Transforming the Culture of Academic Science: Removing Barriers—One Student at a Time

Debra Rolison
U.S. Naval Research Laboratory
Washington, DC

Anne Eisner—Ituri Forest IV (1960)
Mentoring — What is it really?

Mentor: a wise elder to whom Odysseus entrusted his son, Telemachus, when he left for the Trojan War

Mentoring today: wise counsel from a trusted (typically older) voice of experience

“Telemachus and Mentor” Illustration for “Les Aventures de Télémaque” (1699)
But what is mentoring really? What is its currency?

Information → what one needs to work smarter not harder

... and information should be sought from a spectrum of sources, not just a trusted (typically older) voice of experience.

(b) Scale-free network

Remember #1: H. sapiens is lazy ...

Information needs to flow to/fro: Advertise!!

Remember #2: H. sapiens is lazy ...

Confidence = Competence

(don’t feel confident yet? Fake it `til you feel it!)
the most general interpretation of entropy is “missing information” — a measure of our ignorance about a system

Without an input of energy and effort, things go from bad to worse
The Face of American STEM

How good can S&E be when it’s missing two-thirds of its talent?

Is Not the Face of America

Can we really claim American science is a meritocracy??

“Who teaches matters”

Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has.

― Margaret Mead (1901-1978)

**Physicochemical analog: Nucleation and growth**

i.e., inherently singular (at the beginning)
Establish your S&T street cred first!

Always in taste!

... especially in early career or when in a position of lesser power/status

A little revolution now and then is a good thing—Thomas Jefferson

Start small! climate change via creating a microclimate as an existence proof

Change via: Subversion? Revolution?? Meteorology???

1. But you’ve got to know the territory!

2. Take the long view

Establish your S&T street cred first!
Is it time to “Title IX” U.S. Science & Engineering departments for their entrenched inability to increase the number of women represented on their faculties?

Rolison, C&EN, 13 March 2000

As a U.S. Federal Government employee, I signed an oath not to overthrow the U.S. Government, but I didn’t sign anything about not overthrowing the white-male paradigm in science...

The views about to be expressed are mine and are not necessarily those of the Naval Research Laboratory or the U.S. Department of Defense
Title IX, Education Amendments of 1972

Section 1681. Sex  (a) Prohibition against discrimination

No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance

Section 1681. Sex  (b) Preferential or disparate treatment

Title IX may not be used to discriminate... but... “... this subsection shall not be construed to prevent the consideration in any hearing or proceeding under this chapter of statistical evidence tending to show that such an imbalance exists...”

http://www2.dol.gov/dol/oasam/public/regs/statutes/titleix.htm
Percentage of degrees in STEM granted to women in the U.S. before (1970–1971) and 30 years after enactment of Title IX

<table>
<thead>
<tr>
<th>Bachelor's</th>
<th>1970-71 / 2001-02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>0.8 18.9%</td>
</tr>
<tr>
<td>Physics</td>
<td>6.7 22.6%</td>
</tr>
<tr>
<td>Geology</td>
<td>11.0 44.7%</td>
</tr>
<tr>
<td>Computer Science</td>
<td>13.6 27.6%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>18.4 48.4%</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>29.1 60.8%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>37.8 46.7%</td>
</tr>
<tr>
<td>Health Sciences</td>
<td>77.1 85.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Master's</th>
<th>1970-71 / 2001-02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>1.1 21.4%</td>
</tr>
<tr>
<td>Physics</td>
<td>6.9 20.9%</td>
</tr>
<tr>
<td>Geology</td>
<td>9.7 39.7%</td>
</tr>
<tr>
<td>Computer Science</td>
<td>10.3 33.2%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>21.4 45.6%</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>33.6 57.8%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>27.1 42.4%</td>
</tr>
<tr>
<td>Health Sciences</td>
<td>55.4 77.5%</td>
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</table>

<table>
<thead>
<tr>
<th>Doctorates</th>
<th>1970-71 / 2001-02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>0.6 17.3%</td>
</tr>
<tr>
<td>Physics</td>
<td>2.9 15.5%</td>
</tr>
<tr>
<td>Geology</td>
<td>3.4 28.5%</td>
</tr>
<tr>
<td>Computer Science</td>
<td>2.3 22.8%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>8.0 33.9%</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>16.3 44.3%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>7.6 29.0%</td>
</tr>
<tr>
<td>Health Sciences</td>
<td>16.5 63.3%</td>
</tr>
</tbody>
</table>

... but ... “Science is Still a Man’s World”
*Time Magazine* (27 February 2005)

The Nelson Diversity Studies
Top 50 ranking based on research expenditures as determined by NSF

http://cheminfo.chem.ou.edu/faculty/djn/diversity/chemEdiv.html

### Percentage of U.S. Ph.D.s awarded to women, 2000-2001

<table>
<thead>
<tr>
<th>Field</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociology</td>
<td>36%</td>
</tr>
<tr>
<td>Psychology</td>
<td>34%</td>
</tr>
<tr>
<td>Political science</td>
<td>24%</td>
</tr>
<tr>
<td>Biology</td>
<td>20%</td>
</tr>
<tr>
<td>Astronomy</td>
<td>12%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>12%</td>
</tr>
<tr>
<td>Economics</td>
<td>12%</td>
</tr>
<tr>
<td>Computer science</td>
<td>11%</td>
</tr>
<tr>
<td>Chem. engineering</td>
<td>11%</td>
</tr>
<tr>
<td>Civil engineering</td>
<td>10%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>8%</td>
</tr>
<tr>
<td>Mech. engineering</td>
<td>7%</td>
</tr>
<tr>
<td>Physics</td>
<td>7%</td>
</tr>
<tr>
<td>Elec. engineering</td>
<td>7%</td>
</tr>
</tbody>
</table>

Source: Nelson Diversity Survey
### Demand reform at the top: … Doctorate schools of faculty members at the “Top 10” chemistry departments*

<table>
<thead>
<tr>
<th>Ph.D. School of Faculty at Top 10</th>
<th>Women</th>
<th>Men</th>
<th>Total</th>
<th>Younger Faculty (Ph.D.: 1979-1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC-Berkeley</td>
<td>9</td>
<td>33</td>
<td>42 (21.4%)</td>
<td>8 XX/20 (40.0%)</td>
</tr>
<tr>
<td>Caltech</td>
<td>2</td>
<td>23</td>
<td>25</td>
<td>1 XX/19</td>
</tr>
<tr>
<td>Harvard</td>
<td>2</td>
<td>53</td>
<td>55 (3.6%)</td>
<td>1 XX/18 (5.6%)</td>
</tr>
<tr>
<td>Stanford</td>
<td>2</td>
<td>15</td>
<td>17</td>
<td>2 XX/14</td>
</tr>
<tr>
<td>MIT</td>
<td>2</td>
<td>23</td>
<td>25</td>
<td>2 XX/12 (16.7%)</td>
</tr>
<tr>
<td>Cornell</td>
<td>2</td>
<td>7</td>
<td>9 (22.2%)</td>
<td>2 XX/6 (33.3%)</td>
</tr>
<tr>
<td>Columbia</td>
<td>2</td>
<td>16</td>
<td>18</td>
<td>2 XX/10 (20.0%)</td>
</tr>
<tr>
<td>Yale</td>
<td>1</td>
<td>8</td>
<td>9</td>
<td>1 XX/4 (25.0%)</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>0 XX/2</td>
</tr>
<tr>
<td>Chicago</td>
<td>1</td>
<td>11</td>
<td>12</td>
<td>1 XX/5 (20.0%)</td>
</tr>
</tbody>
</table>

- it's a power law: the top 10 hires from the top 10 (preferably the top *5*), but the women educated at the top 10 *really* don't want an academic career in the top 10 (or top 25 or top 50… )

STEM Education is a National Security Imperative

“The harsh fact is that the US need for the highest quality human capital in science, mathematics, and engineering is not being met.”

**Recommendation**

“... fund a comprehensive program to produce the needed numbers of science and engineering professionals as well as qualified teachers in science and math.”

(1) Science and Math Education

(2) Investment in Basic Research ... are American Competitiveness Imperatives !!

“... the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength.”

Why do Congress & the White House care about the health of U.S. S & T?

(1) “Hart-Rudman Report” (2001)

(2) “Augustine Report” (2005)
The U.S. Congress acts on its concerns
<http://commerce.senate.gov>

3 October 2002 — Hearing on Title IX and Science
Senate Subcommittee on Science, Technology, and Space

The Federal government should share some of the spotlight... It's time Congress quantified and qualified the realities facing women in the sciences. Only then can we find fully effective solutions—Ron Wyden (D-OR)


- NRC Committee on Gender Differences in Careers of Science, Engineering, and Mathematics Faculty  <http://www7.nationalacademies.org/cwse/gender_differences.html>
  - Report originally anticipated by mid-2005 (still pending)

- RAND Corp. Study on Gender Differences in Federal External R&D Investment  
  - Report originally anticipated by late 2004 (issued September 2005)
  - NSF passed ... NIH flunked ... DOE & DOD *really* flunked

- GAO task force: Title IX Compliance in Math, Science and Engineering  
  - Audit commissioned January 2004 (report issued July 2004)
    - Study requested by Barbara Boxer (D-CA) and Ron Wyden (D-OR)
**Key GAO finding re: Title IX oversight by funding agencies**

“much of the leverage afforded by this law lies underutilized in the science arena, even as several billion dollars are spent each year on federal science grants”

The primary GAO recommendation to the Secretaries of Energy and Education, the Administrator of NASA, and the Director of the NSF:

“... take actions to ensure compliance reviews of grantees are conducted as required by Title IX”... i.e., proactive not reactive reviews

In response to the GAO report:

NSF, the Dept of Education, DOE, and NASA formed an interagency committee to jump-start Title IX enforcement: NSF/DOE and NASA have each conducted one Title IX compliance review of a research-intensive university
Assessments of Science & Engineering — Town Hall Discussion

Title IX — It’s Not Just for Sports
Debra Rolison, Organizer and Moderator, U.S. Naval Research Laboratory

Title IX — An Effective Change Strategy in Academia
Jocelyn Samuels, National Women’s Law Center

The Slow State of Change in STEM Departments
Willie Pearson, Jr., Georgia Institute of Technology

Funding Agencies and Their Implementation of Title IX for STEM
Judith Sunley, MPS, National Science Foundation

Recruiting and Retaining Women Faculty
George Whitesides, Harvard University

My Thoughts on Applying Title IX
Richard Zare, Stanford University
• Every federal funding agency has the authority to do Title IX compliance reviews *and* the authority to withhold federal funds
• Overcaution prevents universities from taking lawful affirmative steps
• One pattern of science does *not* fit all people or all science!

**Synopsis of 2006 AAAS Symposium**

**Initial NSF/DOE compliance review focus:**
Students in engineering/physics/IT programs at high $$ grantees

- emphasis on admission/retention/access to resources and faculty

**How should compliance reviews operate?**

• Require disaggregated data at every stage
  w/r/t students and (rank of) faculty—and not just XX vs. XY
• Do climate surveys (along the spectrum)
• Note the # of complaints filed with/against the university

... BUT REMEMBER: [as noted by the GAO report] XX in S&E eschew making complaints or filing grievances because of career implications
Sex, lies, and Title IX

Federal law banning sex discrimination in schools may do as much for academics as it has for athletics.

“… THE GREATEST CHALLENGE is changing the perception of what constitutes a successful academic career in STEM … We must dispel the notion that working day and night equates to productivity.

…I strongly favor the application of Title IX to the STEM enterprise … Concentrate on the careful collection and wide circulation of ... Title IX measurables, quantitative measures that help us judge progress in achieving gender equity.

The academic life is a grand profession, and it is not just for men. The smart application of Title IX can help demonstrate that.
(the Feds are slow) so what’s next?
Subversion … a.k.a. how to up the ante …

- Educate faculty and students re implicit bias: as a society we (men and women) overvalue the competence, performance, and productivity of men and undervalue that of women
✓ recognize that there is bias in evaluating “others” (see Valian)

✓ STEM professionals just need to get over the fantasy that they are objective … — we aren’t —

✓ We also need to recognize that it is human to identify (and therefore) pick the person who most reminds one of oneself

Ex. 1: “Blind” auditions can explain 30 to 55% of the increase in women winning orchestral jobs
Washington Post, 13 July 1997

Ex. 2: University psychology professors prefer, 2:1, to hire “Brian” over “Karen”, even when the application packages are identical
Washington Post, 2 April 2000
R.E. Steinpreis, K.A. Anders, D. Ritzke
Sex Roles 41 (1999) 509

Ex. 3: Women applying for a Swedish Medical Research Council postdoctoral fellowship had to be 2.5 times more productive to receive the same competence score as the average male applicant
A telling statistic — even elementary school kidlets know the score

More than 1,000 Michigan elementary school students were asked to describe [in 2000, not 1975 or 1950] what life would be like if they were born a member of the opposite sex …


>40% of the girls saw positive advantages to being a boy: better jobs, more money, and definitely more respect

95% of the boys saw no advantage to being female

WHY?? gender schemas/implicit associations—unconscious mechanisms by which men and women assign higher “value” to men and lesser “value” to women

- Banaji/Greenwald: Implicit Association Test
  <https://implicit.harvard.edu/implicit/demo/measureyourattitudes.html>
We’re scientists … time to do an experiment

✓ Scientists just need to get over our myth of objectivity

Implicit Association Test

Mahzarin Benaji
Harvard University
Anthony Greenwald
University of Washington

https://implicit.harvard.edu/implicit/demo/measureyourattitudes.html

Measure Your Attitudes

I am aware of the possibility of encountering interpretations of my IAT test performance with which I may not agree. Knowing this,

I WISH TO PROCEED

The Bias Finders—A test of unconscious attitudes polarizes psychologists [169 (2006) 250 (22 April)]
Educate faculty and students re implicit bias: as a society we (men and women) overvalue the competence, performance, and productivity of men and undervalue that of women.

Put to rest the myth that a scientist's best creativity and productivity occurs in early career: the tenure clock is an artifice and especially damaging to young women trying to integrate career and family ... time to re-think tenure?

Put to rest the myth of 80-h weeks: Survey of UC tenured faculty show ~55-h/week gets the job done, even for faculty with children (Mason, Gouldin)
... and the tradition of Western science? a “world without women”

- academic culture traces it origins to the monastery and the ecclesiastical schools

- vestiges of that tradition still cling to the “ideal” of dedicated academic life

- this “ideal” requires either a monastery or some other support infrastructure: *i.e.*, a wife

- such is simply no longer life in today’s world … it certainly is not an option open to most women
but, creates, instead, an unhealthy environment for:

(1) those men and women who want children — and to play a continuing, rather than merely genetic role in their lives

(2) those women who, once they demonstrate productivity, scholarship, and mentorship still reap less respect — and the ancillary rewards of space, salary, funding, and awards — than their male colleagues [see the MIT Faculty Report of 1999]

(3) those men and women who want to create collaborative, cooperative, team-based research programs

(4) those men and women who place the educational (including in the research lab) and mentoring aspects of their job first

(5) those undergraduate students (>50% of whom are now women), graduate students, and postdoctoral associates who are trying to envision their lives in science

... an unhealthy environment for ... people?
Late one evening Ernest Rutherford found a diligent student still at work in his lab. “Do you work in the mornings, too?” he asked. “Yes,” replied the student, expecting to be commended for his stamina.

“But when,” Rutherford asked, amazed, “do you think?”


Under Rutherford’s directorship of the Cavendish, Nobel Prizes were awarded to Chadwick for discovering the neutron, Cockcroft and Walton for splitting the atom using a particle accelerator, and Appleton for demonstrating the existence of the ionosphere.

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Put to rest the myth of critical mass: 15%? No!! ≥35%

(the Feds are slow) so what’s next? Subversion … a.k.a. how to up the ante …
What if it isn’t a critical mass that is needed … but a percolation threshold?

~ 15% is where one needs to be to reach a percolation threshold in a 3-D problem.

Once ≥ the 3-D percolation threshold, the small amount of “other” in the sea of majority thinks it represents the whole and electron/ion/heat transfer occurs with impunity, as does communication and a sense of community, if we are talking about women in a man’s world.

• Is reaching >15% a happenstance outcome?

• Is reaching a contiguous network the better goal??

The good news about a percolation mechanism: women *and* men—whites *and* underrepresented minorities—can be members of such networks.
• Educate faculty and students re implicit bias: as a society we (men and women) overvalue the competence, performance, and productivity of men and undervalue that of women

• Put to rest the myth that a scientist's best creativity and productivity occurs in early career: the tenure clock is an artifice and especially damaging to young women trying to integrate career and family ... time to re-think tenure?

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• Put to rest the myth of critical mass: 15%? No!! \( \geq 35\% \)

▷ Redirect resources: Encourage undergraduates to give diversified (human) institutions—and research groups—their first attention when looking at graduate school

• OUT THE TOXIC DEPARTMENTS !!!

    ... guerilla website??
“… you’re only here because you’re a woman…”
when far-too-many men are “here” because they’re men
(gender schemas (XY↑ XX↓) = accumulation of advantage for men)

“preferential hiring”…
we’ve always had it: ~100% white men … now, *that’s* a quota!!!
… or because we’ve had universities since the 11th C: “Isn’t a millennium of affirmative action for white men sufficient??”

“search committee”
manila-envelope-opening committee (disinterested in searching…)

Subversion  ... Throw out the old dictionary ...
STEM departments need to recruit what they need... and they need women (don’t just stand around opening manila envelopes!)

U-Dub Faculty Recruitment Toolkit
http://www.washington.edu/admin/eoo/forms/ftk_01.html

STEM units certainly recruit the men that they want to join their ranks

universities certainly understand that to build a competitive, functional team, recruitment is a necessity...

otherwise, the basketball coach gets fired

Jacob Jordaens, The Four Evangelists, Antwerp, ca. 1625, oil on canvas, Musée de Louvre, Paris
“... you’re only here because you’re a woman...”
when far-too-many men are “here” because they’re men
(gender schemas (XY↑ XX↓) = accumulation of advantage for men)

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“I generally prefer carrots to sticks.”
... We are dealing with carnivores. Carrots are for vegetarians.

“We only want the *best* candidate...”
... “best” is in the eye of the beholder: make them define it!
Diversification of a University Faculty: Observations on Hiring Women Faculty in the Schools of Science and Engineering at MIT.


<http://web.mit.edu/fnl/volume/184/hopkins.html>
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“We only want the *best* candidate…”
... “best” is in the eye of the beholder: make them define it!

old: “diplomacy…”  new: cast-iron-skilllet diplomacy
... which may be required to get a point of logic across to the illogical by whapping them upside the head with cast-iron skillets...
I countered with the following:

So many U.S. citizens ask if they can postdoc with me that (alas) I have to turn most away ...

Why the difference?

1. Our postdocs earn a professional, living wage ($60,120/year in 2006)
2. Compelling research in nanoscience
3. Healthy microclimate emphasizing teamed research + active (not osmotic) professional development

NSF-MPS/Intelligence Community Workshop on Activities to Combat Terrorism, Nov 2002:

Nobel Laureate Rick Smalley voiced concerns regarding the low number of Americans earning STEM Ph.D.s and how difficult it was to attract U.S. citizens into doing postdoctoral research (including with him)
How do STEM departments get more women as faculty?

- On-site day care
- Mentorship that illuminates the choices and opportunities
- Dial-back the demands … STEM faculty work insanely hard
  If faculty must become the equivalent of CEOs (and COOs and CTOs and CFOs and...) to thrive in academia—and it seems they must—the pay had better become commensurate (dream on)
  - Return the faculty to their primary function: training and challenging students in pursuit of scholarly research
- Reconfigure how students are supported to do research as part of their graduate degrees
- Change the reward structure — Reward first and foremost — those professors who truly guide, mentor, and challenge in the classroom and the research lab
  … and the system will turn on a dime

**OUR GOAL:** Women who do more than just survive … THEY THRIVE
People in academics can, and do, do it right — we should stop rewarding the ones who do it wrong, even if they bring in dollars (and renown) galore.

The first and highest rewards should go to those who fulfill their duties to what *is* the product of the U.S. university: the students.

WHY? Brutal environments drain the joy out of doing science...

... this country should want joyous scientists ...

 ✓ Reward via grant funds/renewals, awards, distinction, chocolate, etc. those who do do it right.

... such men and women are indeed national treasures ... REWARD THEM!!!
The most notable fact that culture imprints on woman is the sense of our limits. The most important thing one woman can do for another is to illuminate and expand her sense of actual possibilities.

Adrienne Rich in *Of Woman Born*, 1976

“...places to go...

... from the Declaration of Sentiments adopted at the Woman's Rights Convention in Seneca Falls in 1848:

“He closes against her all the avenues to wealth and distinction which he considers most honorable to himself.”

“...places to go...

Seneca Falls, NY
National Park

Lucretia Coffin Mott introduces Susan B. Anthony to Elizabeth Cady Stanton

[photo: C. Korzeniewski]
... for future reference ...

- Londa Schiebinger: *Has Feminism Changed Science?* Harvard University Press (Cambridge, MA) 1999
- Linda Jean Shepherd: *Lifting the Veil—The Feminine Face of Science*; Shambala Press (Boston) 1993
- Debra Rolison: “A 'Title IX' challenge to academic chemistry—Isn't a millennium of affirmative action for white men sufficient?” *Women in the Chemical Workforce*, National Academy Press (Washington, DC) 2000, Ch. 6, pp. 74-93 [http://www.nap.edu/books/030907293X/html]
- Sarah Glazer: “Gender and learning: Are there innate differences between the sexes?” *CQ Researcher* 2005, 15(19) 445-468 (20 May)