

# Women at the Eye and STEM of society

Women in Science Initiative  
Fairleigh Dickinson University  
(Morristown, NJ)

November 6, 2019

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Department of Biomedical Engineering  
Rutgers University (New Brunswick, NJ)

- **The US Workforce of Women**



- **STEM Careers for Women**

- **Evolving Gender-bias in STEM**

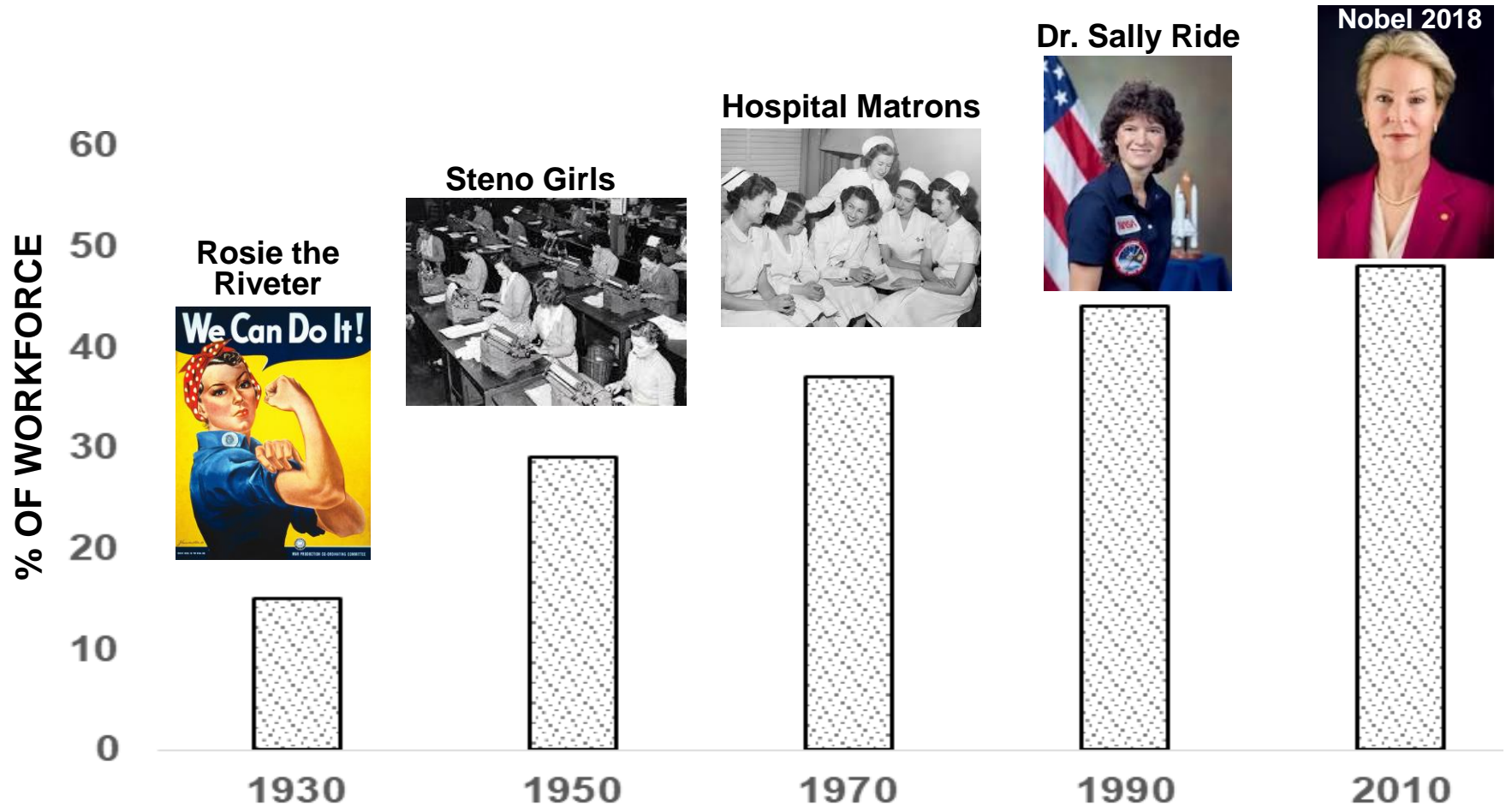
- **Impacts on My Own Career**
  - Undergraduate*
  - Industry*
  - Graduate Study*
  - Faculty*

- **Lessons Learned and Moving Forward**

## USA Population is 49% female

- Under age of 15: M/F Ratio of 1.04 to 1.0
- Over age of 65: M/F Ratio of 0.78 to 1.0

## Workforce has dramatically evolved to include women



## Significant Contributions in STEM

**Elizabeth  
Blackwell**



**Grace Hopper**



**Maria  
Montessori**



**Mother Joseph Butler  
Religious of Sacred Heart of Mary**



**Katherine G. Johnson**



**Rosalind Franklin**



## Nature of women's careers have evolved... but perception of women's contributions and abilities have been slower to change

*Lise Meitner* helped discover nuclear fission. Nominated 19 times for Nobel Prize in Chemistry between 1924 and 1947, and 29 times for Nobel Prize in Physics between 1937 and 1965.

*Female scientists were outliers, ignored*

*Female academics were paid less.... there was an all-male common room, which prevented women scientists from collaborating and integrating. (1950s, R. Franklin)*

*More female scientists, but still not relevant*

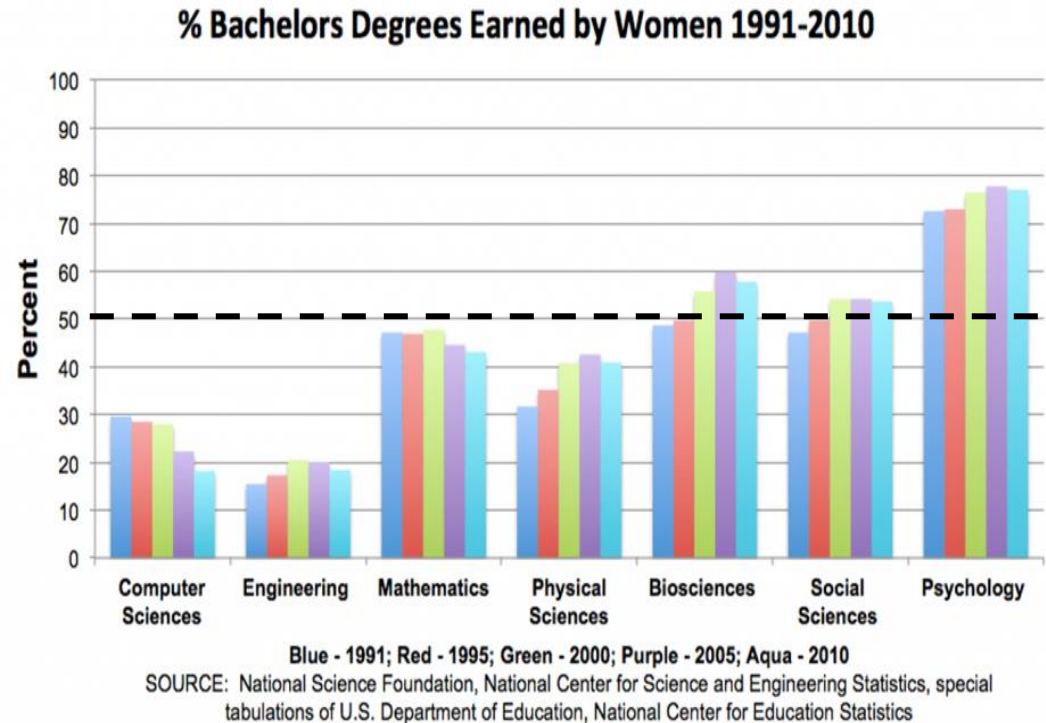
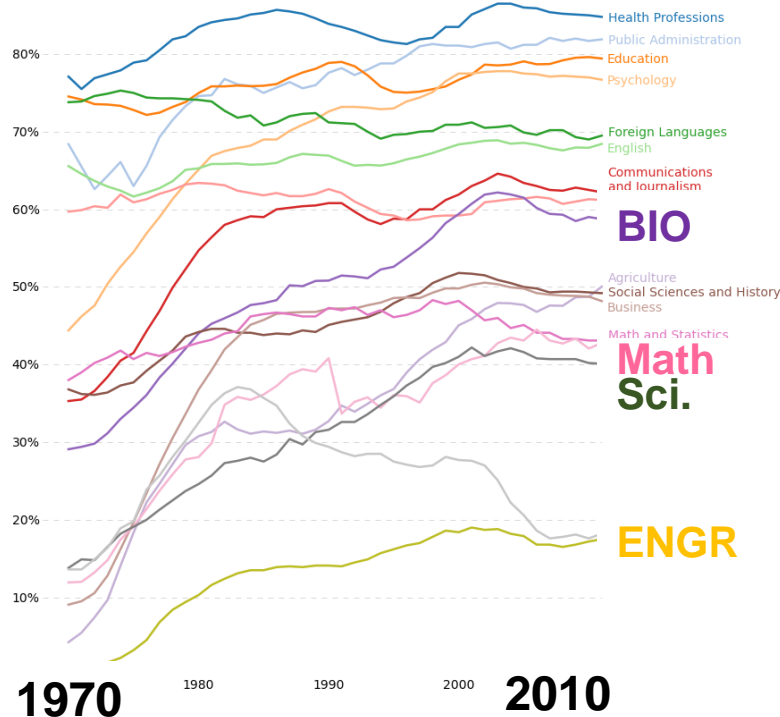
*For whatever reason, I didn't succumb to the stereotype that science wasn't for girls. I got encouragement from my parents. I never ran into a teacher or a counselor who told me that science was for boys. (1980s, S. Ride)*

*STEM females were not rare, but common bias*

*"They might say 'It's not science' or that 'Gentlemen don't do random mutagenesis.' But I'm not a scientist, and I'm not a gentleman, so it didn't bother me at all. (2018, F. Arnold)*

*I laughed all the way to the bank, because it works."*

*Females in STEM are a force, experience hostility*



- Numbers of female undergraduates in STEM are increasing,, but they are not staying!
- Medical school applicants are over 50% female, but women < 50% of MD/Researchers
- Engineering Faculty < 15% females (All Levels) ([SWE.org](http://SWE.org), [NSF.gov](http://NSF.gov))
- National Academy of Medicine (<25% female), Science (<20%), and Engineering (<10%)



## What kinds of factors contribute to this stalled progress?

1. We are more comfortable with those whom we resemble

*Are Your Work Friendships Only with People Who Look Like You? HBR 9/19*

2. We reward/recognize our peers and friends

*Predicting human behavior toward members of different social groups, PNAS 8/18*

3. Old stereotypes and customs die hard



- Antiquated politeness, e.g. Wont tell a joke because ladies are present

*Pneumonic for Resistors: Bad boys rape our young girls, but Violet gives willingly*

- Believe social myths, e.g. Women don't ask, Cant negotiate, Don't take risks

*What Most People Get Wrong About Men and Women, HBR 5/18*

- Treat men and women differently in professional and personal settings

*Sensors Show That Men and Women Are Treated Differently at Work, HBR 10/17*

4. Some advocates have difficulties recognizing subtle gender bias:

- 50% USA do not experience it
- Victims have kept silent/shamed
- Many cannot accept that their friends sexually harass women



- Big changes coming with dissemination of info via internet and 'Me Too'

## Pink Tax: Gender Based Tax discrimination

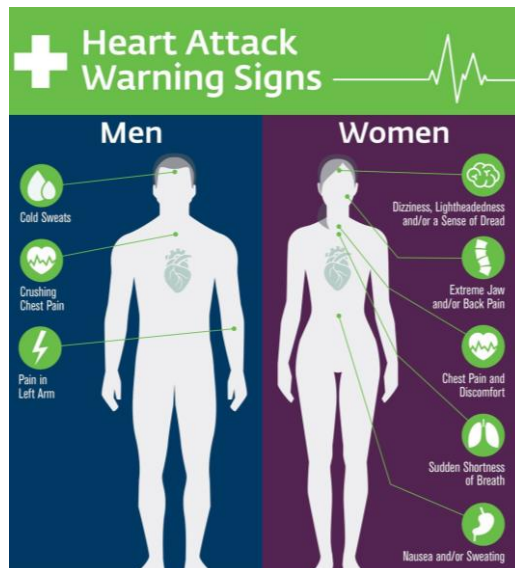
- Toys and clothes have higher cost if coded \*pink\*
- Services cost more for women (e.g. dry cleaning)
- Taxed on non-essential items (e.g. feminine products)

<b>Women's Products</b>	 \$10.00 Each	 \$5.29	 \$29.99	 \$12.99
<b>Men's Products</b>	 \$5.99	 \$4.99	 \$17.99	 \$9.99

NYC Dept of Consumer Affairs 2017

## Equal Pay (Ever?)

- Women earn 77¢ per \$1 of equal work from men
- Worldwide much worse!



## Health Care

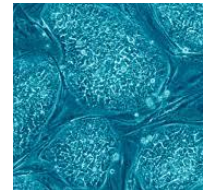
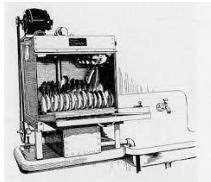
- Cost of OB-GYN services >> Men's Health
- Didn't recognize gender different symptoms for disease
- NIH studies performed on \*all male\* specimens
- Practitioner bias against women and women's health
  - "Pain threshold is lower for women" ???
  - "Women just like to complain" ???





## Too Little Female Representation in Leadership

- Academic leadership (Deans, Provosts, Presidents)
- Technical leaders (Research Awards, Innovation Prizes)
- Business Translation (CEOs, Founders, Patents)



## Factors In Differences of Career Advancement

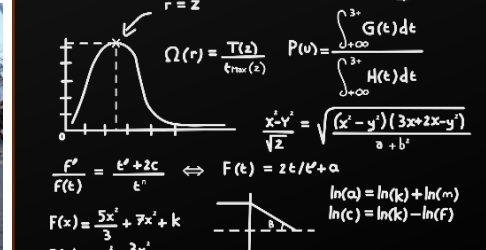
- Imposter Syndrome (Clance & Imes): *Chronic self-doubt and a sense of intellectual fraudulence that override any feelings of success or external proof of competence.*
- Tiara Syndrome (Negotiating Women Inc.): *Women expect to keep doing a job well and for someone to notice and place a tiara on her head. **This. Never. Happens.***
- Primary Bearer of Family Responsibilities
  - Child care (Doctors, Dentists, School HW, Class trips, After School Activities)
  - Elder care (Physical, Emotional, Costly)
  - Household duties, Home Scheduling, Services, Packages, Upkeep

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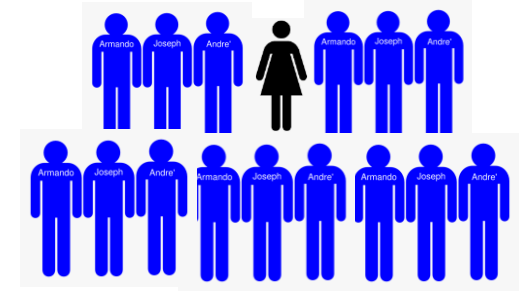
## My Background



- New York City Native (Today's NYC  $\neq$  Old NYC)
- First US citizen, college, engineer, PhD, researcher, faculty.....
- I was good at school so.... \***obviously**\* I should study pre-med
- But since I liked \*Math\* more so.... \***obviously**\* I should become a teacher
- Except I liked this kind of Math.... Everyone was confused

## Mechanical Engineer (Through & Through!)

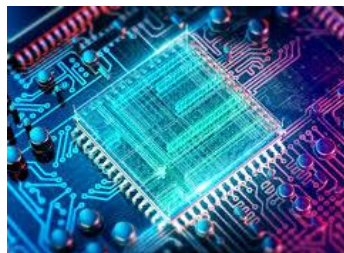
- Love to make things, break things, fix things
- Undergraduate at Cornell University
  - Mechanical and Aerospace (MAE)
  - 8 females in class of 107 students



## Some Harsh Realities

- Assumptions that I was in the program because of gender, race, sports teams (!?).
- Openly stated by Classmates, Teaching Assistants, Staff, Administrators
- So disillusioned .... I left academia after the B.S.

## Industry Experience

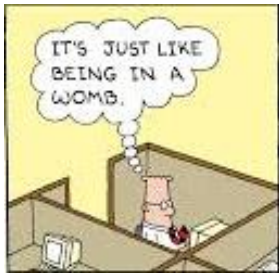


- Intel Corporation (OR, CA)
- General Engineering
- Cleanroom Design
- Production was division(s) goal

- I wanted broader technology applications
- Desired more measureable impact of my skills (Not just stock price)

## Engineering in Industry:

1. Typically 0-2 females in a group of 24-28 engineers
2. I was always treated as a professional by technicians, contractors, engineers,
3. Human Resources training on sexual harassment, professionalism, team building



## Truths from Industry:

1. Recognition and compensation are exclusive to management!!
2. Increased education offers greater project flexibility
3. Need balance between doing what you **want-** and **have-** to do

## Graduate Research

- Awarded a Master's Co-op from Intel to attend MIT
- Biotechnology research via STEM collaborations
- Impacts of educational training on students



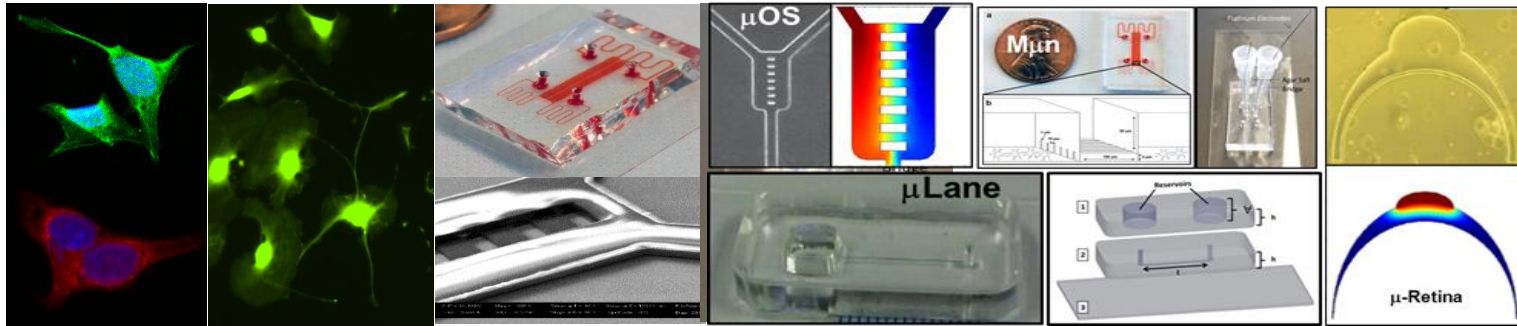
## Surprising Realities

1. Gender harassment by exclusion (aggressive and passive!)
2. Everyone recognized it, no one addressed it (Generational, No Organizational Training)
3. Elite-ism is rampant in established fields (e.g. Biology, Chemical Engineering, Physics)



## Biomedical Engineering: My Academic Home

- Co-founder of BME Department (est. 2002) at City College of New York (CUNY)
- Minority Serving Institution with many Non-Traditional Students (>78%)



- **Microfluidics** create controlled extracellular environments to study cell behavior
- Devices provide a variety of external stimuli including pressure, flow, diffusion, electric fields, mixing and combinations thereof
- Moved my laboratory to **Rutgers University** in 2019 (Research-1 Institution)



RETINAL DEVELOPMENT



RETINAL REGENERATION

***\*\*Rutgers Master of Science in BME accepts non-engineering majors\*\****



## Academic Traps for Women:

### 1. Nearly all dept 'housekeeping' duties fall to women faculty (Nature Blog 5/2017)

- Organizing Student ::Faculty Forums (Town Halls, Feedback, Socials)
- Advising Student Societies (SWE, SHPE, NSBE)
- Student Personal Issues (Advising, Services Navigation)



#### Male Colleague:

- Dept Seminar was his admin; Got dept money and didn't host full day
- Collected # of advisees needing support and put it to the Dean's office
- Provided UG 'experience' to all applicants; Most cut electrical tape

### 2. Women serve on greater numbers of academic committees (Yale 2018, MIT 2002)

- Programmatic (Accreditation, Curriculum, Admissions, Student Probation)
- Many, Many, Many search committees (many outside of BME)



#### Male Colleague:

- Only engaged in high profile committees (Awards, Space)
- Claimed his skill set wouldn't help on any searches outside his area

### 3. Holistically mentor and support students (NEA 2014)

- Motivated graduate student progress; Sent them to conferences
- Invited panelist of student societies/ Speaker at student-organized conferences
- Accepted lectures at community colleges and community events
- Accepted advisees who asked for my help (in addition to my assigned advisees)



#### Male Colleague:

- Set guidelines for graduate student conferences; Threatened termination
- Asked for honorarium for speaking events (No \$ - No Worth)
- Only accepted external invites that would bolster his CV; No internal talks
- Limited advisees to the number assigned. Turned away others.

#### At the End of the Day:

- Teaching awards went based on course evaluations
- Recognition came to those with most \$\$, not most federal funding
- Community engagement was only relevant if televised or in newspaper

**I fell into these traps, but I learned a few things...**

- **Tenure & Promotion:**

- Have confidence... but get yearly feedback and have a backup plan!
- **Don't show fear!** ALL dept decisions are political (100% of the time!)



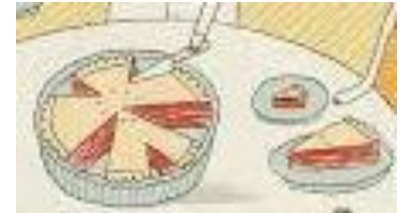
- **Life Issues (e.g. Medical Leave):**

- Teaching load increased to compensate for health coverage
- Be weary because short term solutions become permanent quickly!
- Get list of modified responsibilities **in writing** and their expiration



- **Department Transparency:**

- Distribution of workload and administrative load is NEVER equal
- **All credits ≠ Same.** Voice concerns with faculty and get buy in



- **Organizational Structure:**

- If a group says “We are a Family” ..... **RUN FAR RUN FAST!!**
- There is no greater hierarchy than the family
- Extra work expected (no \$ or recognition) for the “greater good”



## Areas for Collective Improvement

### 1. Women are needed in academic leadership roles

- Understand women's issues; Create mechanisms
- Women in Science (Ad Promotion)
- Women and Negotiation (Podcast)
- Education and NYC Council (Televised)
- Inaugural Gap Funding Initiative saved me!



**Gillian Small**

### 2. Women need recognition for technical prowess

- Self/Nominate for prestigious awards in your field (Inaugural President's Award)
- Get involved in the selection of awards, named lectures, invited seminars (NSF)

### 3. Network within professional societies to keep appraised of opportunities

- Look for high profile activities that pique your interests (Health Disparities, Ethics)
- Consider your best aspects for broader impact (Summer HS Programs, First-Gen College)

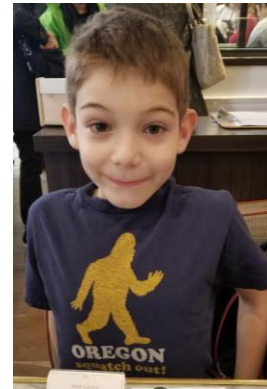


4. Combat mentality that all should '*pay your dues*' or '*stand at the back of the line*'
  - No one should be made to feel undervalued or suffer at work
5. Share experiences to raise collective awareness and create positive change
  - Women's luncheons at national conferences, networking events
  - Peer mentoring groups and professional development workshops
6. Role model for our daughters and teach our sons to value gender parity



Lymah Gbowee,  
Nobel Peace, 2011

*Will you come talk to my class next year  
when YOU win the Nobel in Engineering?*



American Institute for Medical  
and Biological Engineers  
Inductees (AIMBE.ORG)

*Where are all the other engineers? I only  
see the boys. What happened?*

## THANK YOU FOR YOUR ATTENTION!

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## JOURNAL ARTICLE

### **The Matthew Matilda Effect in Science**

Margaret W. Rossiter

*Social Studies of Science*

Vol. 23, No. 2 (May, 1993), pp. 325-341

### **Are Your Work Friendships Only with People Who Look Like You?**

Harvard Business Review 09.9.2019

Andrea S. Kramer and Alton B. Harris

Proc Natl Acad Sci U S A. 2018 Sep 25;115(39):9696-9701.

### **Predicting human behavior toward members of different social groups.**

Jenkins AC, Karashchuk P, Zhu L, Hsu M.

Harvard Business Review

### **A Study Used Sensors to Show That Men and Women Are Treated Differently at Work**

Stephen Turban, Laura Freeman, Ben Waber

10.23.2017

Diff M/F was due not to their behavior but to how they were treated; Gender inequality is due to bias, not differences in behavior

## **What Most People Get Wrong About Men and Women**

Catherine H. Tinsley Robin J. Ely

Harvard Business Review May–June 2018 Issue

Multiple studies show, for example, that women are less embedded in networks that offer opportunities to gather vital information and garner support. When people lack access to useful contacts and information, they face a disadvantage in negotiations. They may not know what is on the table, what is within the realm of possibility, or even that a chance to strike a deal exists. When operating under such conditions, women are more likely to conform to the gender stereotype that **“women don’t ask.”**

