Changing the face of physics

Sherry Yennello
Texas A&M University

7th graders view of scientists

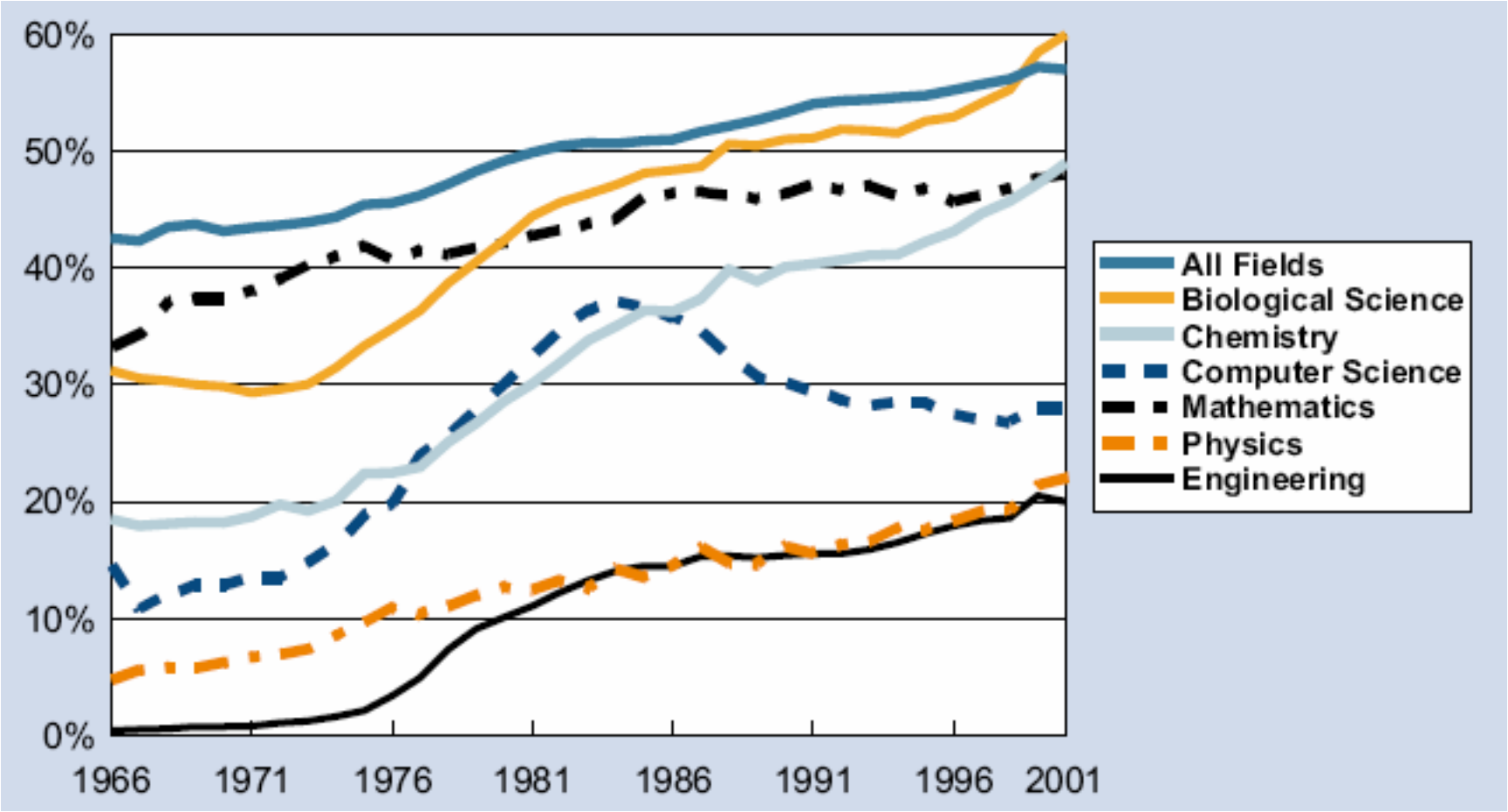
The way I see a scientist is with brown hair, a beard, dorky glasses, a white lab coat, pens in his shirt, a blue polo shirt, khaki-colored pants, and a white-colored lab coat.

The Nations New Majority

- Women and under-represented groups make up a 1/2 to 2/3 of the population of the United States and comprise the nation's New Majority.
- If the US is to maintain economic leadership and be able to sustain its share of high technology jobs, it must draw on all of the talents in our population . . . Innovation is the key.

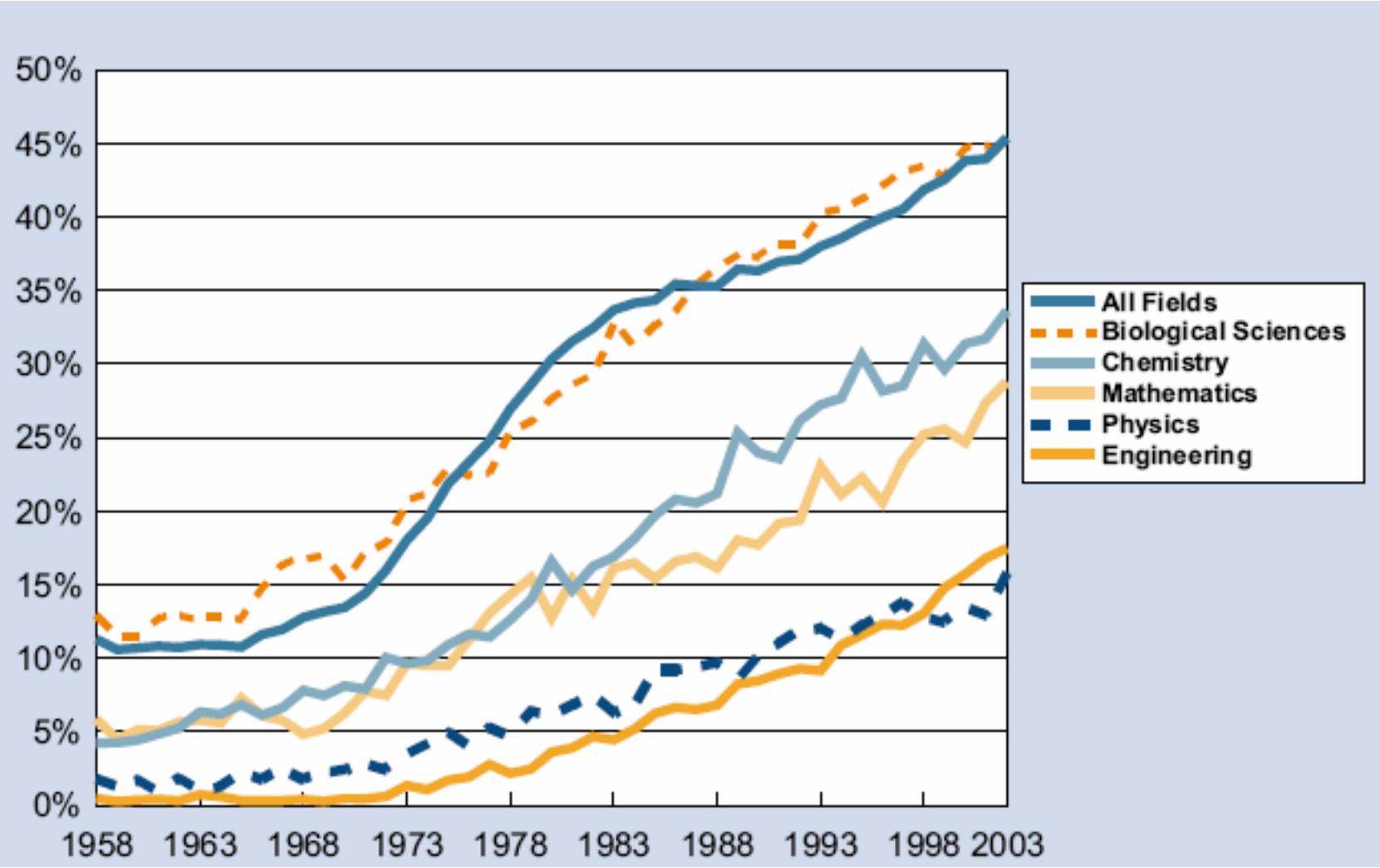
Shirley Jackson,
President of Rensselaer

Percentage of BS Degrees for Women



National Center for Education Statistics. Compiled by AIP Statistical Research Center.

Percentage of PhDs Earned by Women



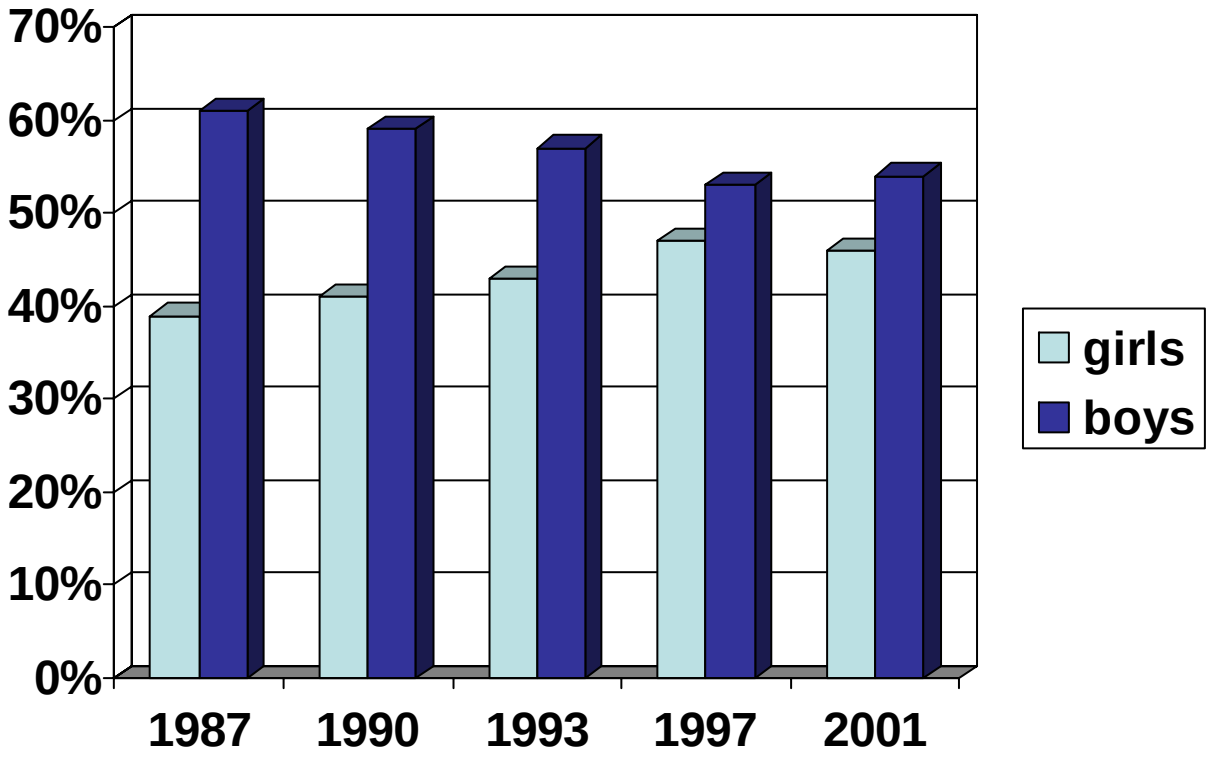
National Science Foundation. Compiled by AIP Statistical Research Center.

Table 7. Percent of Faculty Positions in Physics That Were Held by Women, 1994, 1998 and 2002

		1994 (%)	1998 (%)	2002 (%)
Academic Rank	Full Professor	3	3	5
	Associate Professor	8	10	11
	Assistant Professor	12	17	16
	Other Ranks	8	13	29
Type of Department	PhD	5	6	7
	Master's	7	9	13
	Bachelor's	7	11	14
Total		6	8	10

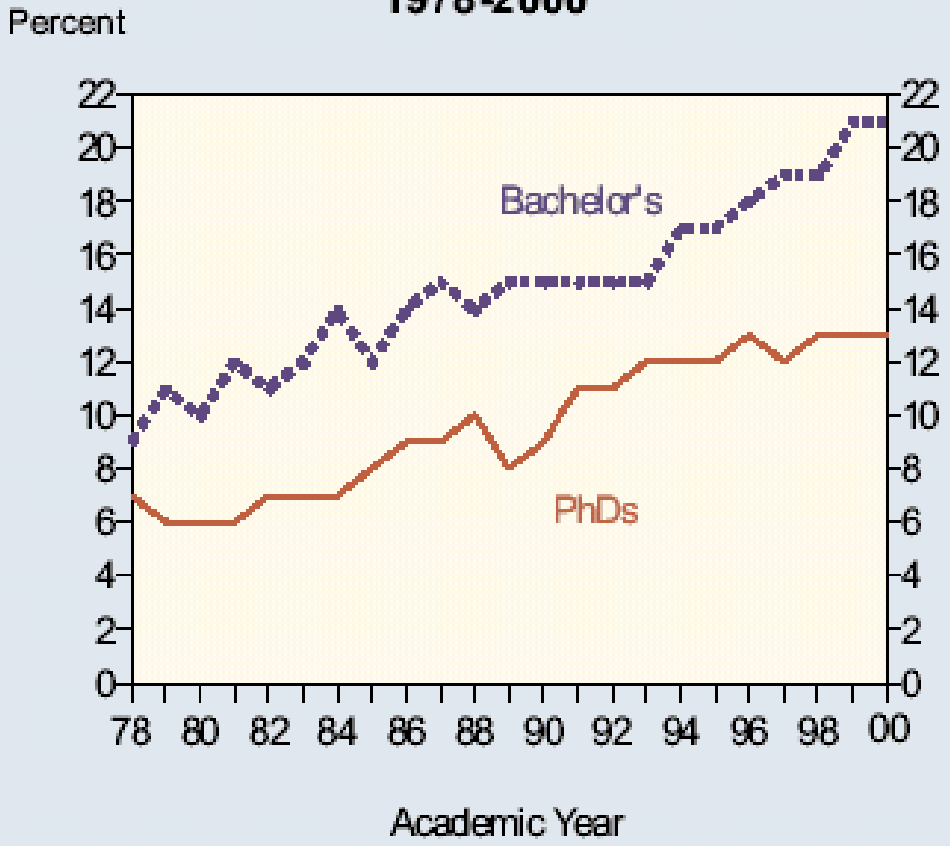
AIP Statistical Research Center: 2002 AWF Survey

Girls Enrollment in HS Physics



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

Figure 7. Percent of bachelor's degrees and doctorates in physics earned by women, 1978-2000

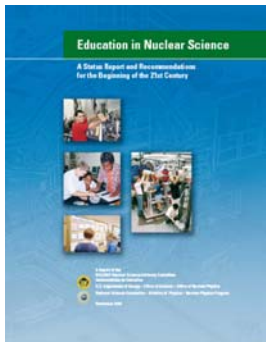


Note: A form change occured in 1994 resulting in a more accurate representation of women among physics bachelors. Some of the increase in 1994 only, may be a result of that change.

AIP Statistical Research Center, Enrollments and Degrees Report.

Women – compared to other fields

- Physical sciences (2000-2003) 25.3
  - Chemistry 32.2
  - Computer science 18.7
  - Earth Science 31.1
  - Mathematics 26.9
  - Physics and Astronomy 15.0
- Nuclear Science (1997-2002) 14.1

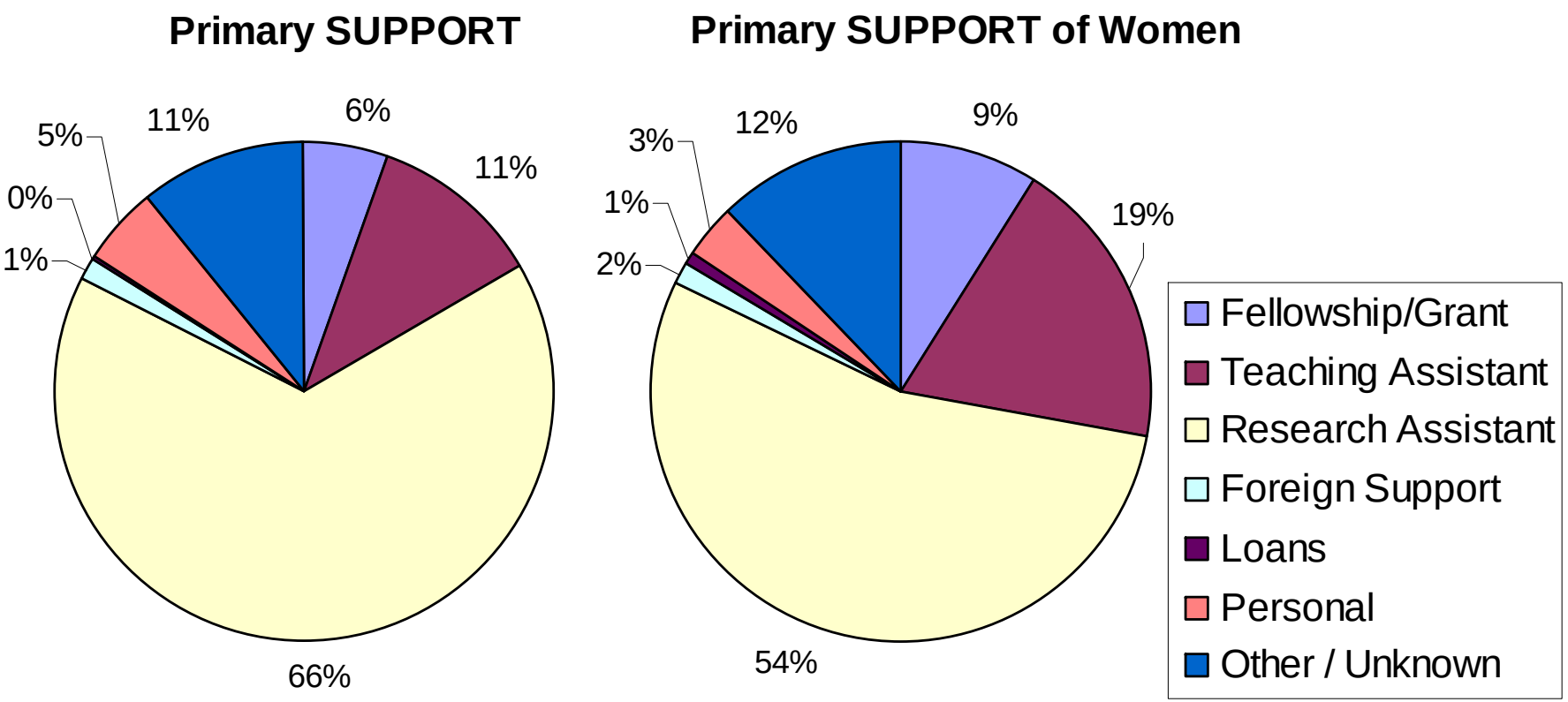


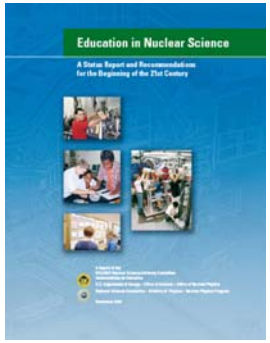
Parity of success in graduate school

	Physics	Chemistry
At Universities Ranked 1–10:		
Female Ph.D. Yield	79.2 %	68.7 %
Male Ph.D. Yield	88.0 %	78.1 %
Parity Index	0.90	0.88
At Universities Ranked 11–25:		
Female Ph.D. Yield	60.9 %	54.9 %
Male Ph.D. Yield	64.1 %	67.8 %
Parity Index	0.95	0.81

Kuck

Gender Differences: Support

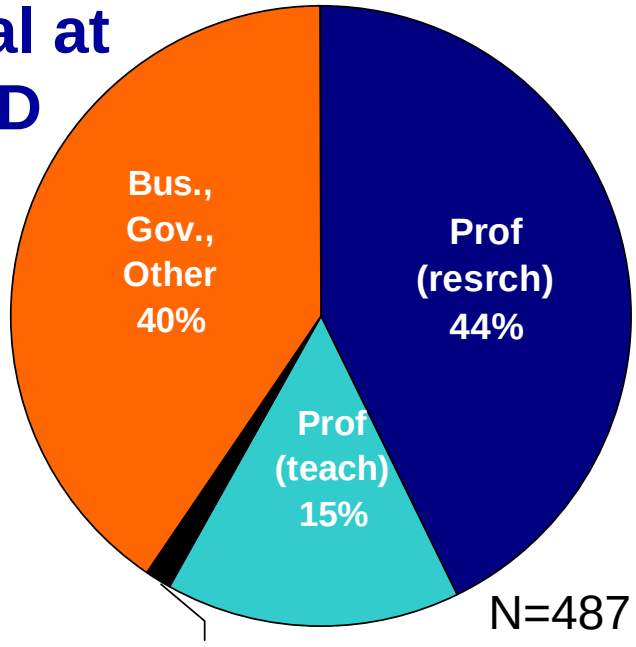




Data from Survey of Earned Doctorates

Career Goal at Start of PhD

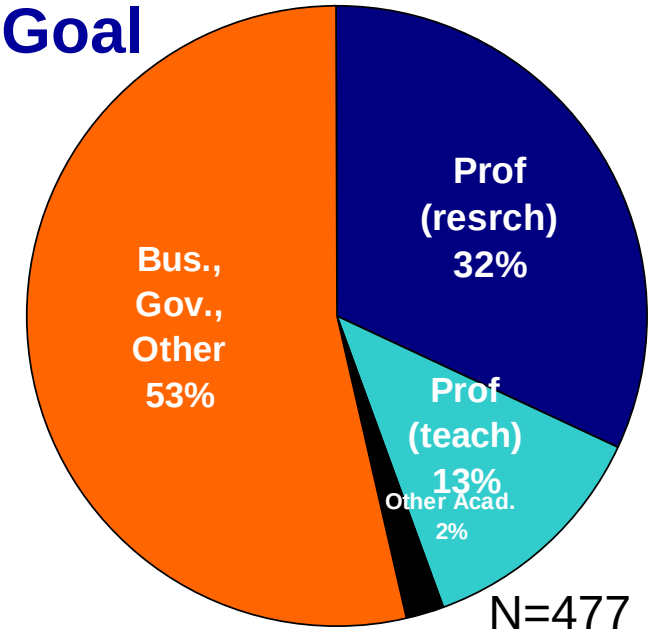
Men



N=487

Current Goal

Men



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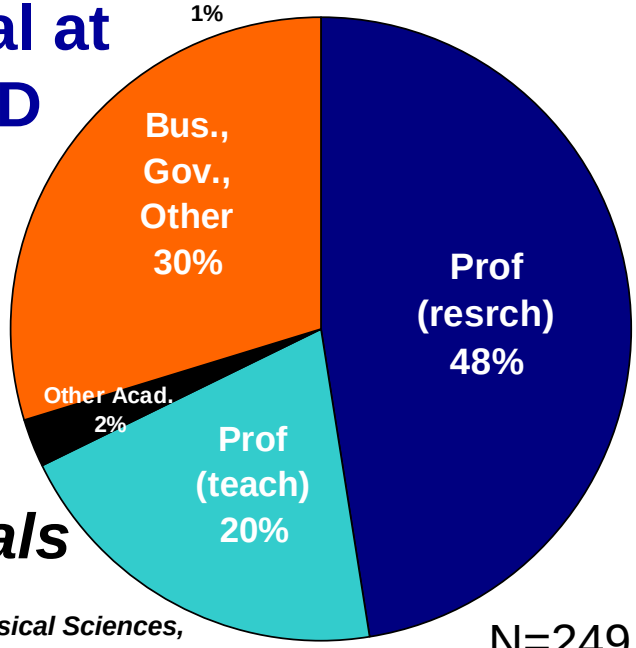
Career Goal at Start of PhD

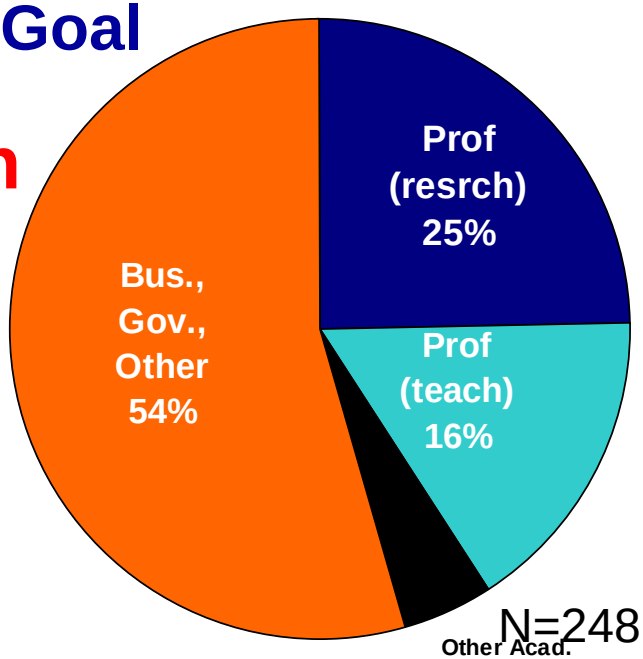
Women



N=249

Current Goal

Women



N=248

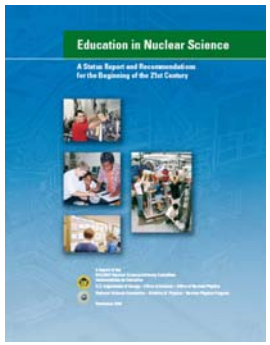
Changing Career Goals – PTEM *(Physical Sciences, Technology, Engineering, Mathematics)*

Source: Mason, Mary Ann and Marc Goulden. 2006. "UC Doctoral Student Career Life Survey." (http://ucfamilyedge.berkeley.edu/grad%20life%20survey.html).

The highest degrees obtained by the spouses or partners of postdoctoral fellows.

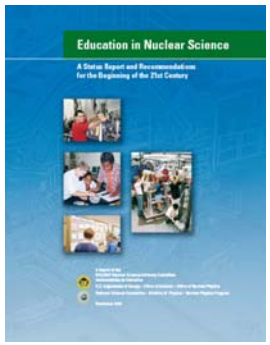
	Women	Men
Bachelor's	0%	30%
Master's	22%	38%
Ph.D., M.D., or J.D.	78%	30%
Other	0%	2%

Dual Career issues are very important to retaining women in physics.

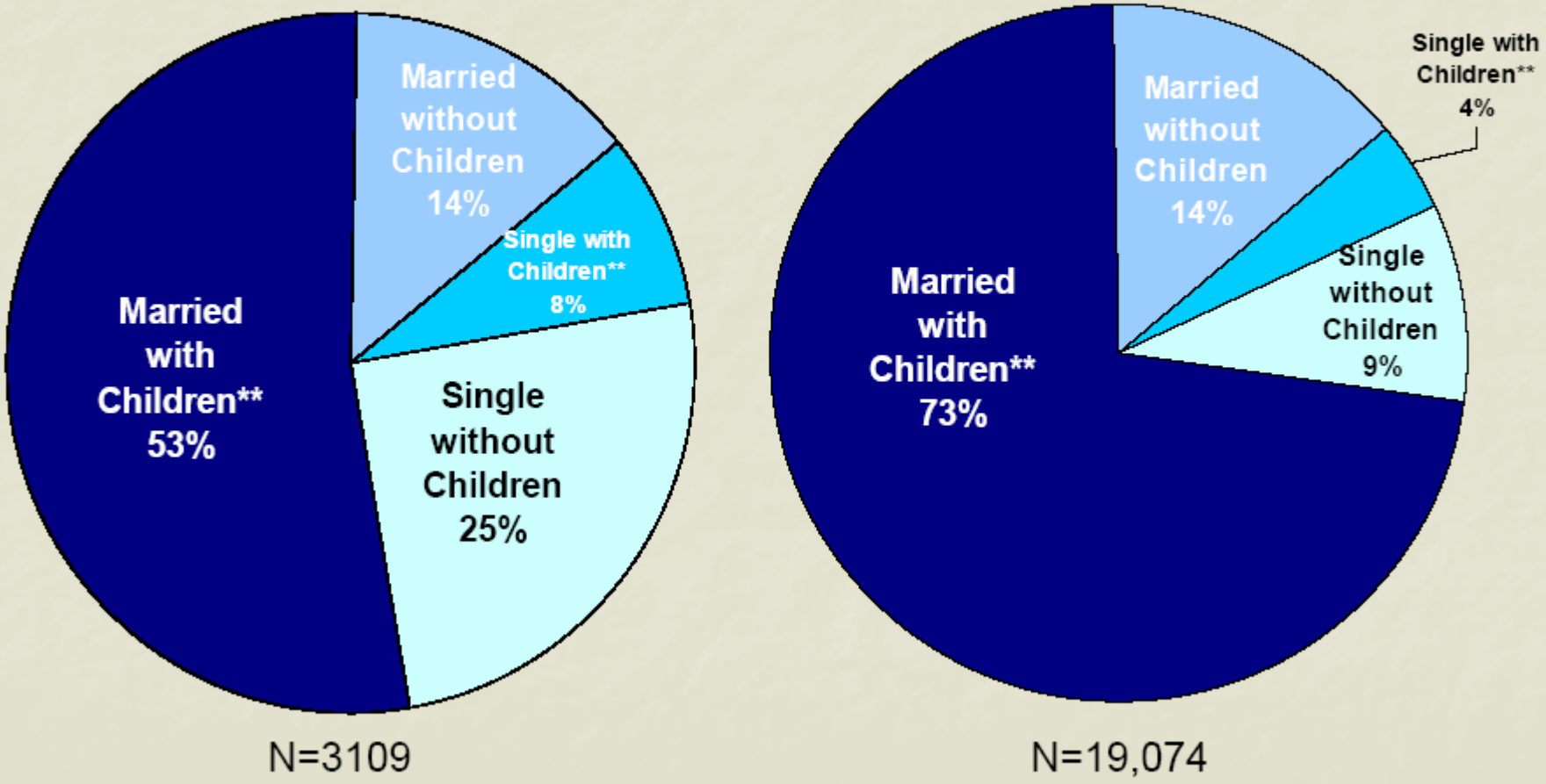


The fields of spouses' or partners' education.

	Women	Men
Nuclear Science	57%	10%
Other Natural Science	17%	17%
Education	0%	9%
Engineering	9%	13%
Fine Arts	4%	3%
Humanities	4%	9%
Social or Behavioral Science	0%	8%
Business Management	0%	9%
Law	0%	4%
Medicine	4%	14%
Other	5%	4%



Family Status of Tenured Faculty in the Sciences*



*PhDs from 1978-1984 Who Are Tenured 12 Years out from PhD in STEM & Bio. Sciences.

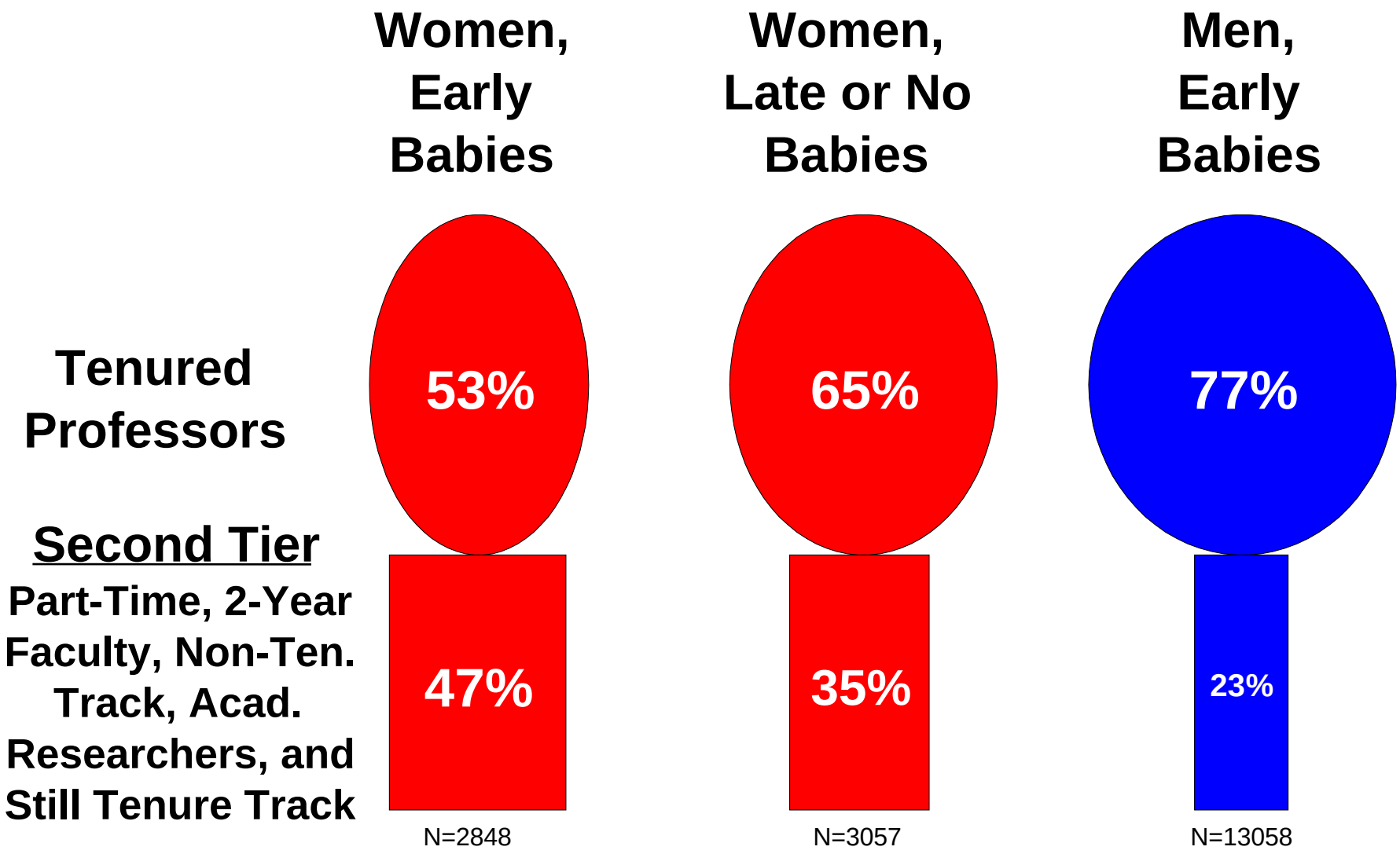
**Had a child in the household at any point post PhD to 12 years out.

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

Note: The use of NSF Data does not imply the endorsement of research methods or conclusions contained in this report.

Mason

Heads and Necks of Science PhD Recipients*

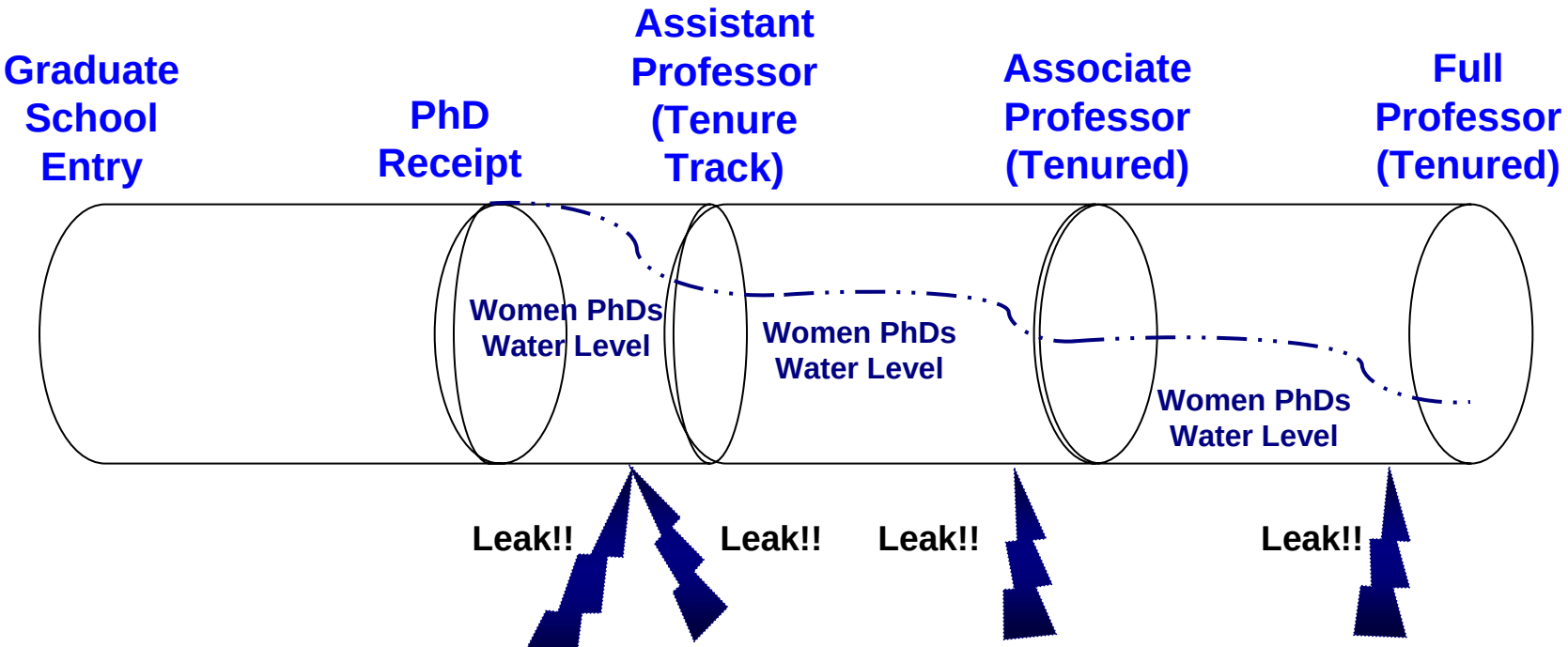


***PhDs from 1978-1984 Who Are Working in Academia 12 to 14 Years Out from PhD**

Mason

Source: Survey of Doctorate Recipients. Sciences, 1979-1999.
Note: The use of NSF Data does not imply the endorsement of research methods or conclusions contained in this report.

Leaks in the Academic Pipeline for Women*



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

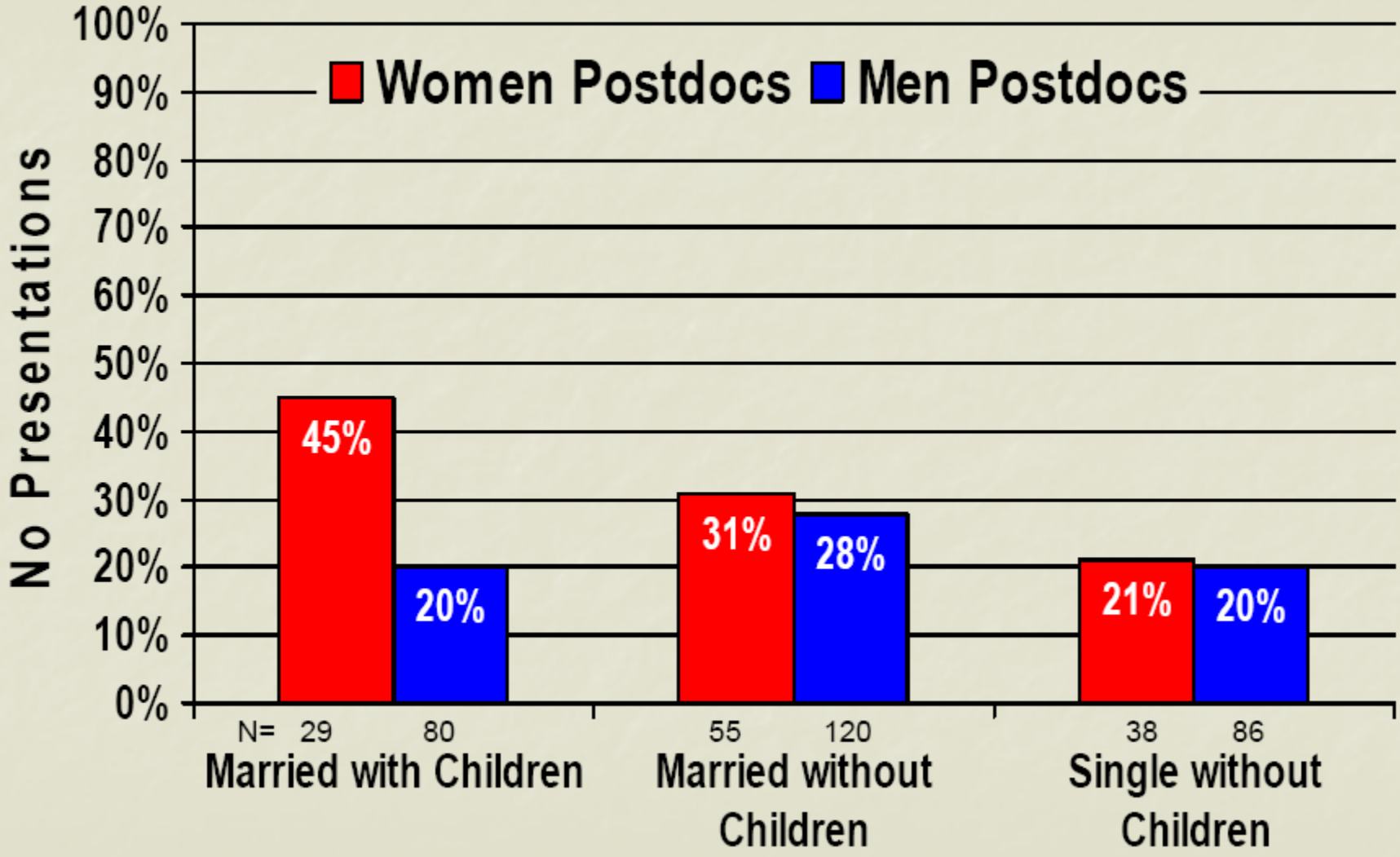
Women, Married (21% less likely than single women to enter a tenure-track position)

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)

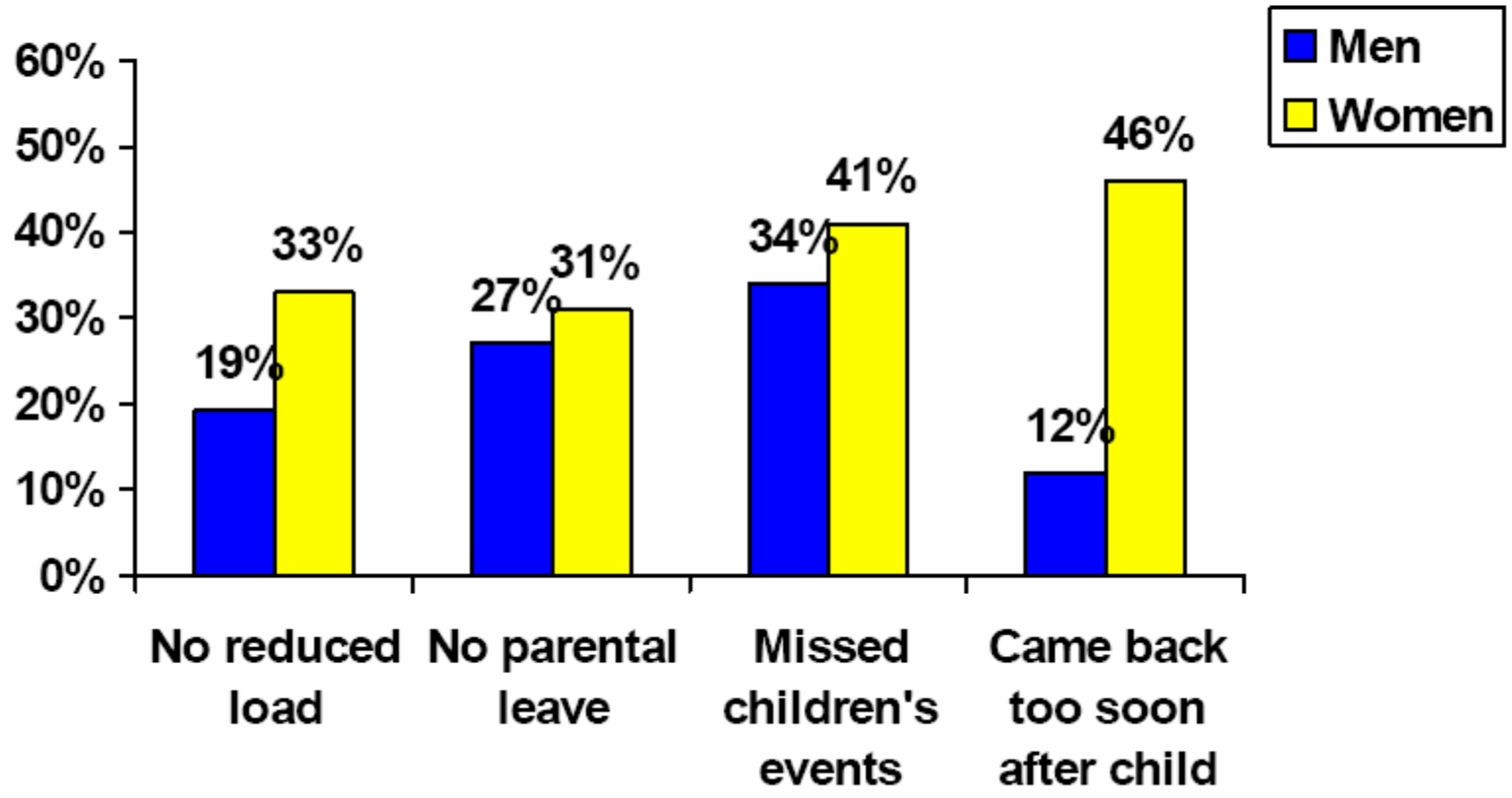
Mason

No Presentations at Conferences in the Last Year



Source: UC Berkeley and LBNL Postdoc Survey, 1999. Conducted by Maresi Nerad, Joe Cerny, and Linda McPheron.

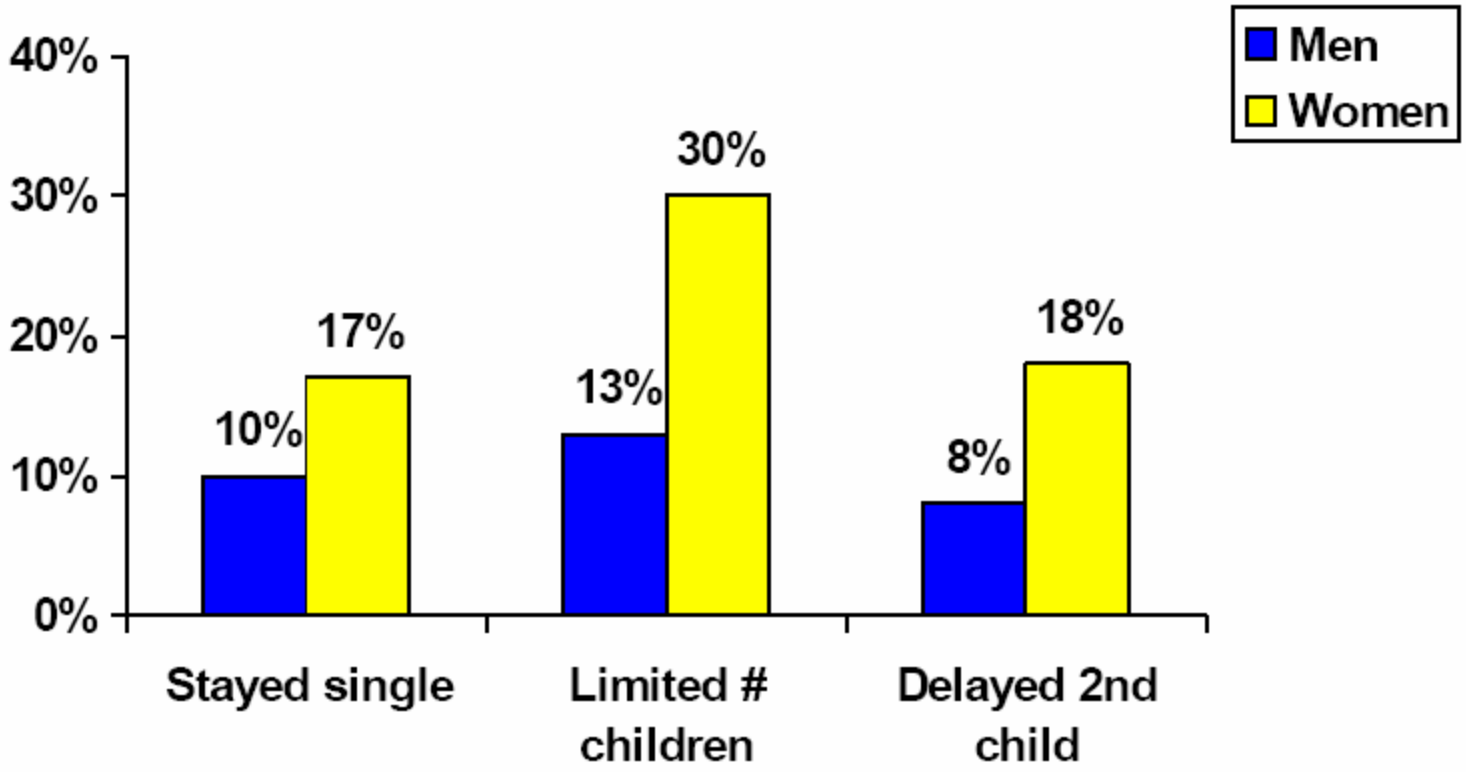
Unproductive Bias Avoidance by Gender, Research Universities



Source: Mapping Project, 2002-2003.

Drago

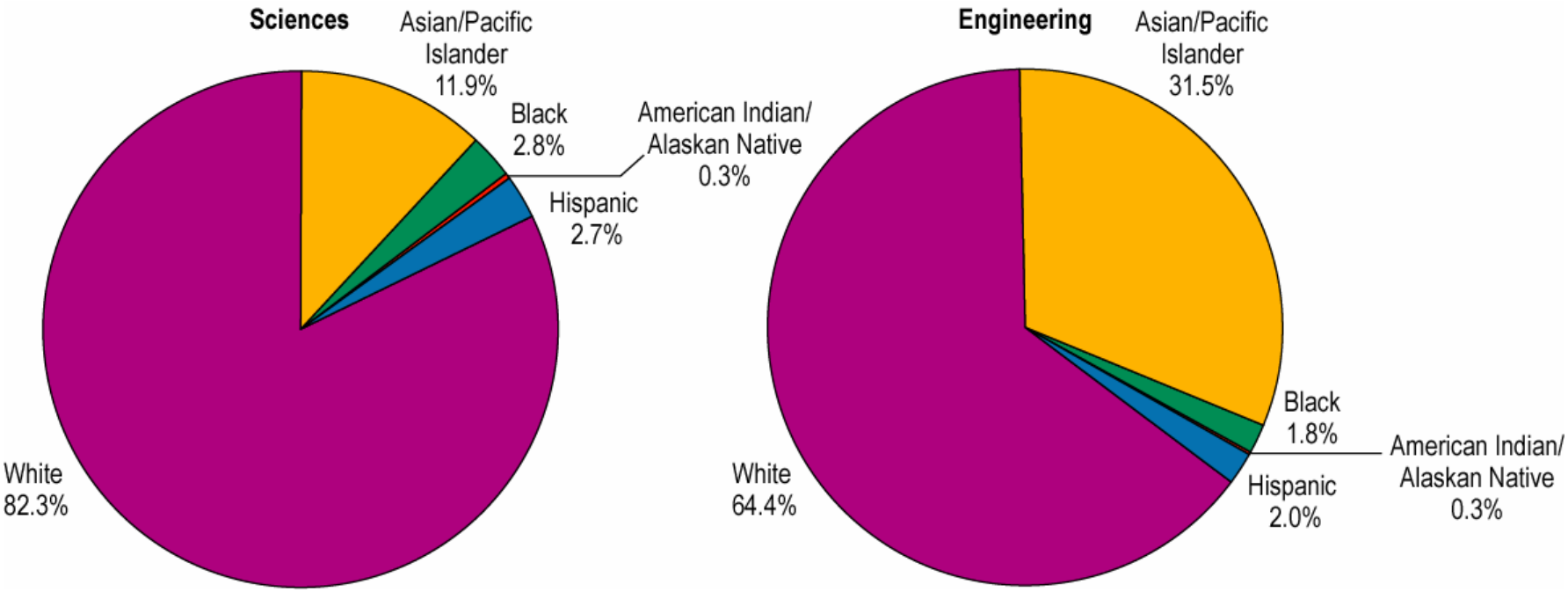
Productive Bias Avoidance by Gender, Research Universities



Source: Mapping Project, 2002-2003.

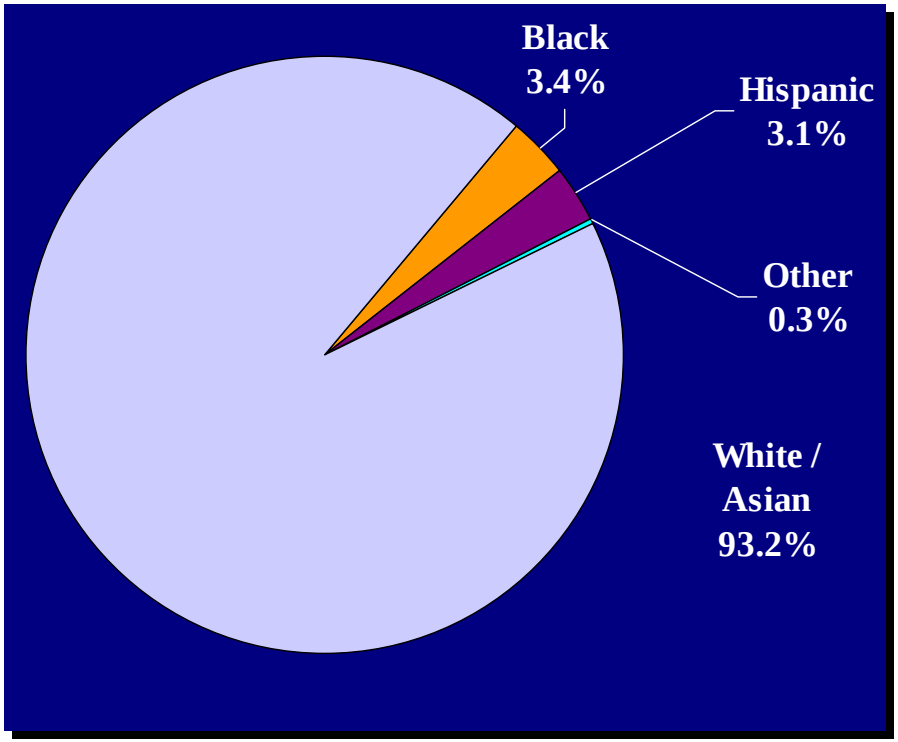
Drago

Employed S&E doctorate-holders, by race/ethnicity and field of doctorate: 2001

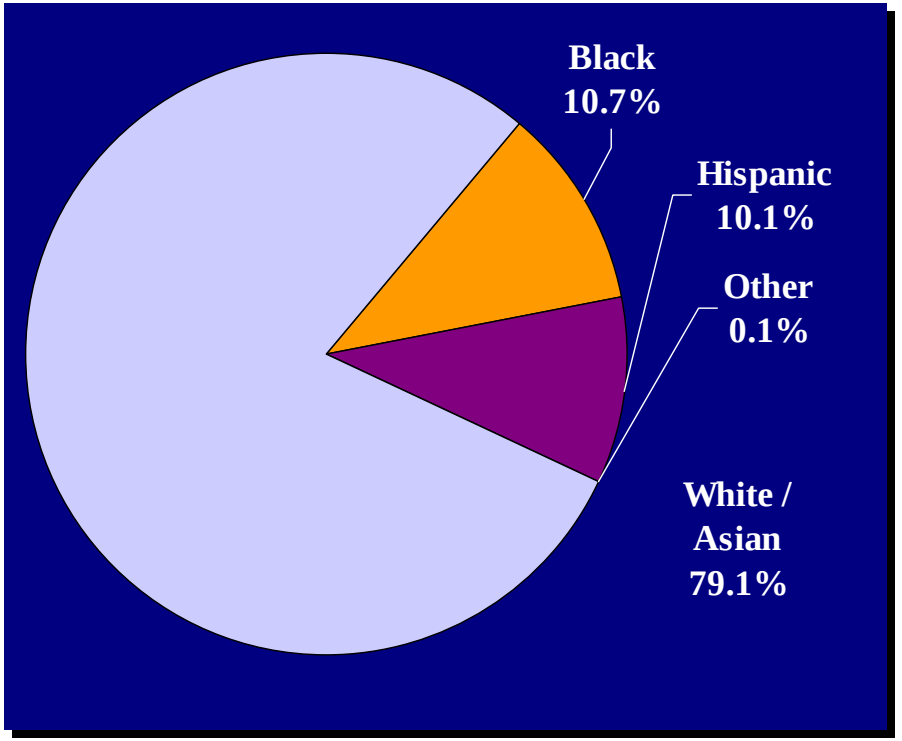


SOURCE: *Women, Minorities and Persons With Disabilities in Science and Engineering-2004*

The U.S. workforce

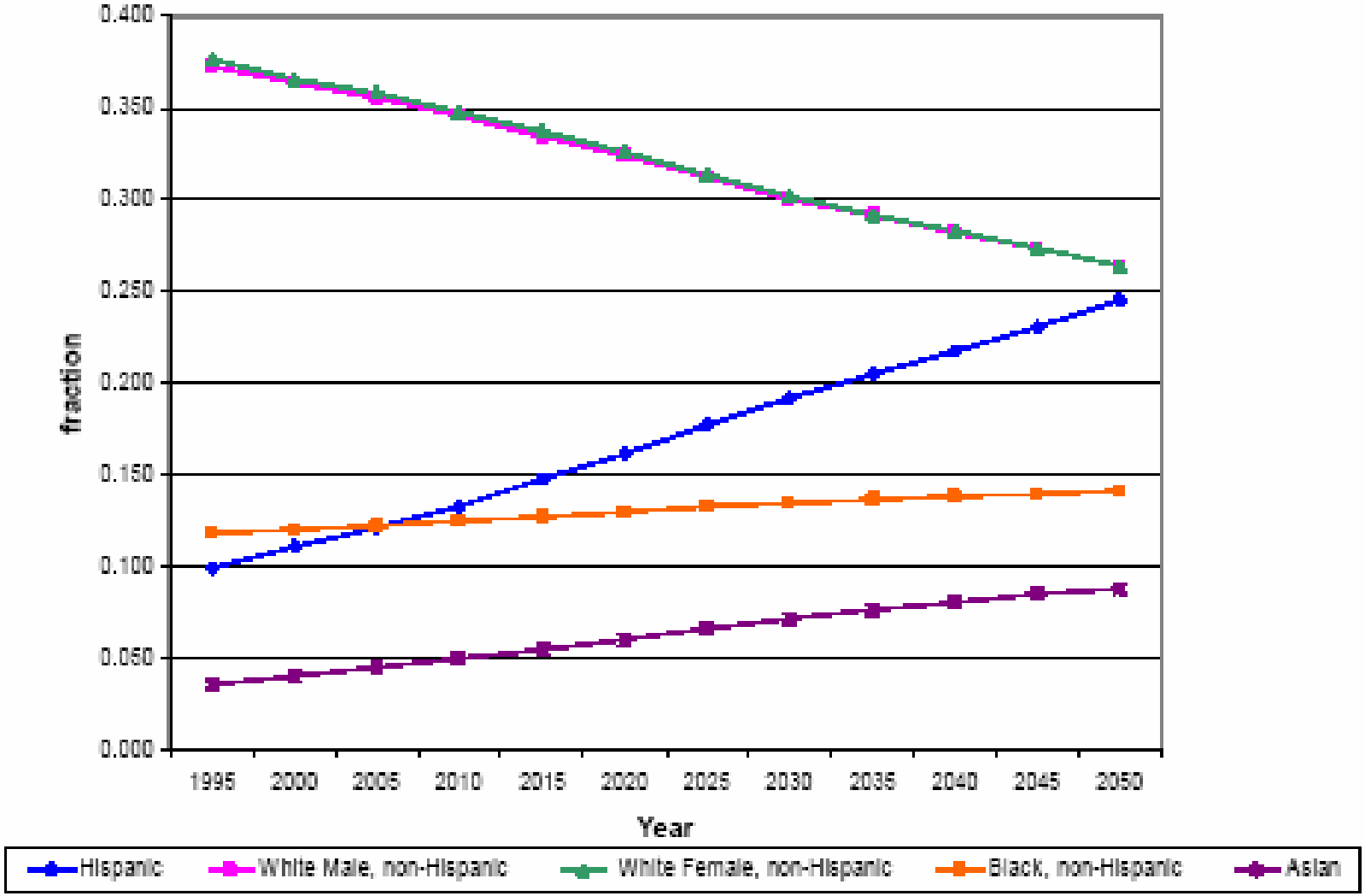


Science and Engineering Workforce



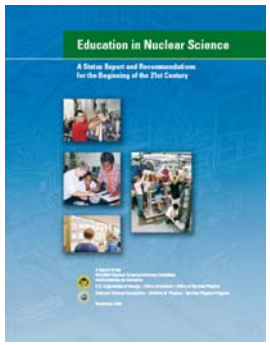
U.S. Workforce

Bureau of the Census Demographic predictions – 18-64 year olds



Percentage of nuclear science Ph.D.'s by ethnicity, compared with the percentage for physics and astronomy as a whole.

	Percentage			
	Native American	Asian	African American	Hispanic
Nuclear Science (91–02)	0.3		1.3	1.3
Nuclear Science (00–02)		3.3		
Physics & Astronomy (00–02)	0.2	9.9	2.1	3.2

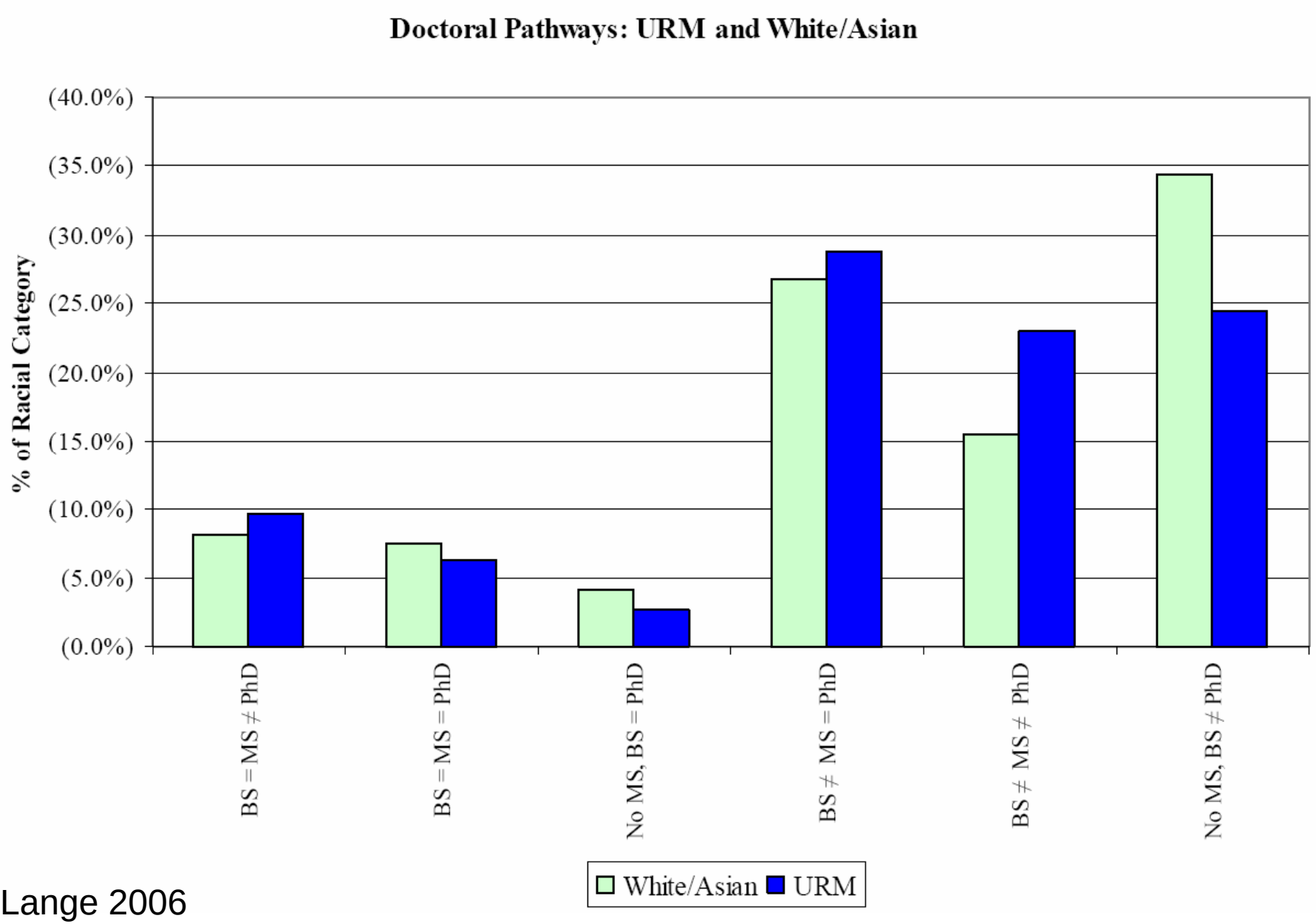


Family incomes for fulltime, full-year dependent undergraduates, by gender and race or ethnicity. (The table entries are in percentages.)

	Low: less than $30,000	Low middle: $30,000–44,999	Middle: $45,000–74,999	Upper middle: $75,000–99,999	High: $100,000 or more
Total	21.6	15.2	29.9	15.4	17.9
Sex					
Male	20.1	15.9	29.7	15.4	19.0
Female	22.9	14.6	30.1	15.4	17.0
Race/ethnicity[1]					
American Indian	28.2	12.0	33.0	9.5	17.3
Asian	38.1	14.2	23.9	8.2	15.7
Black	45.9	17.9	17.9	9.4	8.9
Hispanic	44.4	17.7	21.0	7.8	9.1
Pacific Islander	15.3	23.5	16.4	22.7	22.2
White	14.6	14.6	33.0	17.5	20.3
Other[2]	26.2	15.7	26.9	18.8	12.4
More than one race	36.8	12.6	24.9	13.4	12.3

[1] American Indian includes Alaska Native, Black includes African American, Pacific Islander includes Native Hawaiian, and Hispanic includes Latino. Race categories exclude Hispanic origin unless specified.
[2] Respondents were given the option of identifying their race as "other."

Susan P. Choy and Ali M. Berker, "How Families of Low and Middle-Income Undergraduates Pay for College: Full-Time Dependent Students in 1999–2000," U.S. Department of Education, Institute of Education Sciences, NCES 2003–162, 2003.



Lange 2006

Minorities ~50% more likely to earn Masters en route to PhD.
More institutional transitions.

Minority-Serving Institutions

- Historically Black Colleges & Universities (HBCUs)
  - 2% of all US college enrollment
  - 25% of all African-American bachelor's degrees
  - 50% of Af-Am bachelor's in science/engineering
- Hispanic Serving Institutions (HSIs)
- Tribal Colleges & Universities (TCUs)
- Community colleges
  - 50% of minorities start here

Fisk-Vanderbilt Masters-to-PhD Bridge Program

- ***Preparation needed to earn a PhD***

1. Earn a Masters degree in physics at Fisk, with full funding support.
2. Get valuable, paid research experience.
3. Receive preparation for the GRE.
4. Get fast-track admission to the Vanderbilt PhD program, with full funding support.

- Astronomy, astrophysics, cosmology
- Biophysics
- Materials science, nanophysics, detector development
- Imaging science

Facilitating successful transitions:

- Joint advising committees: Involvement of potential PhD advisors from the start, enhanced communication and tracking of progress
- Requirement of coursework at Vanderbilt: Become known to Vanderbilt faculty, complete PhD requirements
- Requirement of research at Vanderbilt: Demonstrate ability in the lab, develop faculty advocates
- Ancillary support: Identify problems early on, provide tutoring where necessary
- “Professionalization”: Seminar on academic culture, participate in professional meetings
- Social networks: Orientation, “Bridge Club”

APS / CSWP & COM

- Gender Equity Workshop
- Site Visits
- M Hildred Blewett Scholarship
- APS Scholarship for minority undergraduate physics majors
- Best Practices for recruiting and retaining women in physics
- Gazette
- Physics in you Future
- Women Speakers List
- Minority speakers list
- Travel grants for women/minority speakers
- Female friendly physics graduate programs list
- Professional development workshops for women physicists
- Programming at National meetings

The Golden Rules - Best Practices

What should departments do? *(The Golden Rules - Best Practices)*

- **Increase the number of female/URM faculty, postdocs and students**
- **Actively recruit female/URM students**
- **Make sure they get good mentoring - create climate for success**
- **Do not tolerate discrimination - pay, space, $$ research (data!!!)**
- **For much more, see**
  http://www.aps.org/programs/women/reports/bestpractices/index.cfm

Common Weaknesses in Departments (from observation)

- **Senior female faculty are marginalized, paid less, have less space, and sometimes discriminated against**
- **Students have no recourse when faculty misbehave**
- **Often there is poor accountability for hostile actions**
- **Male faculty are passive, happy to benefit from existing system**
- **Sometimes senior university administration are passive, unable or unwilling to help or intervene**
- **Students and junior male faculty learn to accept flawed system**
- **Lack of ethics, fairness, respect, accountability to society**
- **Denial of all of the above**
- **No pressure to change - system works for male faculty in power**

Laudable Strengths - Dream Dept.!

- **Senior and junior female faculty are present and leading aggressive research groups**
- **Critical mass of female postdocs and students also present**
- **Female postdocs and students have high career aspirations**
- **Talented department chair builds trust and broad, open, hiring plan within the department**
- **Male faculty accept, support and mentor female students/faculty**
- **Senior university administration willing to fund targeted diversity hires**
- **Attention to ethics, respect, fairness, accountability to society**

CSWP Site Visits - What Matters

- Critical mass
- Role models
- Family issues
- Community
- Leadership
- Respect

http://www.physics.unc.edu/~mcneil/MM04_files/frame.htm

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General Observations

Major issues

- The overall demographic situation
  - Slowly declining PhD production
  - Low, slowly increasing percentage of women
  - Abnormally low percentage of ethnic minorities
- Inadequate career advice/overall mentoring
  - Poor preparation for careers outside of academia / national labs
  - Serious dual career issues
- Major importance of undergraduate research
- Necessity to improve K-12 and public education

Change culture of field

Only by exposing the underlying assumptions will we address the cultural issues

- Is the model of how scientists work (hours, places, groupings) the only one that can support “good” science
- Does the initiation into the field really need to be primarily a filter
- Is domination the approach that best opens us to discovery
- Does conformity in the initiation phases assure the emergence of genius – either because they conform or are they the few who manage not to conform
- Are scientists elite or the norm

Some possible underlying assumptions

- You must love doing science more than anything else in order to be a good scientist
  - It's not possible to be an excellent scientist part-time, or if you have other absorbing interests
- Diversity can introduce a lack of excellence
- Spirited confrontation is the only way to achieve true peer review and therefore excellence
  - Collaborative, cooperative approaches are inherently suspect
- We are the smartest elite
  - We are more critical of ourselves than others are of themselves
- You have to be like one of "the boys" to succeed
- "Excellence" is obvious and well-defined, we all agree what it looks like, and it is the most important thing
- If you are not a university professor you are a failure
- There is one and only one natural career pathway for success
- The "best" students will make the best scientists