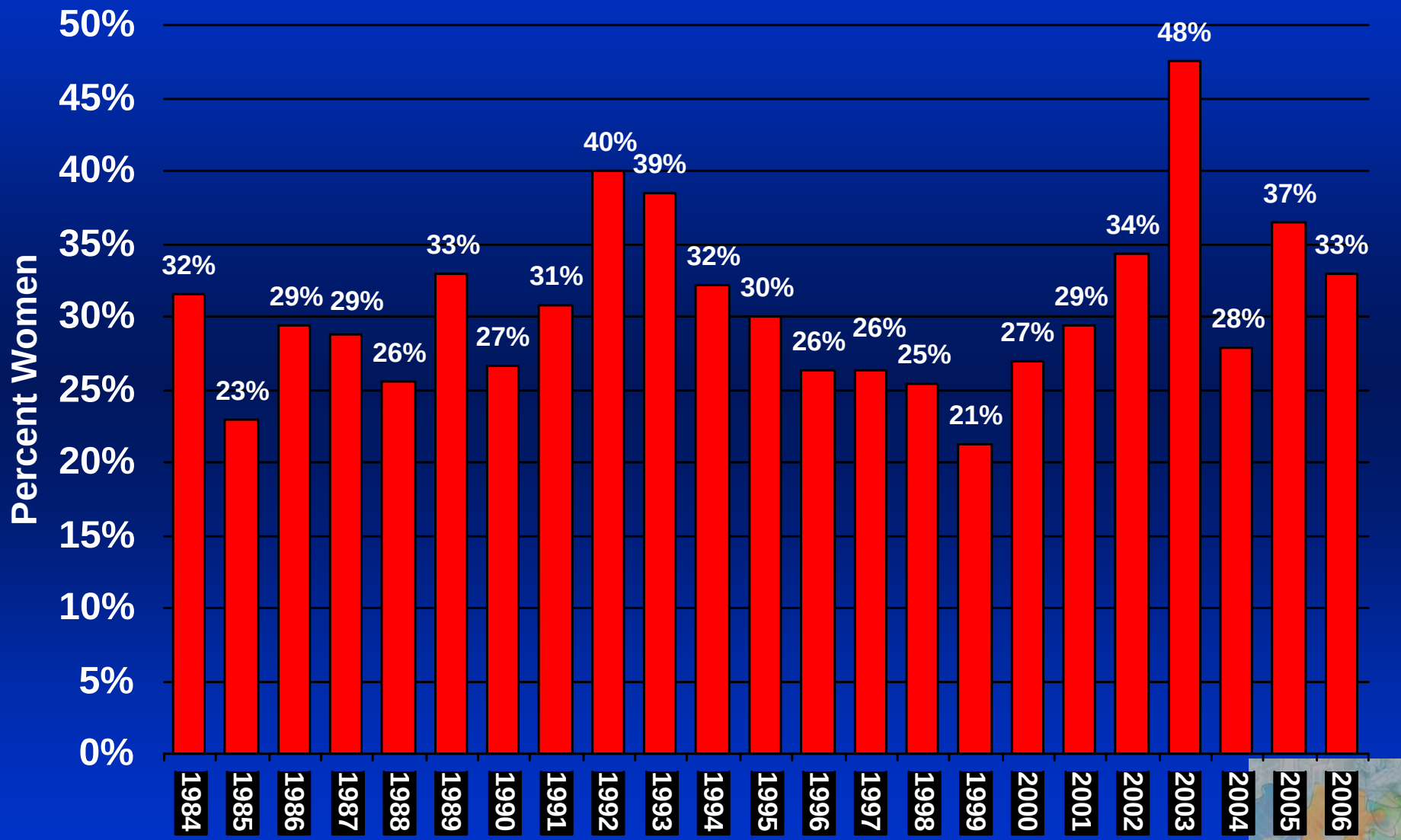
- The drive and motivation of women scientists and engineers is demonstrated by those who persist in academic careers despite barriers that disproportionately disadvantage them.

Everybody is Very Busy *(UC Faculty, ages 30-50)*



It is not lack of talent or drive, but rather unintentional biases and outmoded institutional structures that are hindering the access and advancement of women.

Women as a Percent of New UCB Faculty Appointments 1984-2006



Source: Academic Personnel Records, 1984-2006.

Leaks in the Academic Pipeline for Women*

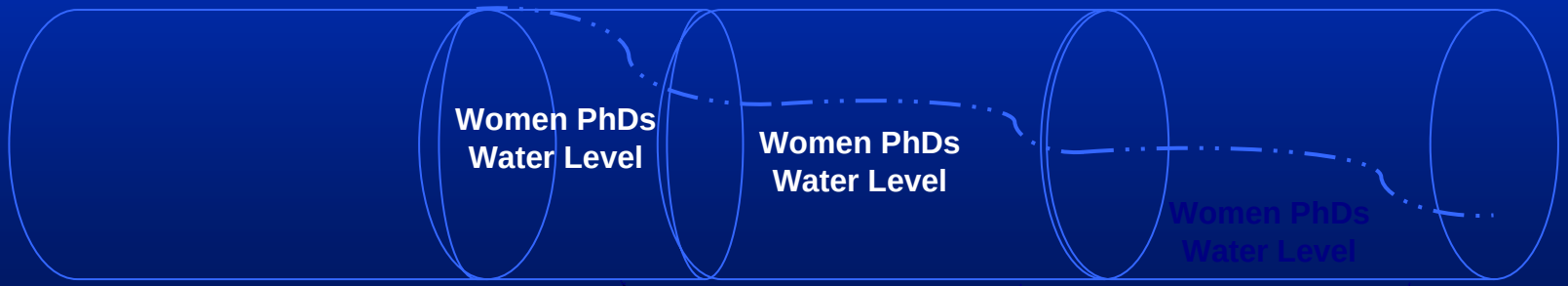
Graduate School Entry

PhD Receipt

Assistant Professor (Tenure Track)

Associate Professor (Tenured)

Full Professor (Tenured)



Leak!! Leak!! Leak!! Leak!!

Women with Babies (28% less likely than women without babies to enter a tenure-track position)

Women, Married (21% less likely than single women to enter a tenure-track position)

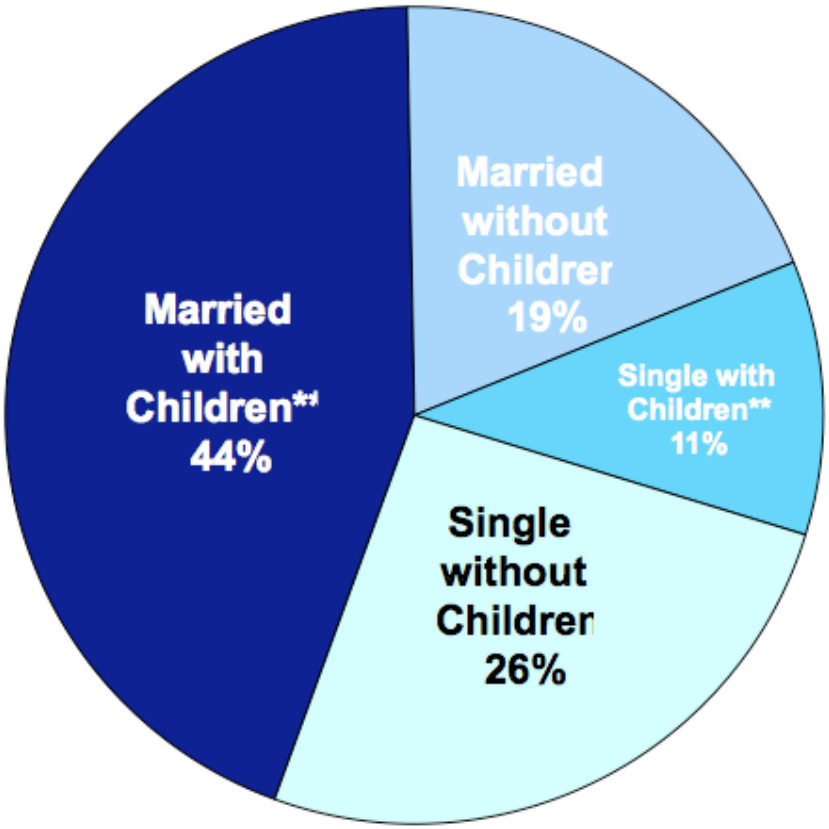
Women (27% less likely than men to become an Associate Professor)

Women (20% less likely than men to become a Full Professor within a maximum of 16 years)

• Preliminary results based on Survival Analysis of the *Survey of Doctorate Recipients* (a national biennial longitudinal data set funded by the National Science Foundation and others, 1979 to 1995). Percentages take into account disciplinary, age, ethnicity, PhD calendar year, time-to-PhD degree, and National Research Council academic reputation rankings of PhD program effects. For each event (PhD to TT job procurement, or Associate to Full Professor), data is limited to a maximum of 16 years. The waterline is an artistic rendering of the statistical effects of family and gender.

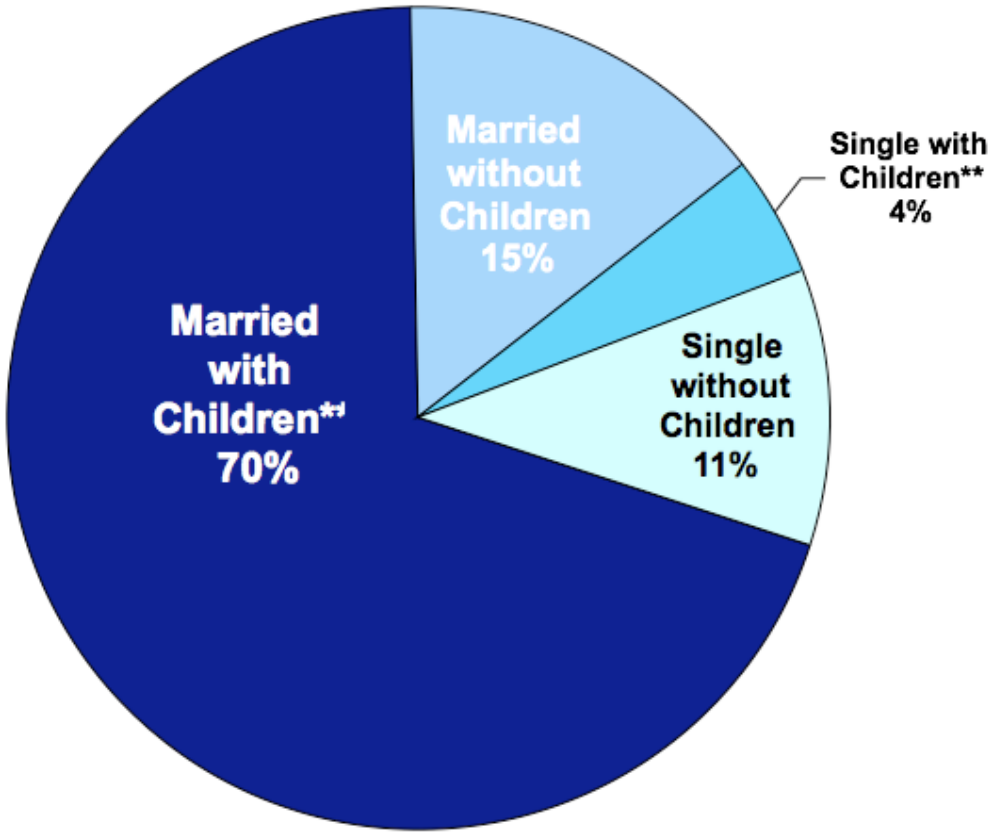
Family Status of Tenured Faculty, All Fields*

Women



N=10,652

Men

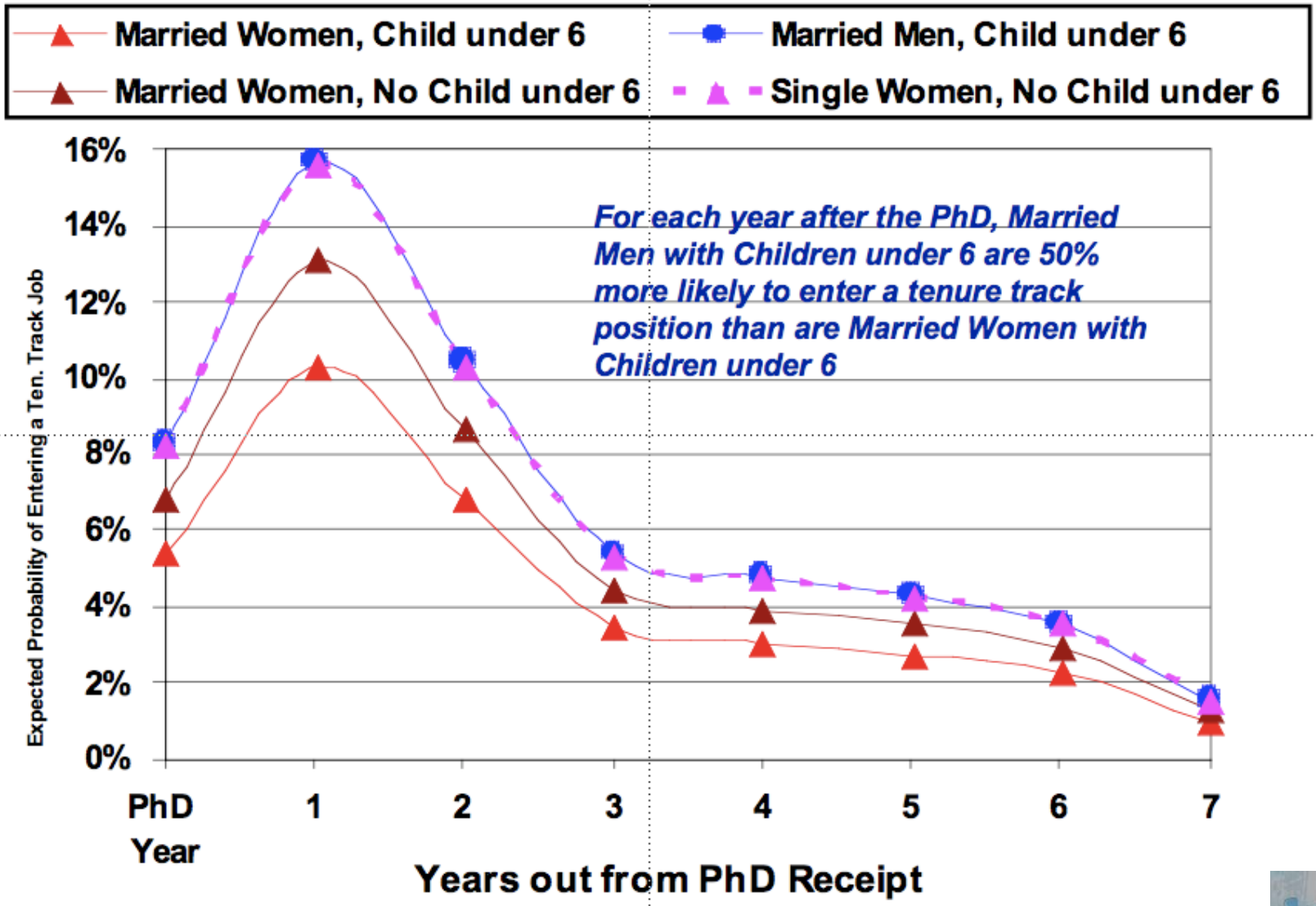


N=32,234

*PhDs from 1978-1984 Who Are Tenured 12 Years out from PhD.
**Had a child in the household at any point post PhD to 12 years out.

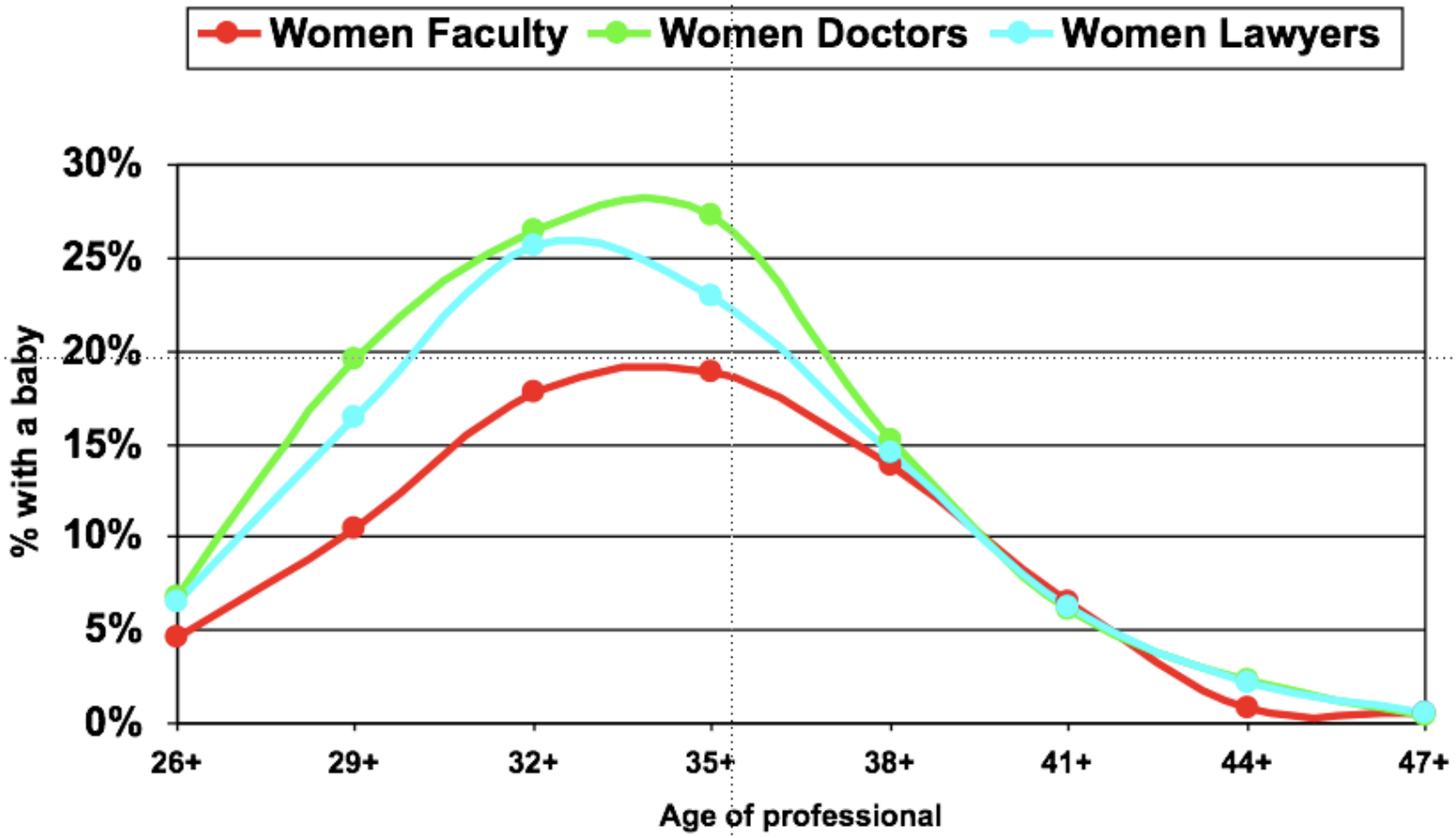
Source: Survey of Doctorate Recipients. Sciences, 1979-1999, Humanities, 1979-1995

Leaks in the Pipeline: PhD to Tenure Track Position



Source: Survey of Doctorate Recipients, Sciences and Humanities, 1981 to 1995.

Women Fast-Track Professionals with Babies* in the Household, by Age of Professional

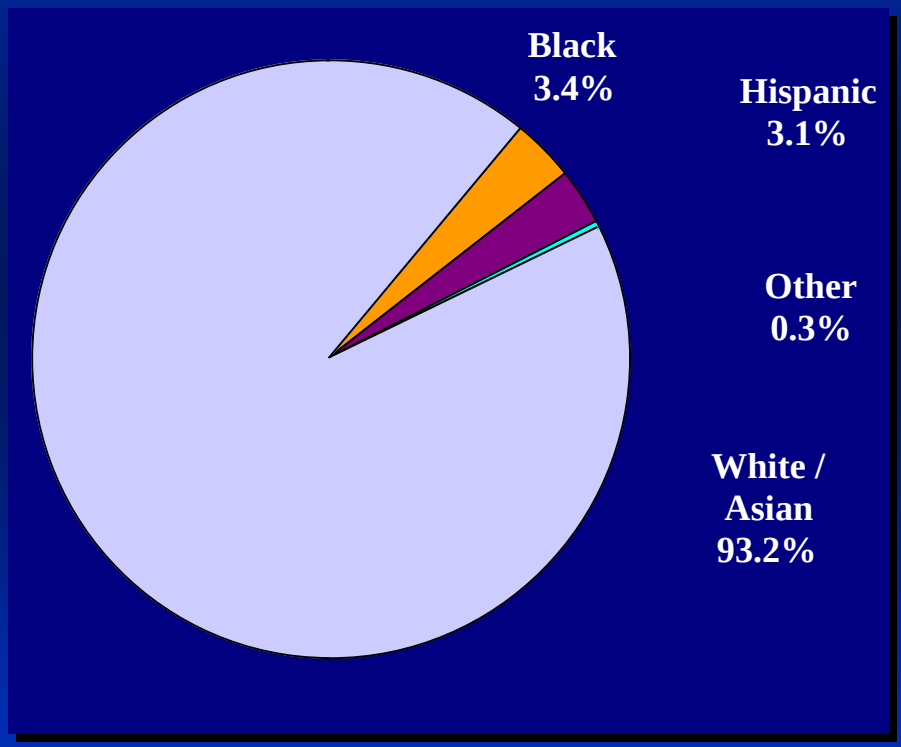


*Children, Ages 0 or 1 in Household.

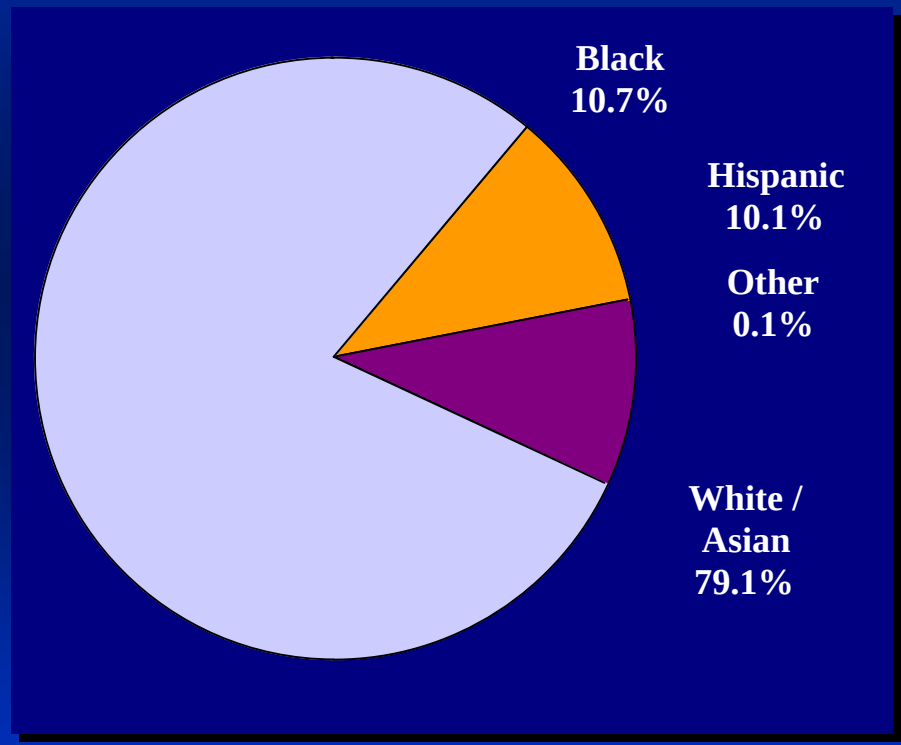
Source: Census 2000, Pums 5%samp

The Nations New Majority

Shirley Jackson, President of RPI

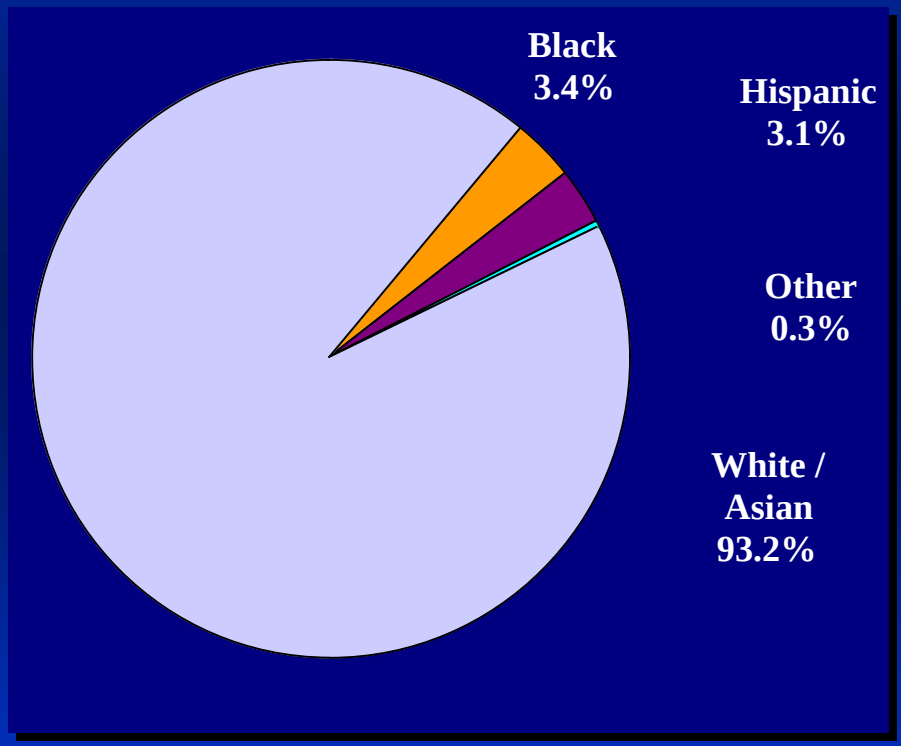


Science and Engineering Workforce

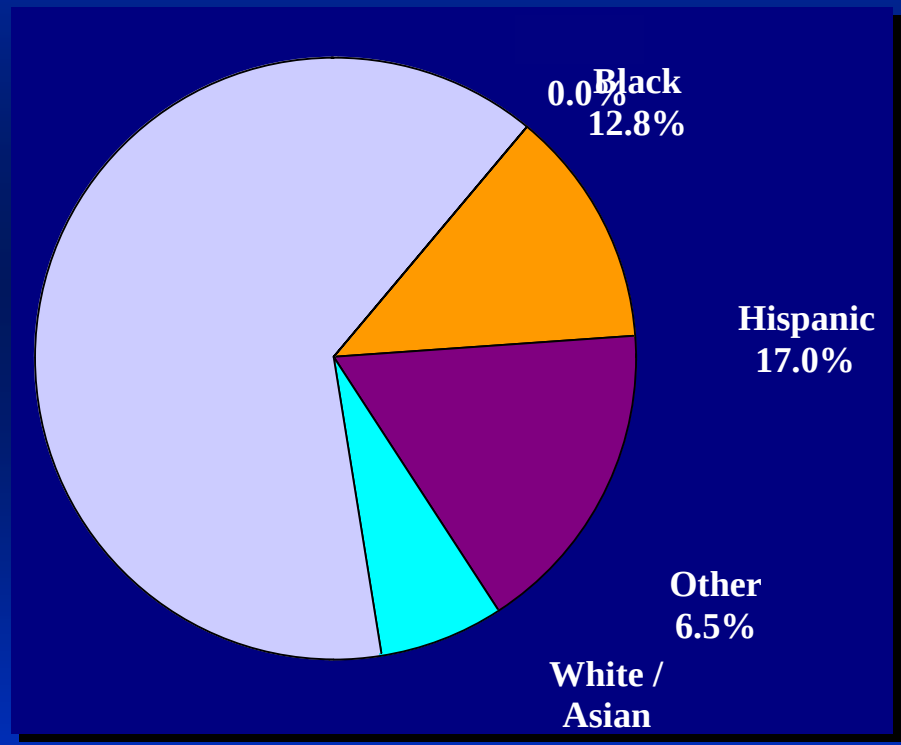


U.S. Workforce

2020?



Science and Engineering Workforce
2000



2020 U.S. Workforce

Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering

Recommendations

Recommendations for Universities

Trustees, university presidents, and provosts

LEADERSHIP

CLIMATE

RECRUITING

HIRING, TENURE, PROMOTION POLICIES

MONITOR AND EVALUATE

Deans, department chairs, and tenured faculty

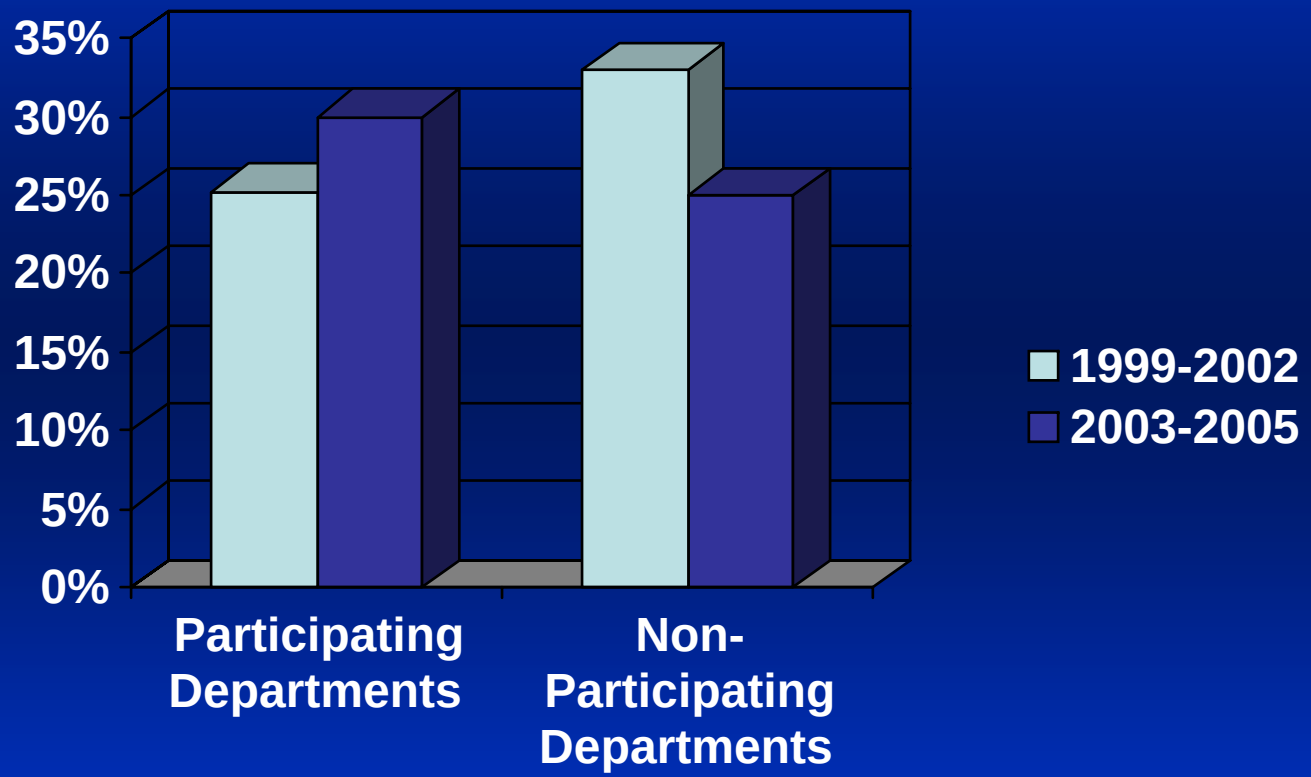
Trustees, university presidents, and provosts:

- Provide clear leadership in changing institutional culture and structure
  - University strategic planning
  - Immediately remedy inequalities in hiring, promotion, and treatment
  - Hold leadership workshops for personnel
  - Require evidence for equitable practices before approving appointments
  - Develop and implement policies accounting for flexibility across life course

Deans, department chairs, and tenured faculty:

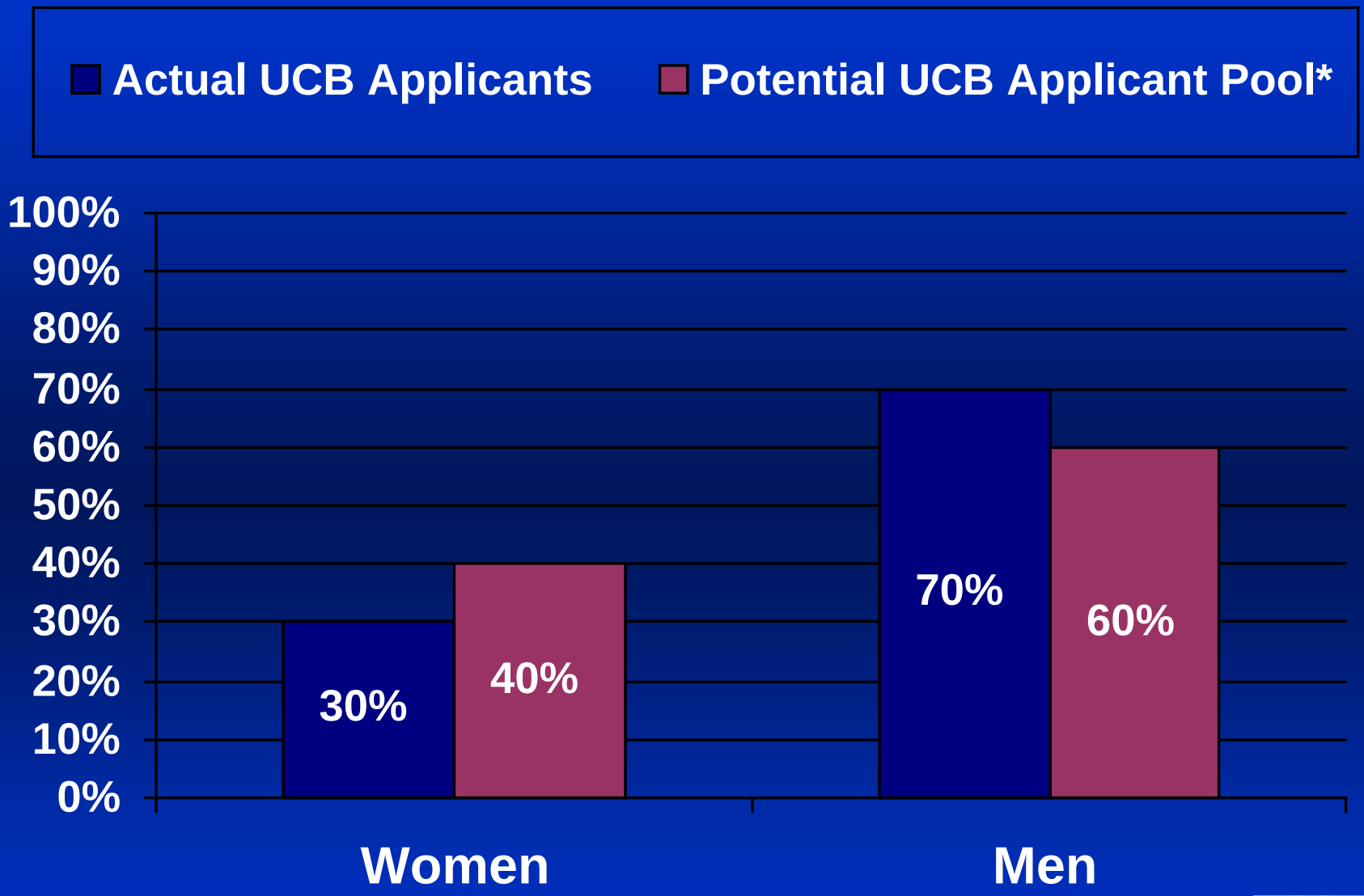
- Take responsibility for creating a productive environment
  - Initiate faculty discussion of climate issues
  - Develop and implement effective evaluation programs for faculty and students
  - Expand faculty recruitment efforts
  - Review equity of tenure processes and timelines

Workshops for Search Committees University of Wisconsin-Madison



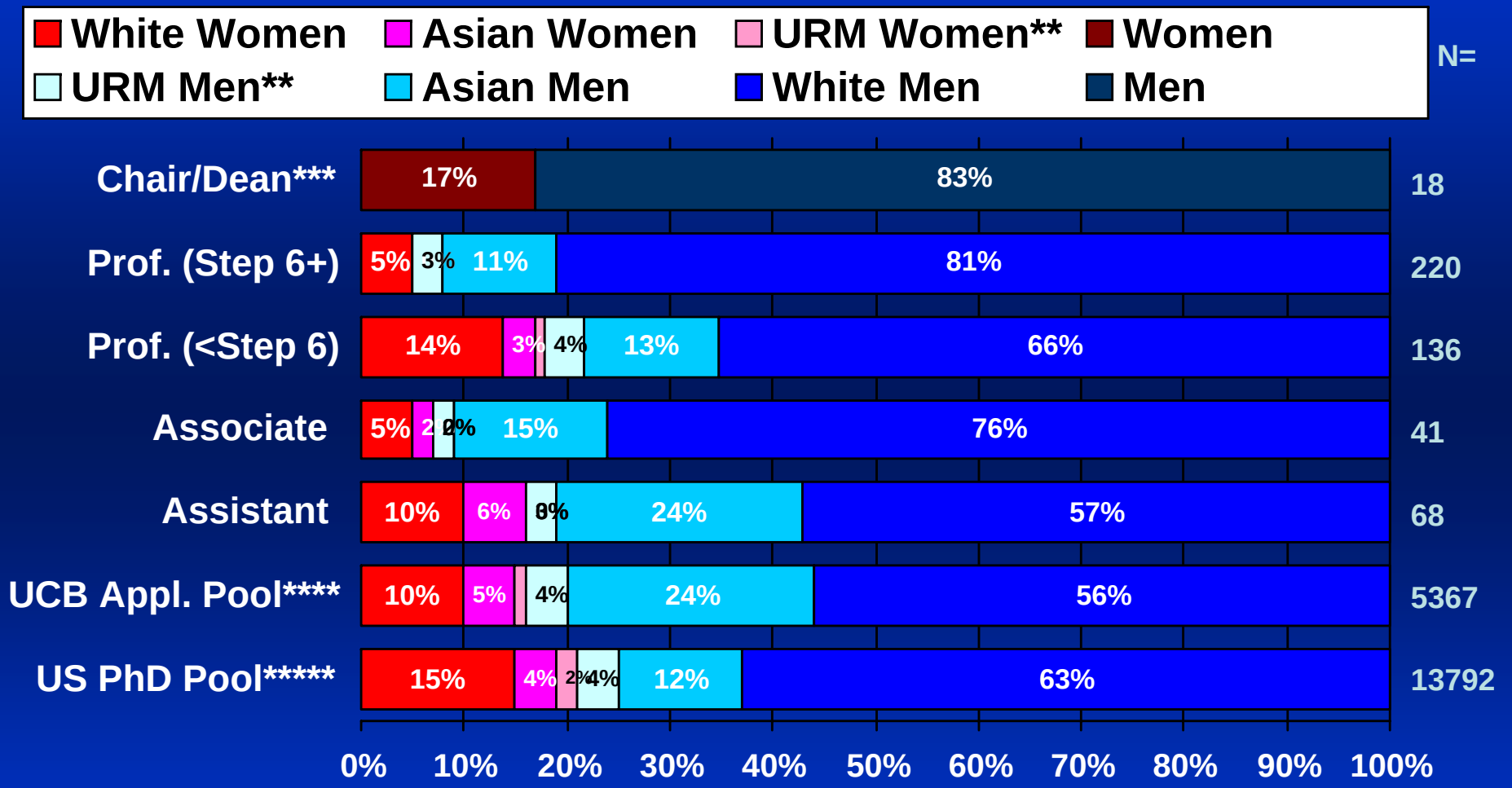
Percentages of women and minority faculty hired increased by 19% for those who attended "fair hiring" workshops compared to a 23% decrease to those who did not.

The Pool Problem at UC Berkeley: Ladder Rank Faculty



*Data prepared by Angelica Stacy, Associate Vice Provost for Faculty Equity, UCB. *Potential UCB Applicant Pool* is derived from NCES data on PhD degrees granted in 2000, cut to a selected group of top-ranked graduate institutions and cut to relevant disciplinary fields for UCB.

UCB Faculty STEM* by Rank, Gender, and Ethnicity, 2005-06



*STEM=Division of Physical Sciences, College of Engineering, College of Chemistry, and School of Info. Manag. Syst. (SIMS).
**URM=African Amer., Hispanic Amer., and Native Amer.
***Chair/Dean (2006-07) figures are broken down only by gender because of low counts.
****Source: UCB Faculty Applicant Pool Database, 2001-2006. Not all departments have responded.
*****Based on PhDs granted to U.S. Residents, 1997-2001, at the 35 Institutions producing the most PhDs at Top Quartile Rated doctoral programs (National Research Council Reputation Ratings), Survey of Earned Doctorates.

Faculty Headcount Source: UCB Faculty Pers. Rec. 2006.

UC Work and Family Survey: History and Response Rates

- The survey was designed to assess the effectiveness of UC's existing family friendly policies for ladder-rank faculty (implemented in July 1988).* It was first conducted at UC Berkeley, Fall 2002, and was rolled-out in Spring-Summer 2003 to the other UC universities (except UCM), with President Atkinson serving as the first contact email signatory.

University	# of Responses	# of Surveyed	Response Rate
Berkeley	743	1351	55%
Davis	820	1385	59%
Irvine	445	910	49%
Los Angeles	789	1758	45%
Riverside	367	663	55%
San Diego	472	998	47%
San Francisco	188	357	53%
Santa Barbara	374	802	47%
Santa Cruz	262	481	54%
Total	4460	8705	51%

*Some questions were based on Robert Drago's Mapping Project Survey Instrument

Methods Used to Encourage Women Applicants

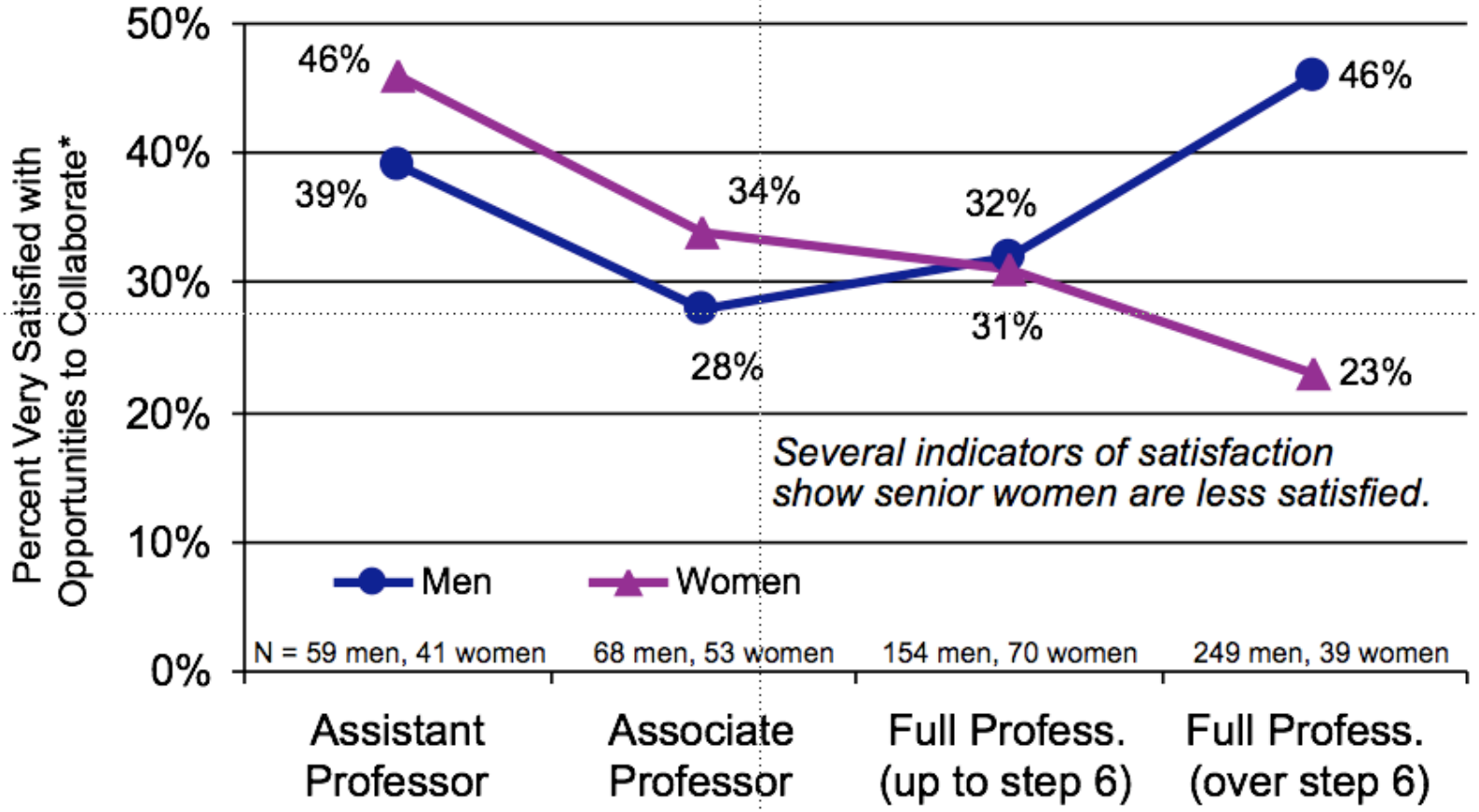
Rank Order	Possible Methods Used by Departments to Enhance Pool	Self Evaluation Women Hired		
		Exc. (n=25)	Not Ex. (n=29)	All Dep. (n=59)
1	Listed faculty positions in multiple venues	96%	97%	96%
2	Job descrip. made clear wom./urm faculty encourg. to apply	76%	90%	84%
3	Made personal calls to enc. potential candidates to apply	84%	86%	84%
4	Selected diverse search committees	92%	79%	84%
5	Included graduate student input in search process	92%	72%	82%
6	Made calls to colleag. asking them to enc. wom./urm to apply	80%	83%	80%
7	Circulated job descr. among networks wom./urm educators	88%	72%	79%
8	Designated an affirmative action officer to serve on search	64%	90%	77%
9	Approached or interviewed applic. at professional meetings	72%	72%	73%
10	Established relation. with local/national women/URM org.	68%	52%	59%
11	Educated search committee members on div./equity/affirm.	52%	55%	54%
12	Discounted care-giving related resume gaps	32%	41%	36%
13	Prioritized sub-disciplines w. high diversity	36%	31%	32%
14	Encouraged UC President's Postdoctoral Fellows to apply	36%	31%	32%
15	Interviewed candidates at a variety of conferences	36%	21%	27%

Note: Yellow shading denotes p<.05 significant difference based on chi-square.

Note: Light Green shading denotes p<.10 significant difference based on chi-square.

Gender and Rank

Crossing lines of opportunities to collaborate



*vs. somewhat satisfied, somewhat dissatisfied, and very dissatisfied.

Source: UCB Faculty Climate Survey, Spring 2003.

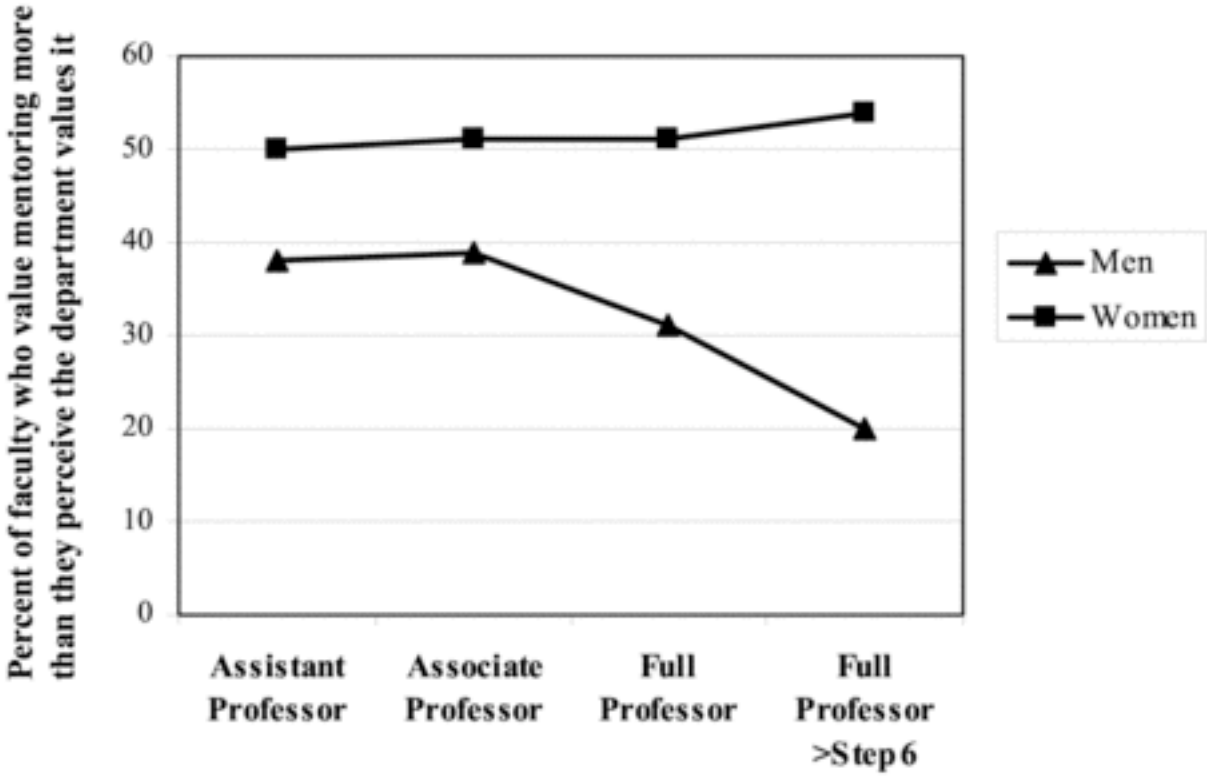


FIGURE 4-1: Individual and Perceived Institutional Value Of Student Mentoring, By Rank and Sex.

SOURCE: University of California Faculty Climate Survey, 2003. Available at http://www.ucop.edu/acadadv/berkeley-response/faculty-climate.pdf.
NOTE: The survey asked faculty to rate whether they valued mentoring more, the same, or less than they perceived their department valued mentoring.

Scientific, professional, and honorary societies:

- Play a leading role in promoting equal treatment of women and men
  - Set professional and equity standards
  - Ensure keynote and invited speakers reflect diverse membership of society
  - Ensure representation of women on editorial boards and leadership positions
  - Recognize women for award nominations
  - Provide child-care and elder-care grants or subsidies for conference and meeting attendees

Journals:

Examine their entire review process, including the mechanisms by which decisions are made to send a submission to review, and take steps to minimize gender bias, such as blinded reviews.

Foundations and federal funding agencies:

- Ensure that practices support the full participation of women
  - Provide workshops to minimize gender bias
  - Collect, store, and publish composite information for all funding applications
  - Make possible the use of grant monies for dependent care expenses, and create additional funding mechanisms for providing support during care giving, including extending grant support (faculty, postdocs and graduate students)
  - Expand research support for programs designed to reduce and research gender bias

Federal Enforcement Agencies

MONITOR

Even without additional resources, federal agencies should *move immediately to enforce the federal anti-discrimination laws* at universities and other higher education institutions through regular compliance reviews and prompt and thorough investigation of discrimination complaints.

Title IX Opportunities

Higher education organizations:

- Create inter-institution monitoring organization

TRACKING AND EVALUATION

BOX 6-8. Scorecard for Evaluating How Well Research Universities Serve Women and Minorities in Science and Engineering

This scorecard should be used as a tool for continuous assessment of institutional efforts to remove the barriers to participation in science and engineering by women. It can be used to identify and publicize institutions that recruit and nurture talented individuals from diverse backgrounds, to create a culture that welcomes and supports all scientists and engineers and helps them realize their potential, and to work to overcome barriers to talented scientists and engineers at all levels

A. Demographics	**Number This year**		**Number 5 yrs ago**		**Number 10 yrs ago**	
Students/Scholars *(report by department)*	Men	Women	Men	Women	Men	Women
(**A1**) S&E undergraduate degrees						
(**A2**) S&E doctoral degrees (see A1)						
(**A3**) S&E postdoctoral scholars (see A1)						
Professors *(report by department/unit)*	**Number this year**		**Number last year**		**Number 2 yrs ago**	
(**A4**) Assistant tenure track professors						
(**A5**) Associate professors • Tenure-track • Tenured						
(**A6**) Full professors						
(**A7**) Endowed chairs						
(**A8**) Department chairs						
(**A9**) Center Directors						
(**A10**) Academic Deans[a]						
(**A11**) Provost						
(**A12**) President						

B. Faculty turnover *(report by department /center/hiring unit)*	**Number this year**		**Number last year**		**Number 2 yrs ago**		**Number 3 yrs ago**	
	Men	Women	Men	Women	Men	Women	Men	Women
(**B1**) Number of faculty searches								
(**B2**) Number of applications								
(**B3**) Number of interviews								
(**B4**) Number of faculty hired								
(**B5**) Number of faculty who left before tenure review								

More Information

For more National Academy study links:
www7.nationalacademies.org/womeninacademe/
www.engineeringpathway.com/

University of California Family Edge:
http://ucfamilyedge.berkeley.edu/

***Chairs and Deans Toolkit for Creating a Family Friendly Department*:**
http://ucfamilyedge.berkeley.edu/Chairs%20and%20Deans%20Toolkit%20FINAL.pdf