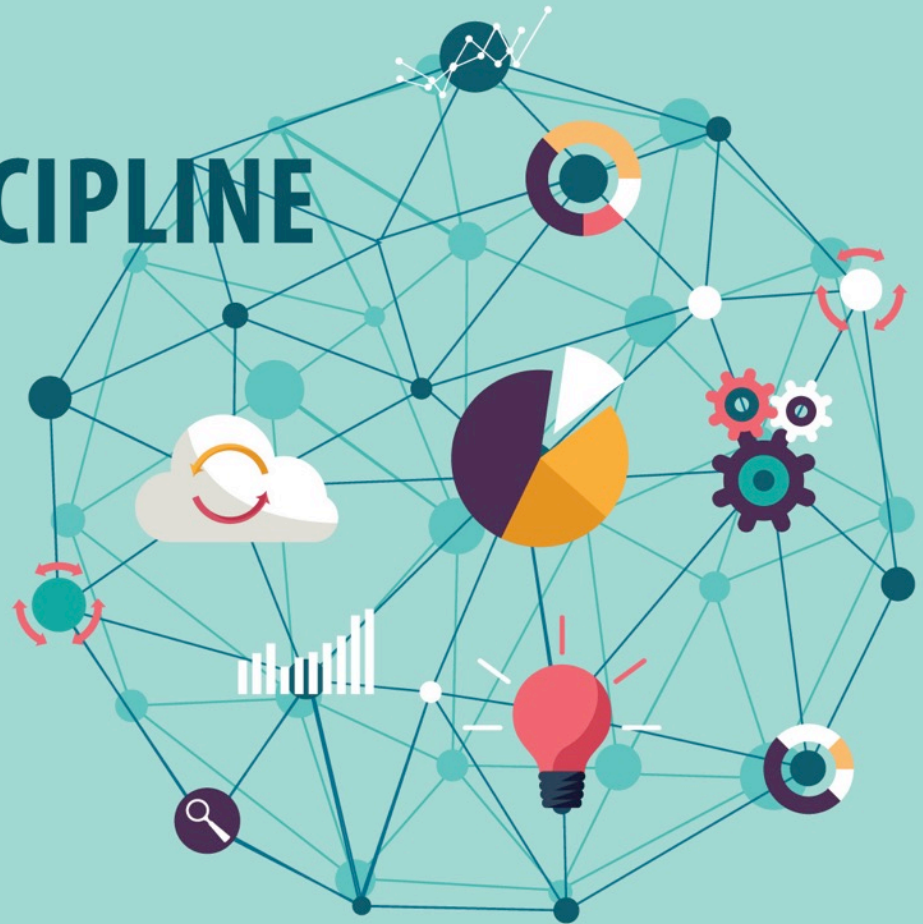Envisioning the
DATA SCIENCE DISCIPLINE
The Undergraduate Perspective

**Webinar Series
Fall 2017**

The National Academies of | SCIENCES ENGINEERING MEDICINE

nas.edu/EnvisioningDS

Envisioning the
DATA SCIENCE DISCIPLINE
The Undergraduate Perspective

9/12/17 – Building Data Acumen
(recording posted)

9/19/17 – Incorporating Real-World Applications *(recording posted)*

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10/10/17 – Inter-Departmental Collaboration and Institutional Organization *(recording posted)*

10/17/17 – Ethics *(recording posted)*

10/24/17 – Assessment and Evaluation for Data Science Programs *(recording posted)*

11/7/17 – Diversity, Inclusion, and Increasing Participation

11/14/17 – Two-Year Colleges and Institutional Partnerships

Provide input, download the interim report, and learn more about the study at www.nas.edu/EnvisioningDS

Envisioning the
DATA SCIENCE DISCIPLINE
The Undergraduate Perspective

Diversity, Inclusion, and Increasing Participation

Allison Master, University of Washington
Research Scientist
Institute for Learning and Brain Sciences

Talithia Williams, Harvey Mudd College
Associate Dean for Research and Experiential Learning
Associate Professor of Mathematics

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The INGenIOus Project (2014)

- To increase diversity within STEM we must boost awareness and promote understanding of problematic unresolved issues such as implicit bias, cultural stereotypes, and a narrow spectrum of role models (Hill, Corbett, & Rose, 2010; National Academy of Engineering, 2008).

- Development and dissemination of successful strategies for increasing diversity should occur at all levels of the mathematical sciences pipeline, from K–12 through graduate study https://www.maa.org/programs/faculty-and-departments/ingenious.

Without inclusion, diversity initiatives may not be enough

Focus on minority experiences in STEM, not just numbers

By **Chandler Puritty,**[1][*] **Lynette R. Strickland,**[2][*] **Eanas Alia,**[3] **Benjamin Blonder,**[4] **Emily Klein,**[5] **Michel T. Kohl,**[6] **Earyn McGee,**[7] **Maclovia Quintana,**[8] **Robyn E. Ridley,**[1] **Beth Tellman,**[9] **Leah R. Gerber**[9]

Diversity among scientists can foster better science (*1, 2*), yet engaging and retaining a diversity of students and researchers in science has been difficult (*3*). Actions that promote di-

Why is progress so limited (*6, 7*)? We see a widespread and underacknowledged disconnect between initiatives aimed at increasing diversity in academic and professional institutions and the experience of URM students (including many of us authors) (*6, 7*). We argue that failure to grasp foundations of this disconnect is the crux of why diversity initiatives fail to reach the students that they were made to recruit. We believe that addressing this will resonate with other individuals and

Science (9/15/2017, 357:6356)

scientific community. In each case, these groups bring valued views and beliefs that will better equip the scientific community to meet future challenges. We must all continue to demand institutional support, resources, and programs for recruiting and retaining URM students into degree programs—but

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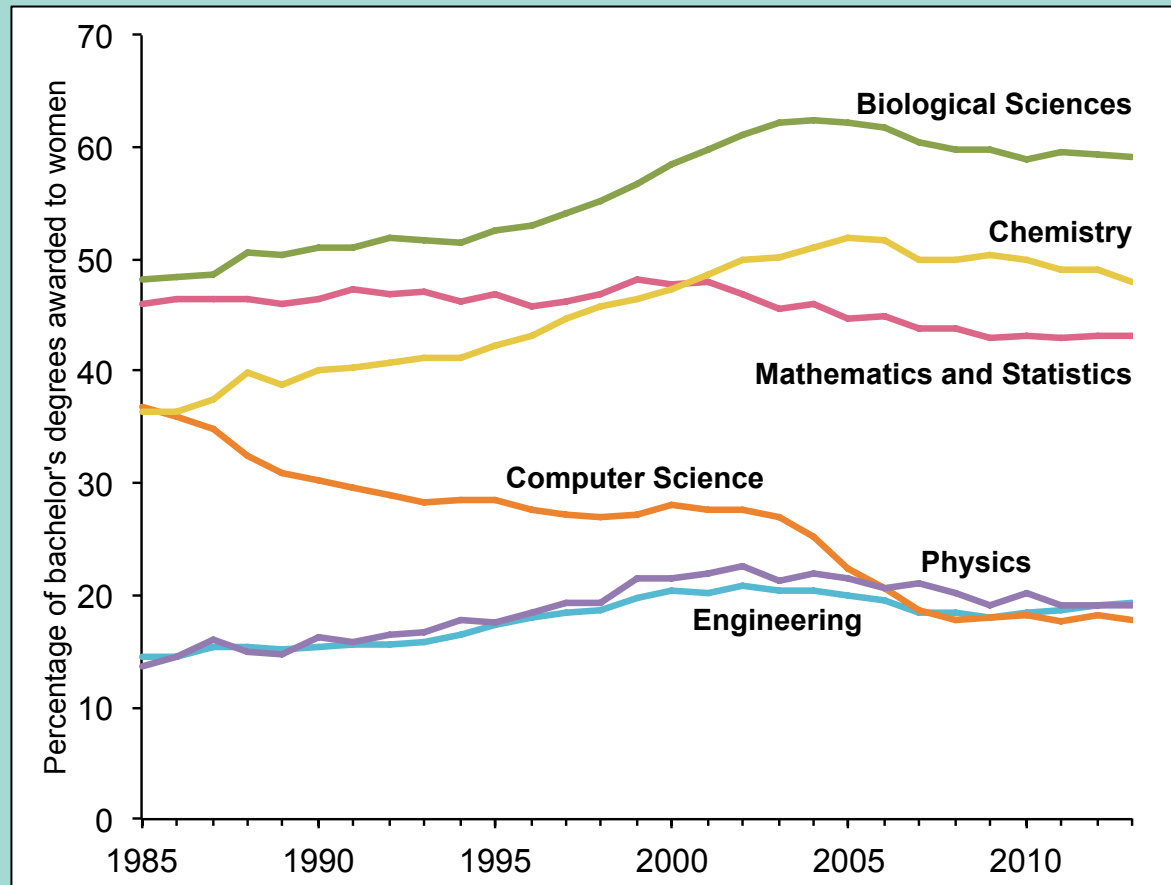## The Undergraduate Perspective

Diversity, Inclusion, and Increasing Participation

Allison Master, University of Washington
Research Scientist
Institute for Learning and Brain Sciences

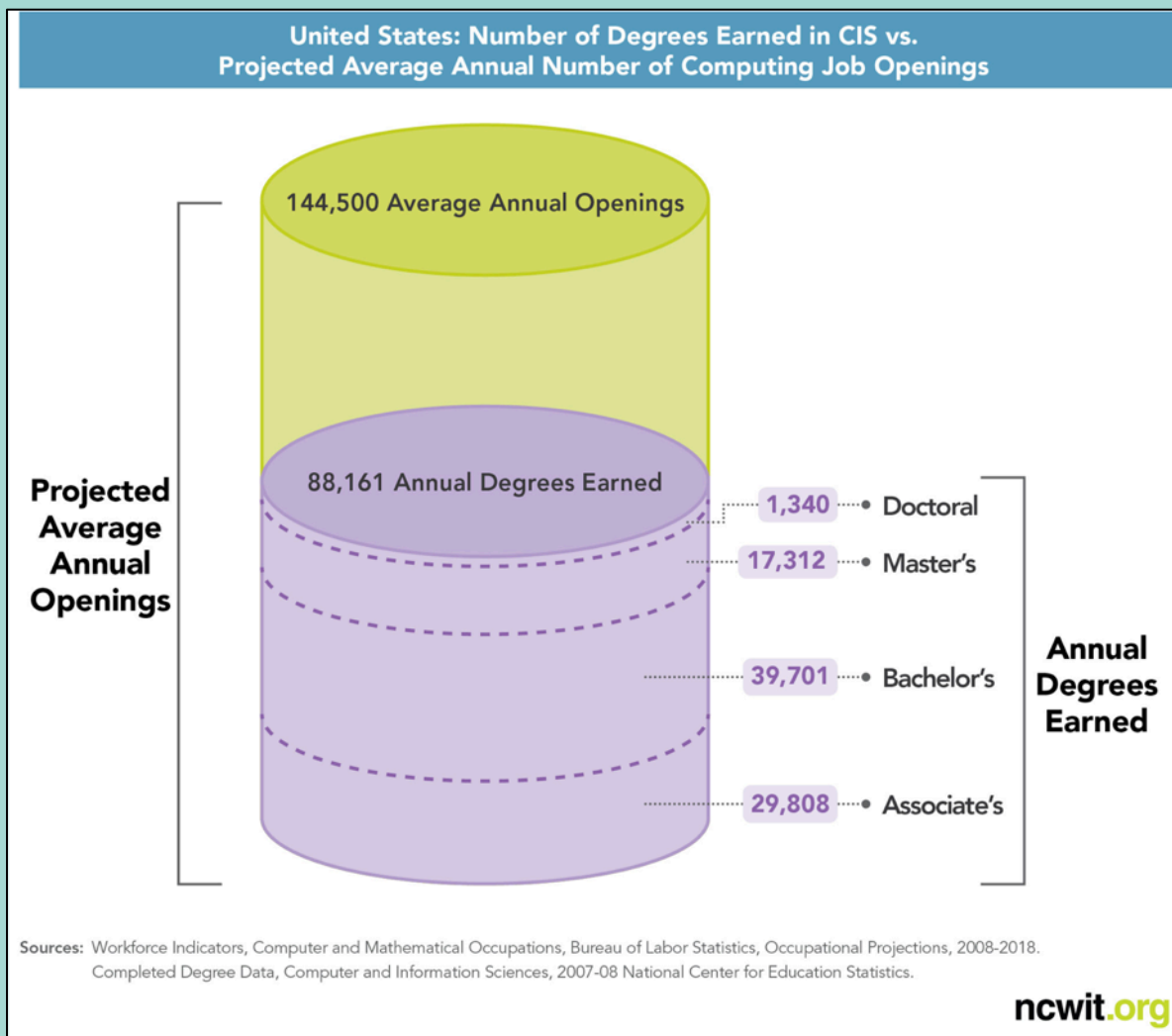Diversity, inclusion, and increasing participation in data science

Diversity in science, technology, engineering, and math (STEM) fields

Percentage of bachelor's degrees awarded to women in STEM fields from 1985–2013. Adapted from: Cheryan, Ziegler, Montoya, & Jiang, 2017, using data from the National Science Foundation, https://webcaspar.nsf.gov

Why is lack of diversity a problem?

United States: Number of Degrees Earned in CIS vs. Projected Average Annual Number of Computing Job Openings

144,500 Average Annual Openings

88,161 Annual Degrees Earned

Projected Average Annual Openings

Annual Degrees Earned

1,340 • Doctoral
17,312 • Master's
39,701 • Bachelor's
29,808 • Associate's

Sources: Workforce Indicators, Computer and Mathematical Occupations, Bureau of Labor Statistics, Occupational Projections, 2008-2018. Completed Degree Data, Computer and Information Sciences, 2007-08 National Center for Education Statistics.

ncwit.org

Provide input and learn more about the study at www.nas.edu/EnvisioningDS

Causes of underrepresentation

- Stereotypes about **who belongs**
- Stereotypes about **who has ability**
- Stereotypes that fields **do not offer communal opportunities**

- These beliefs make women and other minorities feel that **they do not belong**

Tips for Data Science Programs

Broaden beliefs about who belongs

Challenge beliefs about fixed abilities

Show that data science can make a difference

Resources

- NCWIT.org: classroom materials aligned with evidence-based practices
- Changetheequation.org: data about representation
- Csforall.org: connects educators, content providers, and researchers

References:

- Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: Increasing girls' interest in computer science and engineering by diversifying stereotypes. *Frontiers in Psychology, 6:*49.
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- Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology, 102,* 700-717.
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- Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology, 108,* 424-437.
- Master, A., Cheryan, S., Moscatelli, A., & Meltzoff, A. N. (2017). Programming experience promotes higher STEM motivation among first-grade girls. *Journal of Experimental Child Psychology, 160*, 92-106.
- Master, A., & Meltzoff, A. N. (2016). Building bridges between psychological science and education: Cultural stereotypes, STEM, and equity. *Prospects, 46*, 215-234.

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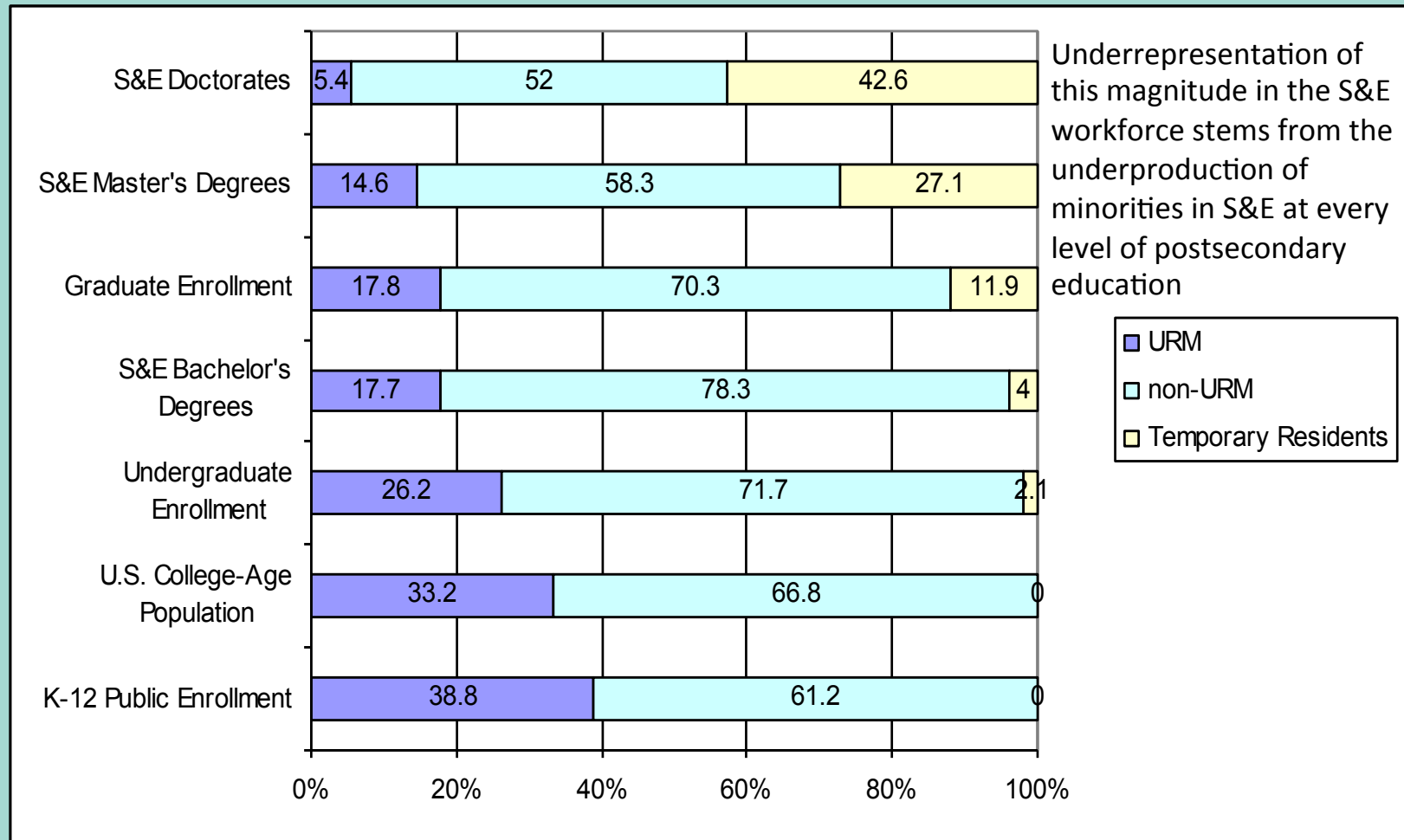
Diversity, Inclusion, and Increasing Participation

Diversity and Inclusion in Data Science: Using Data-Informed Decisions to Drive Student Success

Talithia Williams, Harvey Mudd College
Associate Dean for Research and Experiential Learning
Associate Professor of Mathematics

Enrollment and Degrees, by Educational Level and Race/Ethnicity/Citizenship, 2007
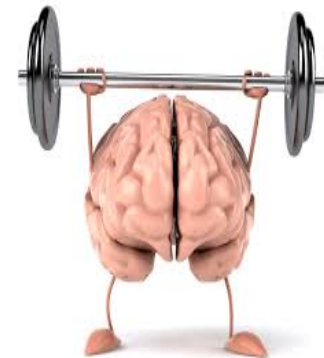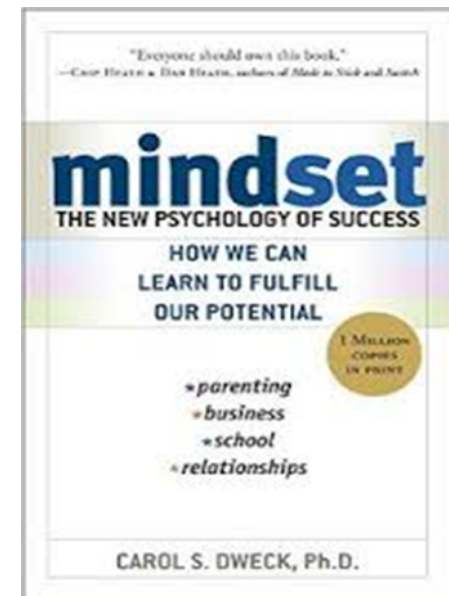

Underrepresentation of this magnitude in the S&E workforce stems from the underproduction of minorities in S&E at every level of postsecondary education

Legend:
- URM
- non-URM
- Temporary Residents

Category	URM	non-URM	Temporary Residents
S&E Doctorates	5.4	52	42.6
S&E Master's Degrees	14.6	58.3	27.1
Graduate Enrollment	17.8	70.3	11.9
S&E Bachelor's Degrees	17.7	78.3	4
Undergraduate Enrollment	26.2	71.7	2.1
U.S. College-Age Population	33.2	66.8	0
K-12 Public Enrollment	38.8	61.2	0

Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads (2011)
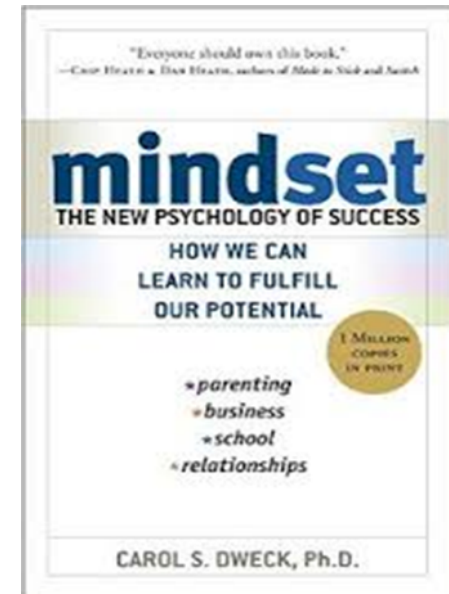
Carol Dweck - Mindset

"In a **fixed mindset**, people believe their basic qualities, like their intelligence or talent, are simply fixed traits. They spend their time documenting their intelligence or talent instead of developing them. They also believe that talent alone creates success—without effort. They're wrong."

Provide input and learn more about the study at www.nas.edu/EnvisioningDS

Carol Dweck - Mindset

"In a **growth mindset**, people believe that their most basic abilities can be developed through dedication and hard work—brains and talent are just the starting point. This view creates a love of learning and a resilience that is essential for great accomplishment. Virtually all great people have had these qualities."

HOW DID WE CHANGE?

Most computer science majors in the U.S. are men. Not so at Harvey Mudd

OPEN FUTURE

Half of This College's STEM Graduates Are Women. Here's What It Did Differently

Just 18 percent of computer science graduates nationwide are women--but at Harvey Mudd College, President Maria Klawe is beating the odds

By Kimberly Weisul *Editor-at-large, Inc.com* 🐦 @weisul

f 🐦 in 🔴 🌀 ✉   💬 WRITE A COMMENT

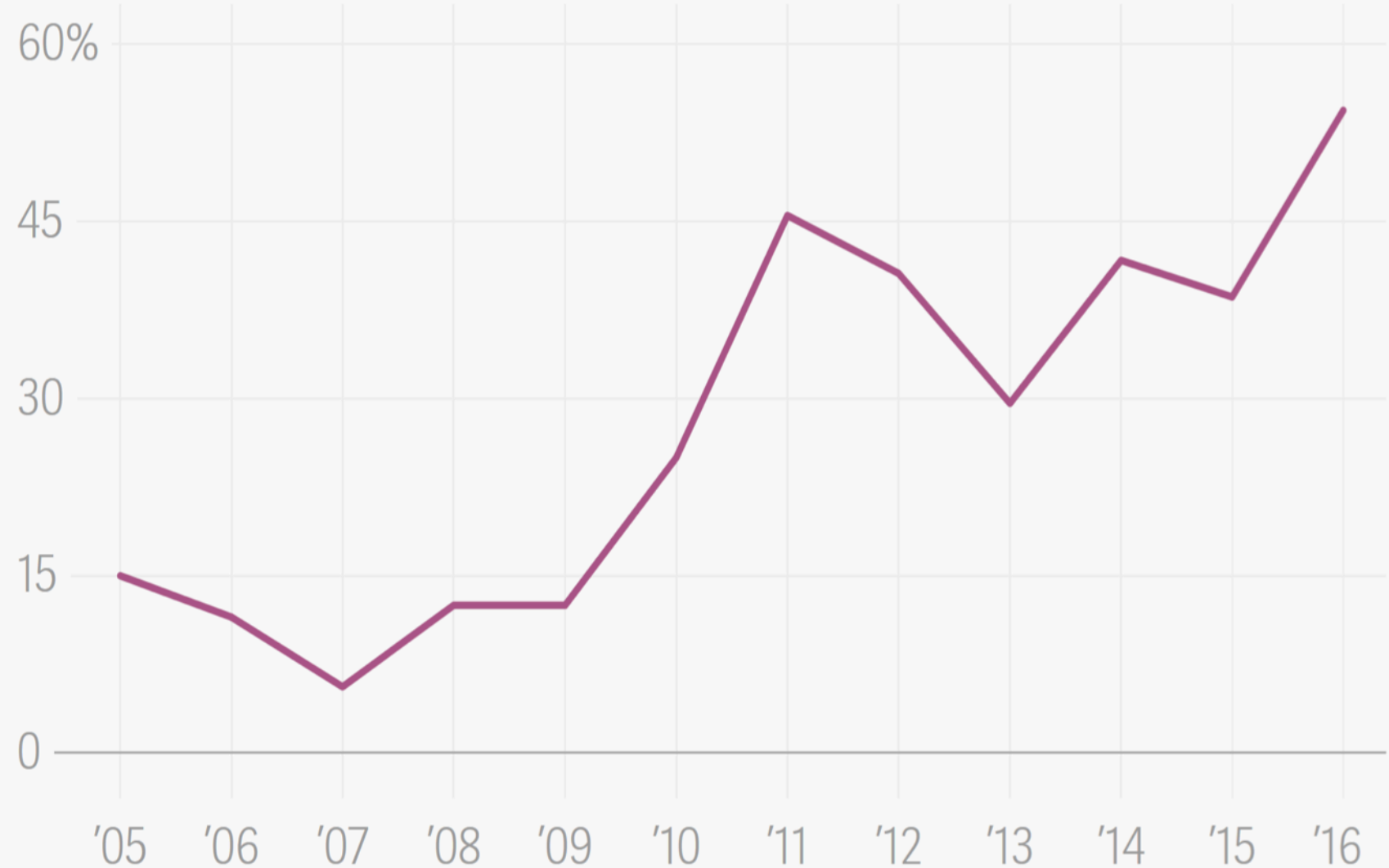QUARTZ

IN BALANCE

Harvey Mudd College took on gender bias and now more than half its computer-science majors are women

By Oliver Staley | August 22, 2016

Provide input and learn more about the study at www.nas.edu/EnvisioningDS   18

Percentage of female computer-science graduates at Harvey Mudd

Harvey Mudd **Computer Science Curriculum Transformation**

"If Harvey Mudd created an environment that was supportive and engaging for everyone; if the school built confidence and community among underrepresented groups; and if it demystified the path to success, a diverse group of students would be attracted to the college and succeed here."

- Maria Klawe

Harvey Mudd **Computer Science Curriculum Transformation**

1. Professors were to set the expectation that success in the class was dependent on hard work and asking for help.

2. Problems were to be framed as creative problem solving, using real-life examples. Professors encouraged collaboration and paired students on homework assignments.

3. The professors eliminated "Macho Behavior" – the students who love the course but dominate discussion with their constant comments and questions. We created 4 different styles of the same intro CS course.

4. Professors encouraged every student to take the second computer science course. Because the classes were 50/50 [male/female] it no longer seemed weird to be a female in computer science.
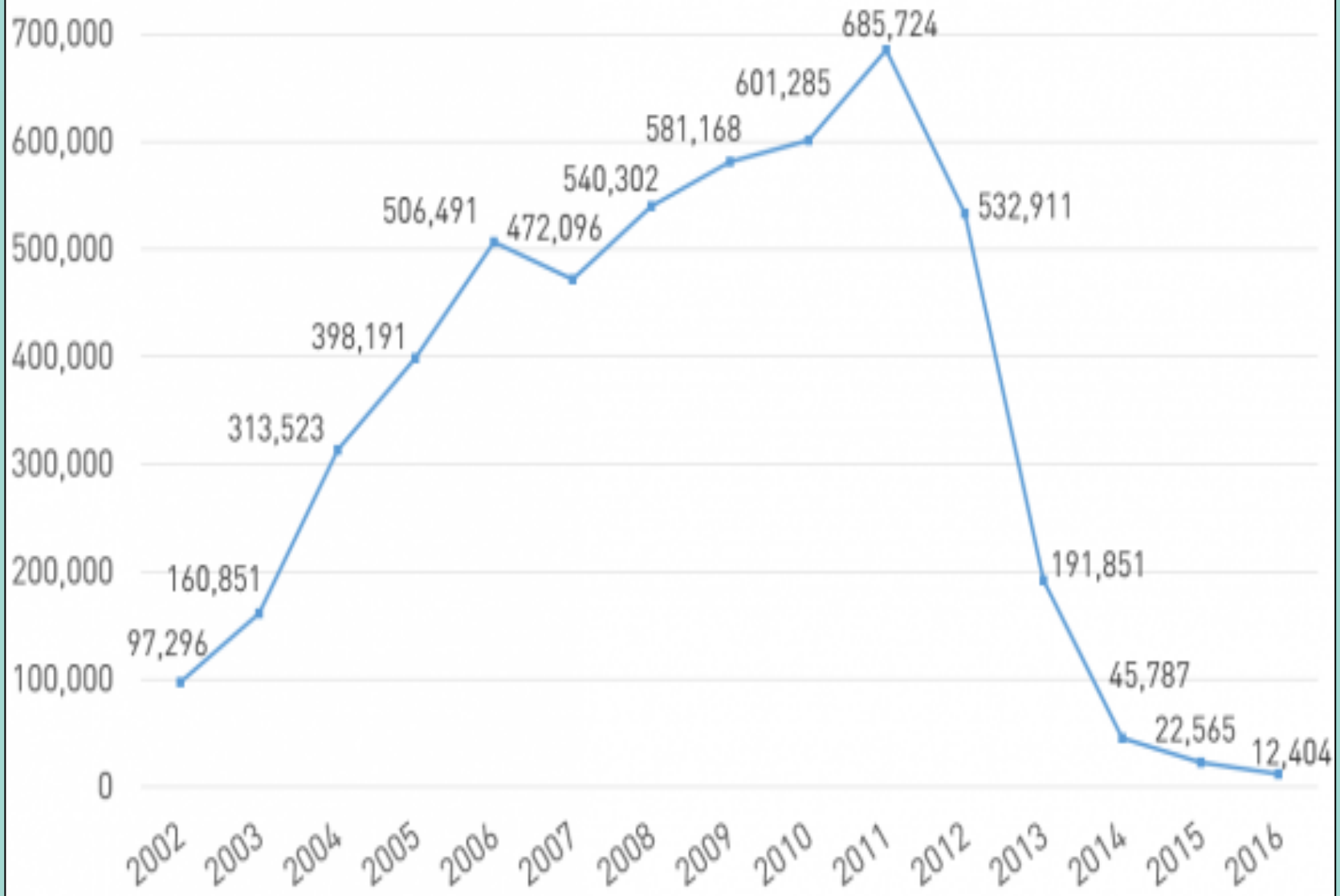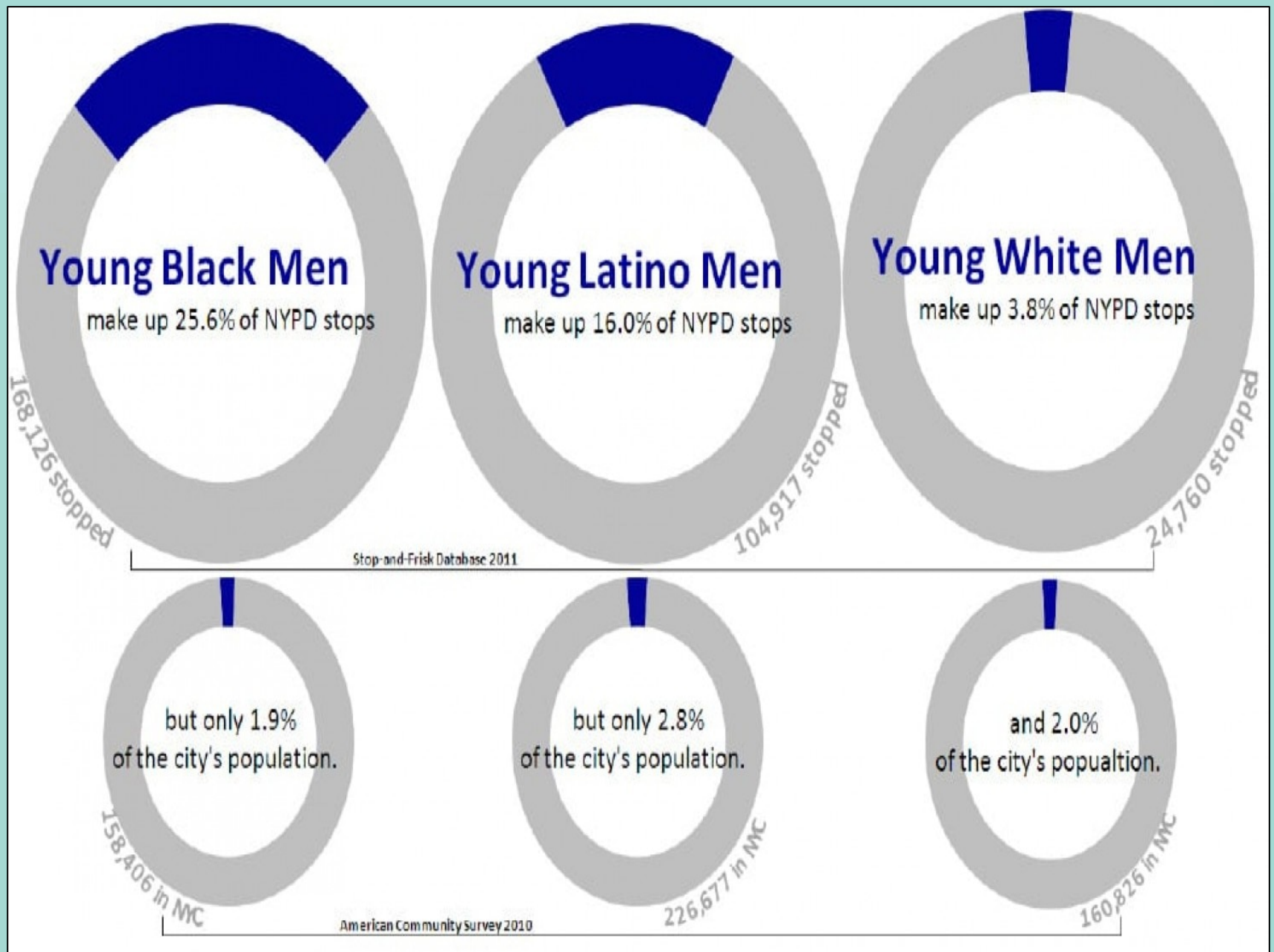
Provide input and learn more about the study at www.nas.edu/EnvisioningDS

Unsurpassed **excellence** and **diversity** at all levels

- Harvey Mudd was mostly male and white since its founding in 1955.

- In 1996 female students made up 20% of the student body. Today, ~47% of the student body is female.

- In 2012, about ~2% of Harvey Mudd students were African-American. Today, it's close to 10%.

- Hispanic students are ~20%, Native American and Pacific Islanders are ~3%, Asian Americans between 20 to 25%.

Provide input and learn more about the study at www.nas.edu/EnvisioningDS

Number of NYPD Stop-and-Frisks, 2002-2016

Young Black Men
make up 25.6% of NYPD stops

Young Latino Men
make up 16.0% of NYPD stops

Young White Men
make up 3.8% of NYPD stops

168,126 stopped

104,917 stopped

24,760 stopped

Stop-and-Frisk Database 2011

but only 1.9%
of the city's population.

but only 2.8%
of the city's population.

and 2.0%
of the city's popualtion.

158,406 in NYC

226,677 in NYC

160,826 in NYC

American Community Survey 2010

Provide input and learn more about the study at www.nas.edu/EnvisioningDS

Forbes / Education

Increasing Education Opportunities For Minorities In STEM

Maria Klawe, CONTRIBUTOR
My life goal is to enhance the diversity of science and engineering.

FOLLOW ON FORBES (9)

Opinions expressed by Forbes Contributors are their own.

FULL BIO ∨

This summer I had the honor of attending an event that brought together educa...
industry leaders involved in improving the state of STEM education in the U.S...
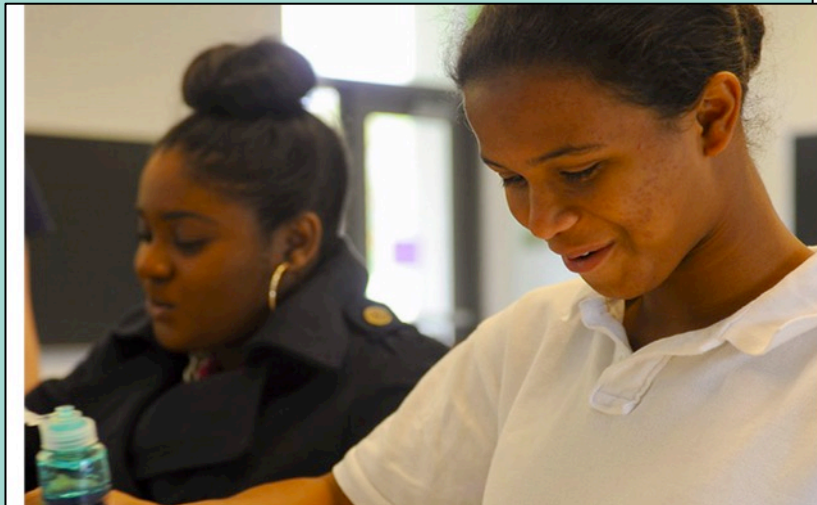panel discussion, I was asked whether I was encouraged or discouraged by whe...

Continued from page 1

High school girls participate in the Sacred SISTAHS Math and Science conference at Harvey Mudd College

How are you engaging the girls at the conference?

We run a daylong workshop for over 150 local African American girls aged 13-18. We designed the workshop to target middle and high school girls, because research has demonstrated that even though girls perform as well as boys in math and science in K-12, many girls start to lose interest in STEM areas in middle school.

Provide input and learn more about the study at www.nas.edu/EnvisioningDS

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INLAND VALLEY NEWS

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Sacred Sistahs, Inc. Presents STEM Conference for African-American Girls

4/23/2015, 1:52 p.m. | Updated on 4/23/2015, 1:52 p.m.

DAILY BULLETIN

NEWS

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Math, science conference attendees told to follow their dreams, even if they are difficult

By Imani Tate Staff Writer

POSTED: 04/15/11, 12:01 AM PDT | 0 COMMENTS

It isn't necessarily easy, but it is possible, black professional women told 200 black girls about careers in math, science, technology, engineering, law and medicine.

The women acted as role models and examples of excellence at the first Math and Science Conference presented March 26 at Harvey Mudd College by Sacred Sisters In Solidarity Teaching and Healing our Spirits (S.I.S.T.A.H.S.).

Dr. Tonia Causey-Bush, Sacred S.I.S.T.A.H.S. founder, said the conference goal was to increase the number of black girls in college majors preparing them for science, technology, engineering and math careers.

The professionals donated their time to encourage and inspire girls.

Provide input and learn more about the study at www.nas.edu/EnvisioningDS

HMC Sacred SISTAHS Math, Science and Technology Conference for Underrepresented girls!

Parent Workshop

"I most enjoyed seeing the **excitement** and **wonder** in each young woman as they **sat at the footstools of women** who are practicing and actualizing their dreams."

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