

# Is Science a Meritocracy? Issues of Diversity & Equity

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## Professional Development Program



*Preparing scientists and engineers to be leaders in effective and inclusive education*

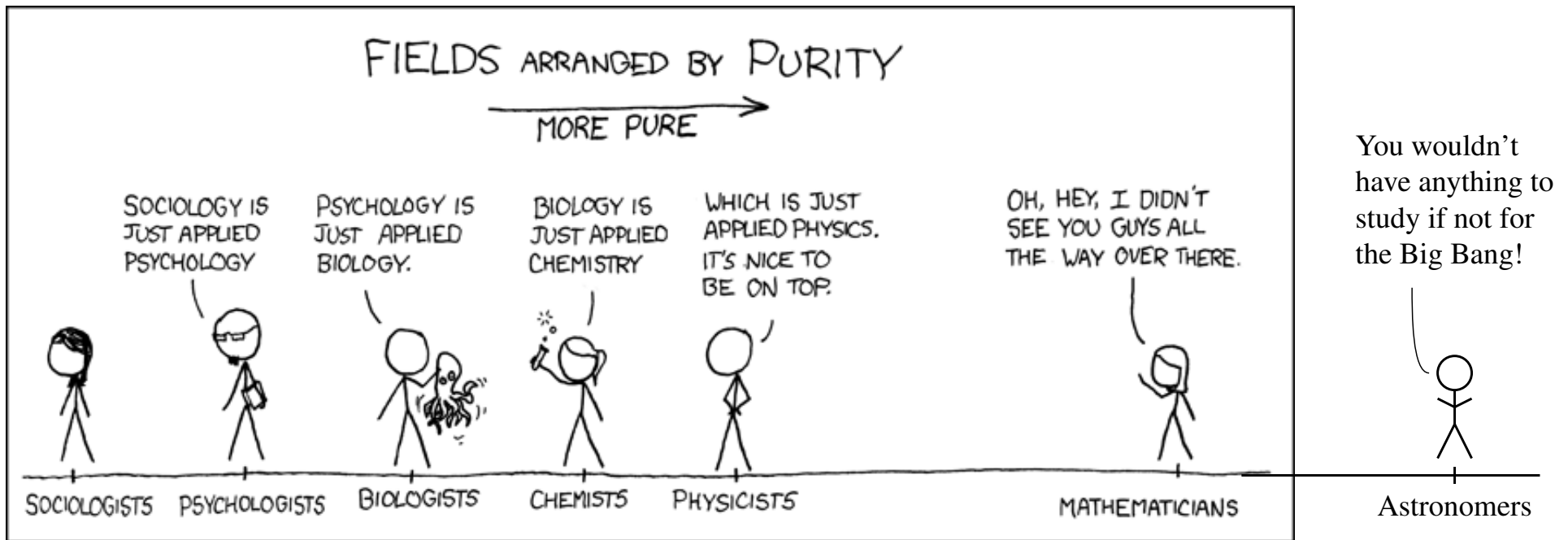
# What This Talk *IS*

- Simplified
- Some evidence for *inequity* & *exclusion* in STEM
- Arguments *for* diversity, equity & inclusion
- 3 “diseases” adversely affecting success
- What you can do for yourself

## What This Talk Is *Not*

- Comprehensive

← Complexity  
← Error Propagation



(Adapted from <https://xkcd.com/435/>)

National Science Board *Science & Engineering Indicators 2014–2020*

# DEMOGRAPHICS

# Canonical **Underrepresented** Groups in S&E

- Males: 49.2%; **Females: 50.8%**
- **Hispanic or Latino: 16.3%**; **Not: 83.7%**  
18.3% 81.7%
- **White: 72.4%**  
72.2%
- **Black or African American: 12.6%**  
12.7%
- **American Indian and Alaska Native: 0.9%**
- **Asian: 4.8%**  
5.6%
- **Native Hawaiian and Other Pacific Islander: 0.2%**
- **Some other Race: 6.2%**  
5.0%
- **Two or More Races: 2.9%**  
3.4%

(<http://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf>; [c2010br-02.pdf](http://www.census.gov/prod/cen2010/briefs/c2010br-02.pdf))  
(<https://data.census.gov/cedsci/table?q=United%20States&tid=ACSDP1Y2018.DP05&hidePreview=true>)

# Leaky Science Pipeline: Logic

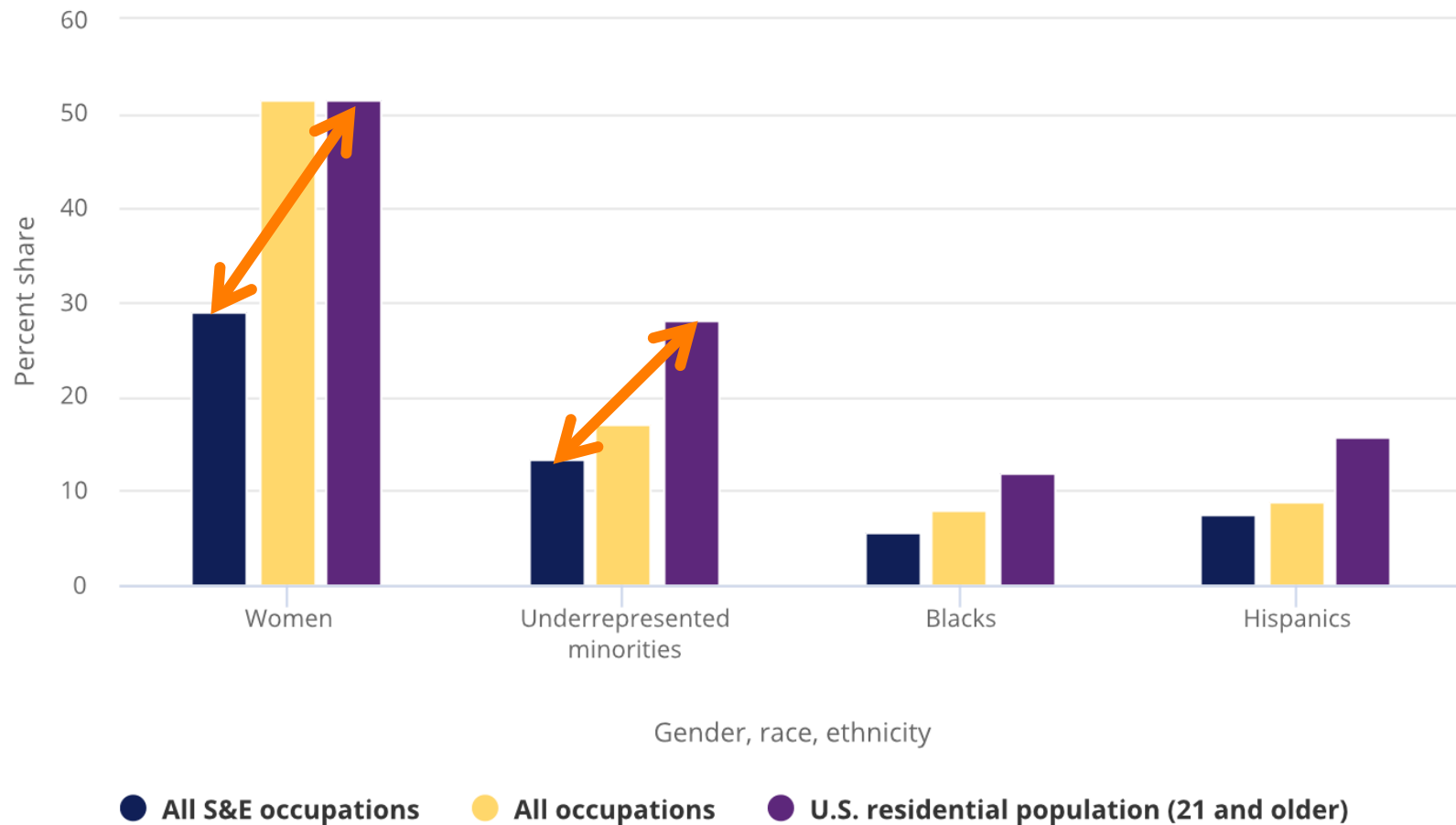
- In the science pipeline (from high school to undergrad to grad to workforce)...  
<http://www.nsf.gov/statistics/seind14/index.cfm/etc/figures.htm>
- Women and URMs are smaller and smaller fractions *compared to national representation*.

51.5% and 28.1% of population → Women are 29% and  
→ URMIs are 13% of S&E Workers

National Science Board | Science & Engineering Indicators | NSB-2020-1

FIGURE 6

Women, underrepresented minorities, blacks, and Hispanics in S&E and all occupations: 2017



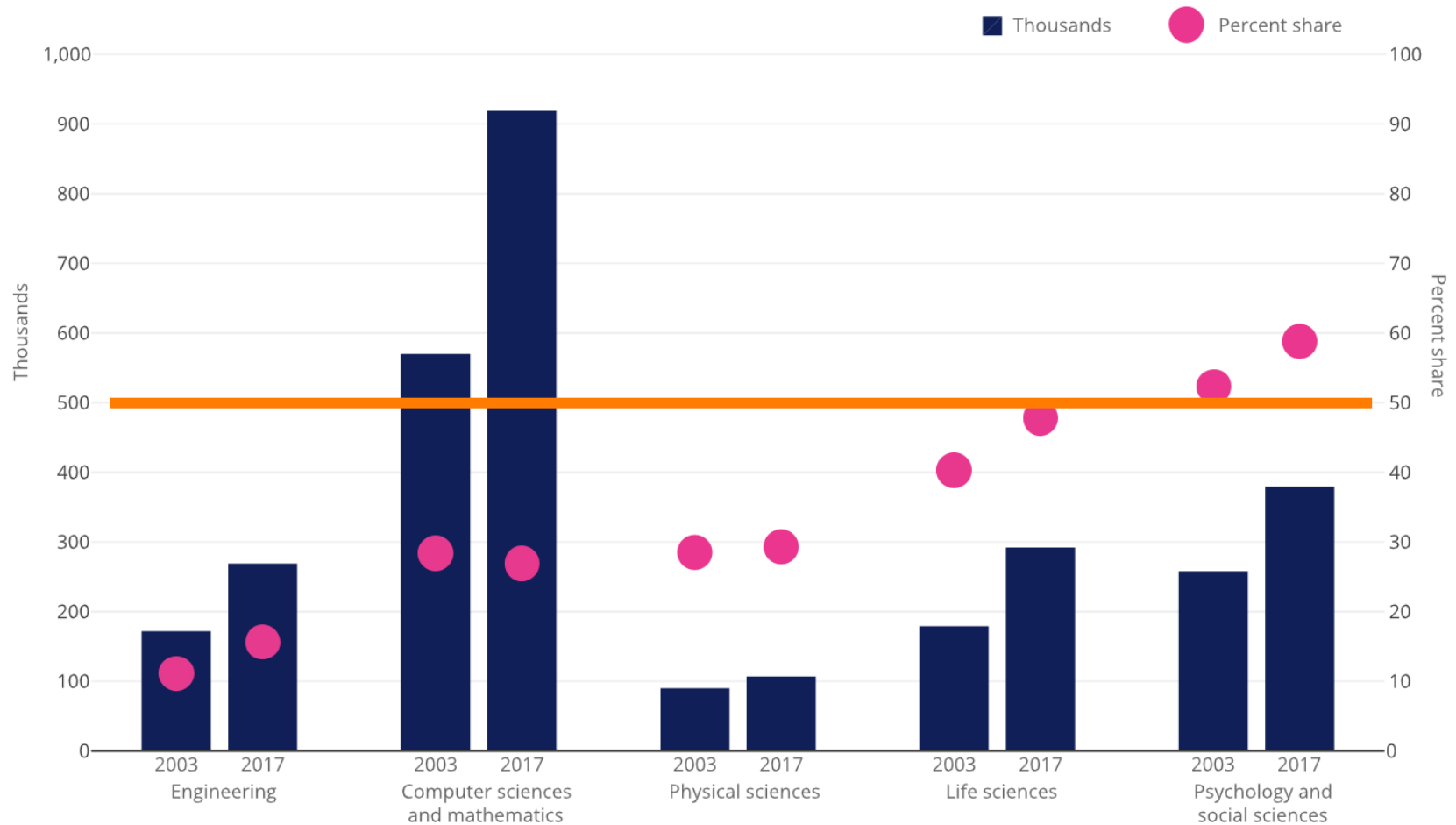


# Female Percent Depends on Field

National Science Board | Science & Engineering Indicators | NSB-2020-1

FIGURE 7

Women in S&E occupations, by broad occupational category: 2003 and 2017

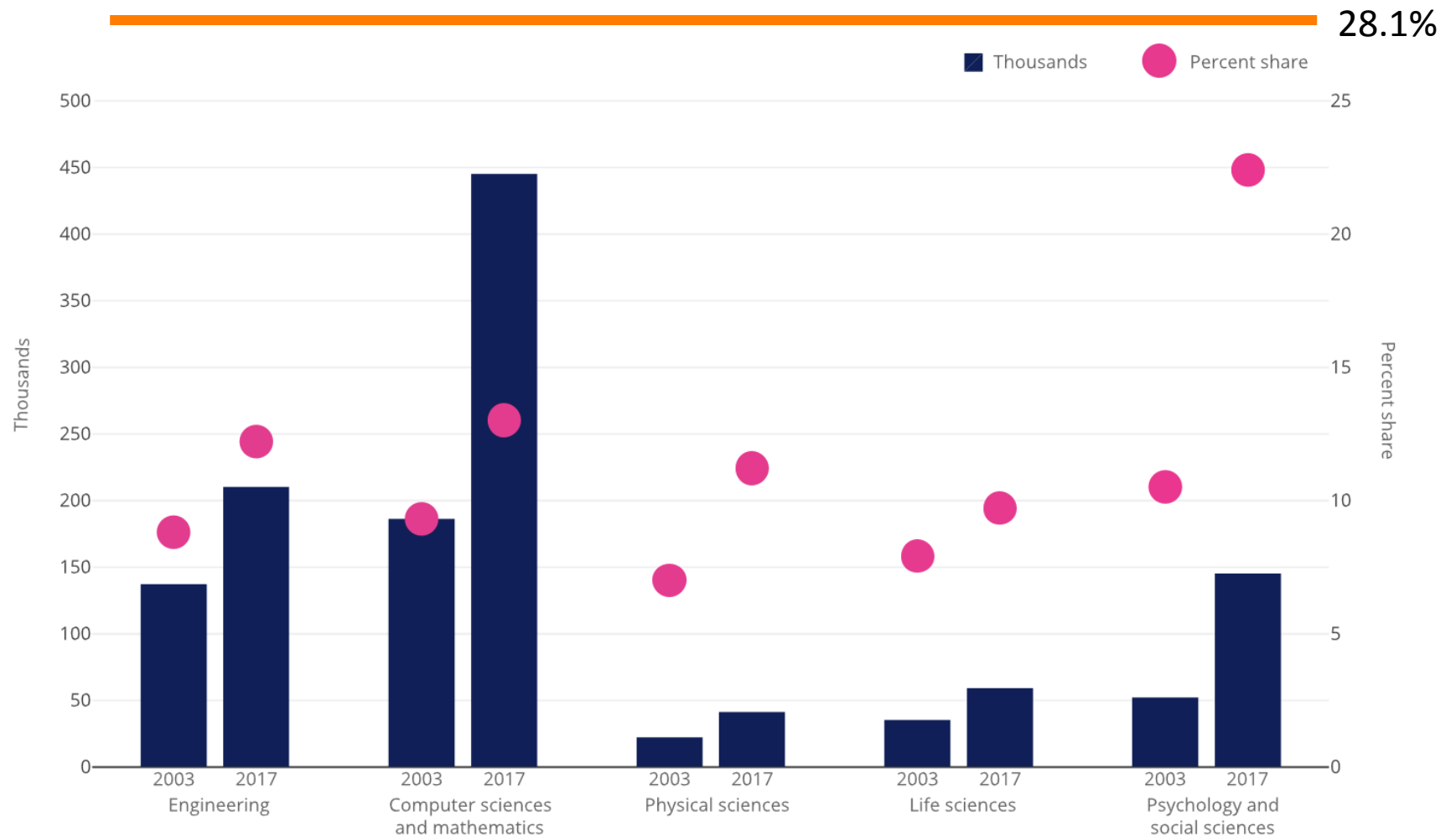


# URM Fraction Depends on Field

National Science Board | Science & Engineering Indicators | NSB-2020-1

FIGURE 8

Underrepresented minorities in S&E occupations, by broad occupational category: 2003 and 2017



# Leaky Science Pipeline: Logic

- In the science pipeline (from high school to undergrad to grad to workforce)...  
<http://www.nsf.gov/statistics/seind14/index.cfm/etc/figures.htm>
- Women and URMs are smaller and smaller fractions *compared to national representation*.
- Assuming (though there is evidence) ability and initial interest are not genetic...
- We conclude systemic issues induce women and URMs to “leak out”

# Why Should STEM Be More Diverse?

- Fairness:
  - “... it is simply unjust for a profession to organize itself, intentionally or unintentionally, in such a way as to exclude a significant portion of the population.”
- Talent pool:
  - “... if we are not tapping into the entire talent pool that is available to make a contribution to science, the enterprise will by definition be under-performing its potential.”

Princeton President Shirley Tilghman

[Response](#) to Harvard former-president Lawrence Summer’s words in 2005

# Not Just Talent Pool *Answering* Questions

The questions *asked* will be more diverse.

- Medical research used to ignore females in clinical research

– Louann Brizendine 2007, *The Female Brain*

# Why Should STEM Be a Meritocracy?

- Everyone should have a chance to set the record straight
  - Grace Hopper (c. '50s–'60s)
  - Neil deGrasse Tyson (c. now)
  - Just read or watch *Hidden Figures* (c. '60s)
  - And so many [more](#) (starting with [Hypatia](#), c. 400 AD)
- Grant process attempts to be meritocratic
  - [NASA moves to “dual-anonymous peer review”](#)

Stereotype Threat, Imposter Syndrome, Implicit Bias

# **“DISEASES” ADVERSELY AFFECTING DIVERSITY & EQUITY IN STEM**

# What is Stereotype Threat?

“...being at risk of confirming, as self-characteristic, a **negative** stereotype about **one's group** (Steele & Aronson 1995). [...] Research has shown that stereotype threat can harm the academic performance of any individual for whom the situation invokes a stereotype-based **expectation** of poor performance.”

[\(http://reducingstereotypethreat.org/\)](http://reducingstereotypethreat.org/)



# What is Imposter Syndrome?

- Feelings of not deserving to be in the position one is in
- Feelings of being afraid that employers, instructors, peers, etc. will come to realize one is not as capable as may seem
- AKA imposterism

Lucas Laursen, *Science Careers*, 15 Feb 2008 ([10.1126/science.caredit.a0800025](https://doi.org/10.1126/science.caredit.a0800025))

Kathy Cooksey, AAS CSMA SPECTRUM, January 2014

([http://csma.aas.org/spectrum\\_files/spectrum\\_Jan14.pdf](http://csma.aas.org/spectrum_files/spectrum_Jan14.pdf))

# Negative Effects of Stereotype Threat and Imposter Syndrome

- Negative stress
  - Overworking, unhappiness, anxiety...
- Self-sabotage
  - Underworking, under-aspiring
- Unconscious underperforming
  - (primarily induced by stereotype threat)

# What is Implicit Bias?

- “positive and negative evaluations that occur outside of our conscious awareness and control.”
- AKA unconscious bias

(<https://implicit.harvard.edu/implicit/iatdetails.html>)

# Negative Effects of Implicit Bias

- Resumes with female or “black” names land less jobs
  - <http://abcnews.go.com/blogs/business/2013/07/man-named-kim-adds-mr-to-resume-lands-job/>
  - <http://www.cbsnews.com/news/black-names-a-resume-burden/>
- Recommendation letters with softer language
  - <http://das.sagepub.com/content/14/2/191.abstract>

# Implicit (or Explicit) Bias in Hiring

Women in Science

## Elite Male Faculty Employ Fewer Women

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By Vijaysree Venkatraman

June 30, 2014

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*Consequently, women are underrepresented as postdocs in these important feeder labs—surely an explanation for the paucity of women faculty at these top institutions.*

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Vijaysree Venkatraman, *Science Careers*, 30 Jun 2014 ([10.1126/science.caredit.a1400167](http://dx.doi.org/10.1126/science.caredit.a1400167))

Implicit bias in allotting resources

(<http://web.mit.edu/fnl/women/women.html#The Study>)

# Implicit Bias in Promotion



Women in Science

## Equally productive women are tenured less

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By Beryl Lieff Benderly  
August 18, 2014

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*“It’s not that we need to make women more productive. It’s that we need to change the processes.” —Kate Weisshaar*

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Beryl Lieff Benderly, *Science Careers*, 18 Aug 2014 ([10.1126/science.caredit.a1400212](https://doi.org/10.1126/science.caredit.a1400212))

More negative course evaluations ([Inside Higher Ed, 11 Jan 2016](#))

# Negative Effects of Implicit Bias

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  - <http://www.cbsnews.com/news/black-names-a-resume-burden/>
- Recommendation letters with softer language
  - <http://das.sagepub.com/content/14/2/191.abstract>
- Resumes with stereotypical activities viewed poorly
  - [http://www.nytimes.com/2013/06/09/opinion/sunday/coontz-richer-childless-women-are-making-the-gains.html?\\_r=0](http://www.nytimes.com/2013/06/09/opinion/sunday/coontz-richer-childless-women-are-making-the-gains.html?_r=0)
- Situation interpreted to confirm implicit bias
  - Sharon Traweek 1992, *Beamtimes and Lifetimes: The World of High Energy Physicists*

Stereotype Threat, Imposter Syndrome, Implicit Bias

**SO WHAT HELPS?**



# Combating Stereotype Threat

- Knowing is half the battle
- Community
- Little things: mindfulness of decorations
  - [Cheryan, Plaut, Davies, & Steele](#) (2009, Journal of Personality and Social Psychology)
- Not asking for demographics before standardized tests!

R Dyer-Barr 2013, [“What Works In STEM Intervention Programs \(Sips\) For URM Undergraduates: Perspectives from SIP Administrators”](#)

# Stereotype Busting

## Girls Love Blue Too

Fun clothing, toys, books & accessories that crush gender stereotypes and let kids express who they are!



Biana Betz, *Scientific American*, 11 Sep 2012 ([the-trouble-with-barbie-science](#))      Beryl Lief Benderly, *Science Careers*, 17 Sep 2013 ([10.1126/science.caredit.a1300200](#))

# Combating Imposter Syndrome I

- Growth mindset (as opposed to fixed)
  - Carol Dweck, *Scientific American Mind*, Dec 2007/Jan 2008
    - Also see <https://slatestarcodex.com/2015/04/08/no-clarity-around-growth-mindset-yet/>
- Community (trusted external metric)
- “Self efficacy: belief in capacity to succeed (Bandura ‘77)” –Marta Stoeckel
- Be the worst on the team (and be fine with that)
  - Being surrounded by and working with talented people improves your ability
  - Attempting to be the worst stops you from selling yourself short
  - Chad Fowler 2005, *My Job Went to India (And All I got Was This Lousy Book)*

# Combating Imposter Syndrome II

- Calibrate:
  - the more you know, the more you know there is to know, so the less you *think* you know
  - $$\sum_{e=\text{everyone} \neq \text{you}} N_{\text{success},e} \gg \sum_{u=\text{you}} N_{\text{success},u}$$
  - Fisher Files, <http://scripts.mit.edu/~podcast/wordpress/about/>, “Imposter!”, ep. 1, seq. 2
- Accept “zone of proximal development” is uncomfortable... that’s learning
  - Vygotsky 1978, *Mind in Society: The Development of Higher Psychological Processes*
- In research, it’s your job not to know
- And... suffering from Imposter Syndrome beats suffering from Dunning-Kruger Effect...

Counterpoint to Imposter Syndrome:

## Dunning-Kruger Effect

“When people **are incompetent** in the strategies they adopt to achieve success and satisfaction, they suffer a dual burden: Not only do they reach erroneous conclusions and make unfortunate choices, but their **incompetence robs them of the ability to realize it.**”

Errol Morris, *NYT*, 20 Jun 2010

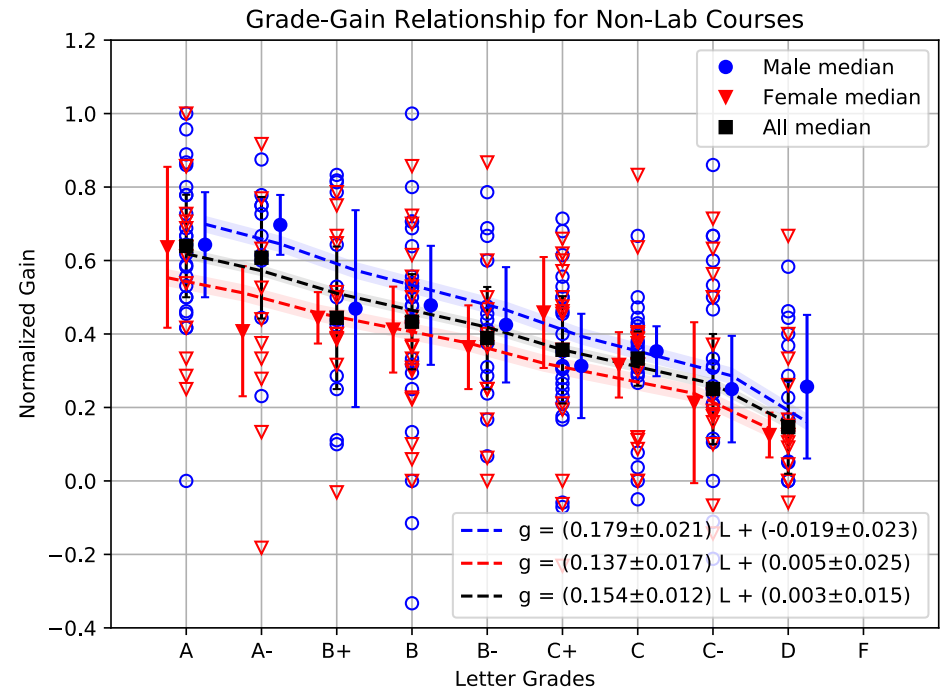
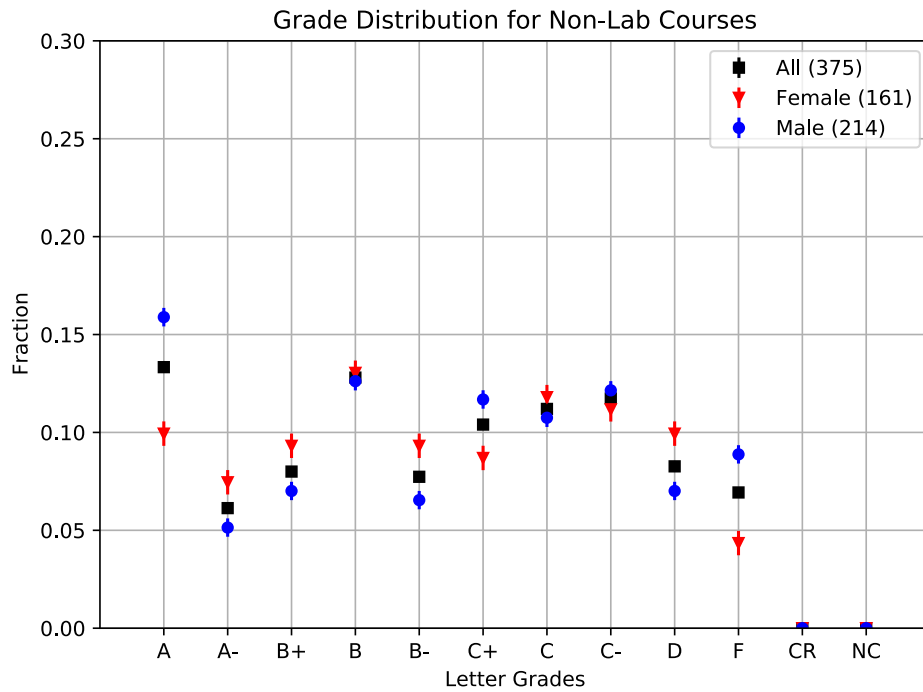
(<http://opinionator.blogs.nytimes.com/2010/6/20/the-anosognosics-dilemma-1/>)

# Combating Implicit Bias

- Everyone being aware
- Letter writers being aware
  - Be comfortable discussing
- Dual-anonymous peer review (i.e., double blind)
  - NASA SMD: <https://science.nasa.gov/researchers/dual-anonymous-peer-review>
- Initials on resumes, CVs, applications, proposals...

# Awareness with Evidence

$$\text{gain} = \frac{\text{Post \%} - \text{Pre \%}}{100\% - \text{Pre \%}}$$





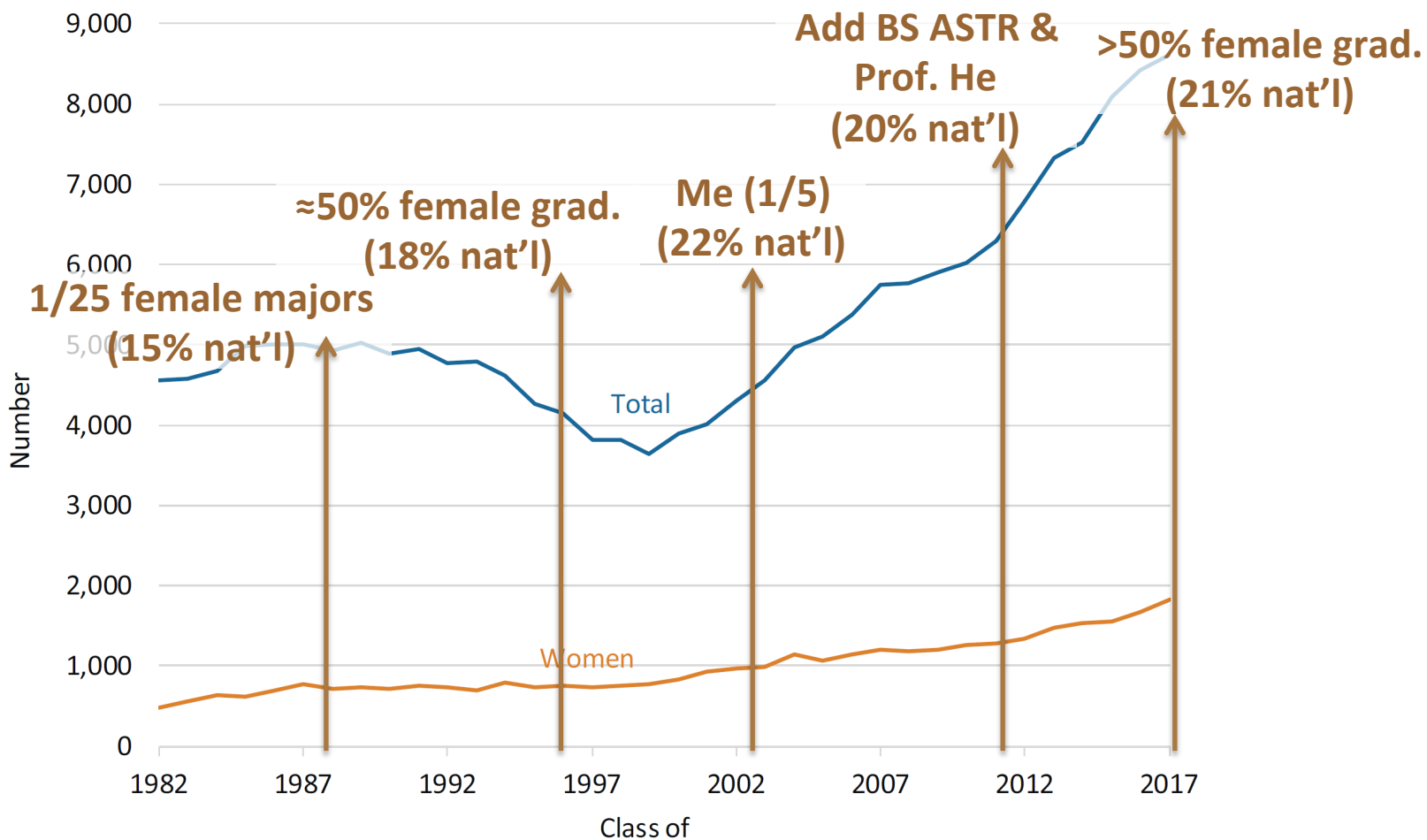
Department of Physics & Astronomy

# IN CONTEXT



# Timeline in Context

Number of Bachelor's Degrees Earned in Physics, Classes 1982 through 2017



Source: AIP Statistical Research Center, Enrollments and Degrees Survey.

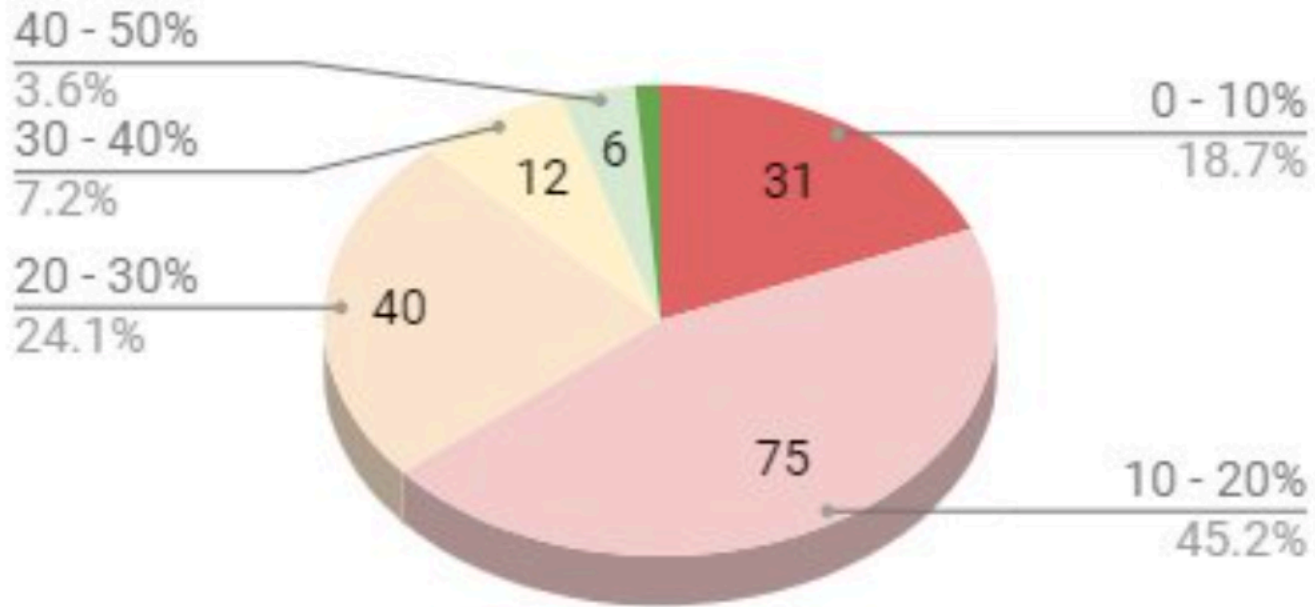
# When is it bias/discrimination?



**James Ghostochon** @astrocrash · Jan 4, 2019

Here is the breakdown of fraction of women faculty that I surveyed. Note that most programs fall very short of parity. Of the 165 programs I surveyed, the departments would have to replace 1,482 men with women to achieve 50/50 parity (!!!)

## Number of departments with each fraction



3

8

15



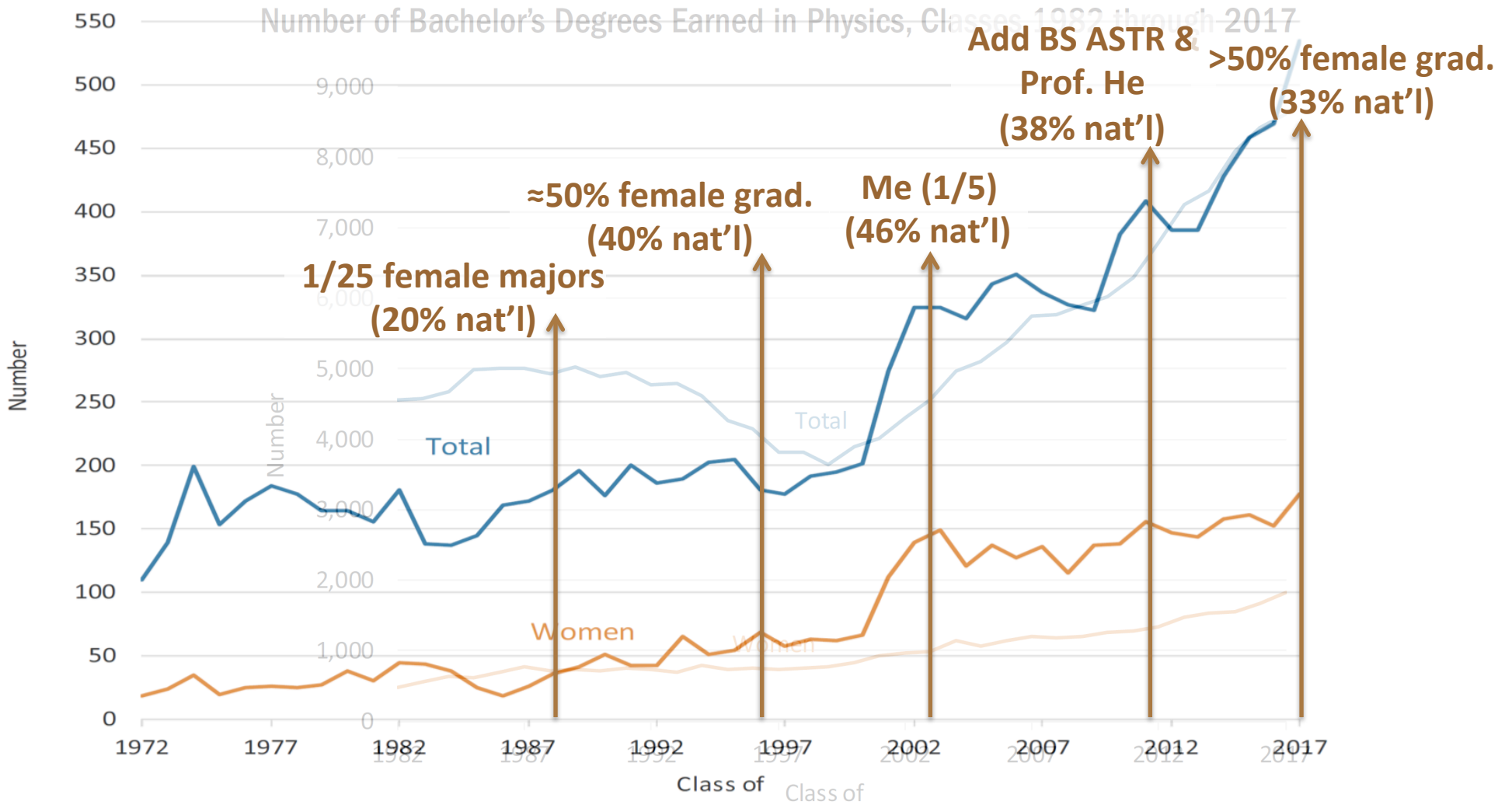
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Phy

By Jim Aus  
July 29, 20

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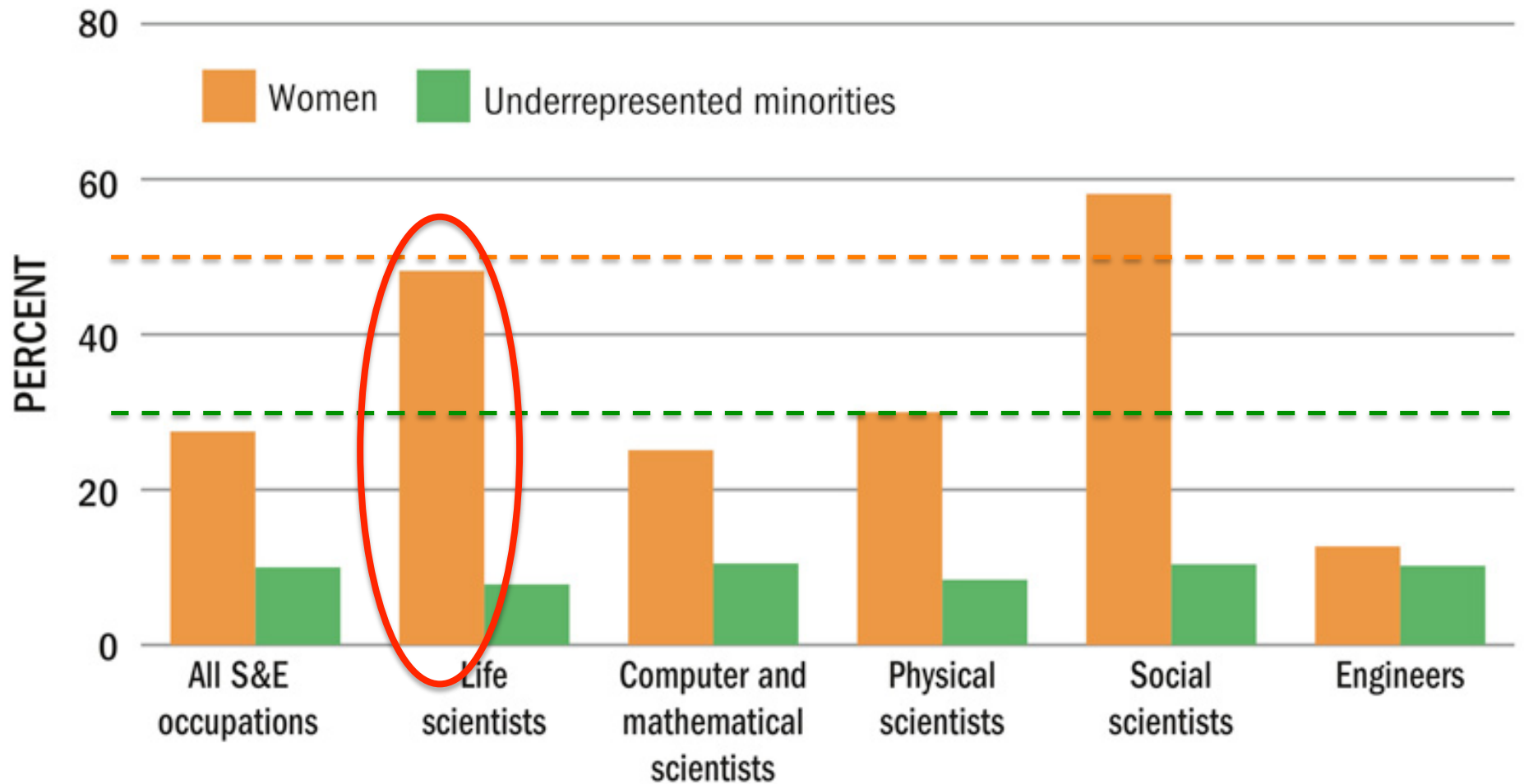
# Number of Bachelor's Degrees Earned in Astronomy, Classes of 1972 through 2017



Source: AIP Statistical Research Center, Enrollments and Degrees Survey.

Source: AIP Statistical Research Center, Enrollments and Degrees Survey.

# Female Percent depends on Field



# Women Interested in Community



Women in Science

## Women Benefit from Project-Based Approach to Learning STEM

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By Beryl Lieff Benderly  
December 04, 2013

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Beryl Lieff Benderly, *Science Careers*, 4 Dec 2013 ([10.1126/science.caredit.a1300265](https://doi.org/10.1126/science.caredit.a1300265))

Margolis, Fisher, & Miller 1999,  
“The Anatomy of Interest: Women in Undergraduate Computer Science”

Brunner 1997, “Opening Technology to Girls,” *Electronic Learning*, February.

# Many Demographics Interested in Community



Taken for Granted

## Choosing Between Science and Caring?

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By Beryl Lieff Benderly  
December 03, 2010

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*Diekman's data suggest that many college students on the verge of setting a career direction see STEM careers as "inhibiting communal goals," the article states.*

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Beryl Lieff Benderly, *Science Careers*, 3 Dec 2010 ([10.1126/science.caredit.a1000117](https://doi.org/10.1126/science.caredit.a1000117))



# UH Hilo Well Situated to Be Diverse S&E Community

## THE CHRONICLE OF HIGHER EDUCATION Almanac of Higher Education 2014

HOME PROFESSION STUDENTS DIVERSITY FINANCE TECHNOLOGY INTERNATIONAL STATES

August 18, 2014

### Most-Diverse Campuses, Fall 2012

Among states, California had by far the highest number of most-diverse campuses appearing on this list: 36. It was followed by Hawaii, with 14, and New York, with 10. The diversity index measures, on a scale of 0 to 100, the probability that any two students at an institution are from different racial or ethnic groups.

4-year public												
Rank	Institution	Total enrollment	Nonresident alien	American Indian/Alaska Native	Asian	African-American	Hispanic	Hawaiian/Pacific Islander	White	2 or more races	Race unknown	Diversity index
1.	U. of Hawaii at Hilo	4,157	4.4%	0.4%	22.1%	1.2%	9.1%	11.3%	23.4%	28.2%	0.5%	87.32

Am. Indian/ Alaska Native	Asian	Black	Hispanic/Latino	Hawaiian/ Pacific Isl.	White	Two or more races	Unknown
0.4%	22.1%	1.2%	9.1%	11.3%	23.4%	28.2%	0.5%
0.9%	4.8%	12.6%	16.3%	0.2%	72.4%	2.9%	6.2%



# Got Astronomy?

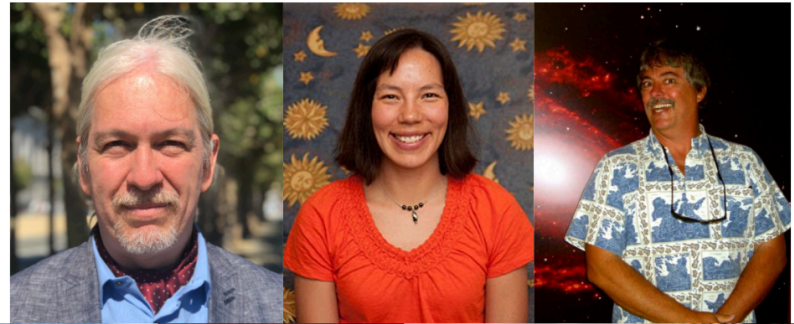
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[astro.uhh.hawaii.edu](http://astro.uhh.hawaii.edu)



(CNHS Awards 2019)



(CAS Awards 2018)



# Issues Not Even Addressed

- Economic background
  - e.g., [“What’s it like to be poor at an ivy league school?”](#), Foster, *Boston Globe*, 9 Apr 2015
- Age
  - e.g., [“Tech industry job ads: older workers need not apply”](#), Kopytoff, *Fortune*, 19 Jun 2014
- Disabilities
  - e.g., [“Biologist with a vision”](#), McKarney, *Science Magazine*, 6 Jun 2003
- LBGQTQI
  - e.g., [“Gravitational wave research succeeds by being herself”](#), Venkatraman, *Science Magazine*, 1 Jun 2012
- Affirmative action
  - e.g., [Fisher vs University of Texas](#)
- ...

# Take-Home Messages

- Decide yourself whether science should be a meritocracy
  - And if so, is it?
  - If it should be and isn't, what can you do?
    - Women & URMs—by definition—need overrepresented pluralities/minorities' support
- Knowing is half the battle
  - Stereotype threat, imposter syndrome, implicit bias
- Possible recourses:
  - Growth mindset, diverse applicant pools, community

# Resources

- National Science Board Science & Engineering Indicators: <https://nces.nsf.gov/indicators>
- <http://reducingstereotypethreat.org/>
- <https://implicit.harvard.edu/implicit/iatdetails.html>
- Center for Research on Gender in STEMM [https://crg\\_stemm.ucsd.edu/](https://crg_stemm.ucsd.edu/)
- Just Google terms; there's a lot of literature

**Big mahalo!**

Questions?