Increasing Diversity in STEM fields

Abigail Kerr
Illinois Wesleyan University
May 9, 2017
Noninstitutionalized resident population of the United States ages 18–64, by race, ethnicity, and sex: 2014

- White women 31.0%
- White men 31.0%
- Hispanic men 8.7%
- Hispanic women 8.3%
- Black men 6.1%
- Black women 6.6%
- Asian men 2.7%
- Asian women 3.0%
- Other men 1.2%
- Other women 1.3%

NOTES: Hispanic may be any race. Other includes individuals not of Hispanic ethnicity who reported more than one race or a race not listed separately.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Undergraduate enrollment, by type of school: 2014

NOTE: Hispanic may be any race.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Full-time enrollment among undergraduates, by institution type: 2014

- White women
- White men
- Asian women
- Asian men
- Hispanic women
- Hispanic men
- Black women
- Black men
- American Indian or Alaska Native women
- American Indian or Alaska Native men
- Native Hawaiian or Other Pacific Islander women
- Native Hawaiian or Other Pacific Islander men

Percent

NOTE: Hispanic may be any race.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
High participation fields for women: Biosciences and social sciences, 1995–2014

NOTE: Data not available for 1999.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Science and engineering degrees earned by underrepresented minority women and men: 1995–2014

Percent

Bachelor’s, women
Bachelor’s, men
Master’s, women
Master’s, men
Doctorate, women
Doctorate, men

14
12
10
8
6
4
2


NOTE: Data not available for 1999.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Science and engineering bachelor's degrees earned by Hispanics, by field: 1995–2014

Notes: Data not available for 1999. Hispanic may be any race.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Science and engineering bachelor's degrees earned by blacks or African Americans, by field: 1995–2014

Percent

25

20

15

10

5

0

Psychology
Social sciences
Computer sciences
Biological sciences
Physical sciences
Mathematics and statistics
Engineering


NOTE: Data not available for 1999.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Science and engineering bachelor’s degrees earned by Asians, by field: 1995–2014

NOTE: Data not available for 1999.
Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Science and engineering bachelor's degrees earned by Hispanic women, by field: 1995–2014

NOTES: Data not available for 1999. Hispanic may be any race.

*Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017*
Science and engineering bachelor's degrees earned by black or African American women, by field: 1995–2014

NOTE: Data not available for 1999.
Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Scientists and engineers working in science and engineering occupations: 2015

- White men 49%
- White women 18%
- Asian men 14%
- Asian women 7%
- Black men 3%
- Black women 2%
- Hispanic men 4%
- Hispanic women 2%
- Other men 1%
- Other women 1%

NOTES: Hispanic may be any race. Other includes American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, and multiple race.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
Academic employment among early career doctorate holders with a science and engineering degree: 2014

- Full-time faculty: 39%
- Postdoc: 38%
- Other positions: 13%
- Other faculty: 10%

*Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017*
How does IWU compare to the national picture?

STEM ENGAGEMENT AT IWU
What are some practices you engage in to increase inclusivity in your departments?

WHAT ARE WE DOING NOW?
What are some things you/your department have thought of instituting?
What are some “best practices at other institutions?

WHAT CAN WE DO?
Centralized Research Office

• Maintain database of available research opportunities for students
• Help to facilitate student/faculty research relationships
• Help to identify students who would benefit from research opportunities
• Help students identify summer research opportunities, prepare competitive applications, etc.
• Provide training opportunities for students to relieve faculty workload
  – Basic research skills – methods/statistics/library research/etc.
  – Research tutors to help with basic analyses, scientific writing, poster construction, oral presentations
Summer Bridge Programs: OSU

• Ohio House of Science and Engineering
  – Summer camps for K-12 to help recruit and mentor STEM majors
  – Precollege prep classes
  – Peer mentoring once arriving on campus

• Pre-College and cooperative Education Program (PREFACE)
  – Minority students going into engineering

• Ohio’s Science and Engineering Talent Expansion Program (OSTEP)
  – Minority students and first generation college students entering STEM fields
  – HS students take rigorous classes that parallel freshmen science, technology, engineering and math curriculum
  – Professional development opportunities
Summer Bridge Programs: W.M. Keck Science Dept.

**Summer Science Immersion Program**

- Support from Howard Hughes Medical Institute
- Biology, Chemistry, Environmental Science, and Physics

- Targets first generation students, students from underrepresented groups in science (including women), and students who attended underresourced high schools
- One-week session for first-year students
  - Theme: The Chemistry of Life
- 20-25 students annually

- Interactive seminars, full day devoted to issues faced by underrepresented groups in the sciences, two hands-on experiments from introductory Chemistry curriculum, analysis of the genome and proteome of the protozoan *Tetrahymena Thermophila*
Interdisciplinary First-Year Programs: IQS

• University of Richmond: Integrated Quantitative Science (IQS) Course
  – Biology, chemistry, physics mathematics, and computer science

• Hypothesis-driven lab, Workshop, Lecture
• 9 contact hours/week
• 5 faculty (1 from each of 5 disciplines) teach the course to 20 students/year – at least 2 attend all class sessions to provide connections between disciplines

• Integrated science minor
  – Biological Imaging
  – Math Models in Biology or Medicine
Interdisciplinary First-Year Programs: IQS

- Students apply for admission into the course during HS senior year
- Overarching theme: New Materials for Living Systems
- Fulfills science and formal reasoning requirements for gen ed
- Completion of the 1-year sequence can substitute for introductory requirements in participating majors

100% of IQS students who chose STEM majors graduated in 4 years
30% of IQS students have gone on to Ph.D. programs
99% of IQS students take additional STEM courses
Interdisciplinary First-Year Programs: SMART

• University of Richmond: Science, Math and Research Training Course

• Introductory concepts and techniques from biology, chemistry, and math in 2 coupled courses associated with an integrated, discovery-based laboratory component

• Biology-Chemistry course taught alongside a loosely coupled Calculus I and Calculus II course
  – Bio-Chem course spans 2 semesters – focus: antibiotic resistance (Fall), HIV (spring)
  – Students end up with credit for Intro bio course, Intro Chem course, and 2 math courses (formal reasoning requirement)
Interdisciplinary First-Year Programs: SMART

• Students coordinate undergraduate research projects the summer following their first year (in collaboration with faculty)
  – Interdisciplinary research projects with faculty mentor
  – Summer housing, stipend, funds for research supplies, grants for travel to professional conferences provided

95% of SMART students declare a STEM major or minor
98% of students completing SMART take additional STEM courses
100% of students enrolled in SMART complete the 2 semester course
First-Year STEM Retention at Univ of La Verne

Goal: Improve retention to 70% after first year

• Strategy 1: Utilize university-wide changes to facilitate changes at dept. level
  – Professional development (AAC&U workshops, conferences, etc.)
  – FLEX initiative (similar to our pathways) – First year learning communities, 2 course sequence, writing intensive

• Strategy 2: Faculty buy-in
  – Departmental retreat – data, read publications on science vision and pedagogy, establish departmental vision, develop introductory-level learning outcomes
First-Year STEM Retention at Univ of La Verne

• Strategy 3: Curricular changes in the first-year series (combined with FLEX)
  – Implement HIPs: primary research, writing and peer critiquing, presenting an original research grant

• Outcomes
  – Year 1: retention was 60%
  – Year 2: retention was 62%
  – CURE survey results
    • Student gains in skills of science process (analyze data, read and understand literature, lab techniques)
    • Student gains in understanding of scientific process
    • Clarification of career path with greater interest in pursuing graduate degrees
    • Gains surpassed national averages
Undergraduate Research Opportunity: UofM

• For first year students (options for second year students as well)
• Faculty mentor
• Peer mentors (meet at least monthly)
• 6-12 hours per week for the academic year
• Bi-weekly research seminars
  – Interdisciplinary
  – Introduce students to research issues including methodology and ethics
• Present at annual Research Symposium (JWP)
• Compensation: Work-study, Academic Credit
Stepped Mentoring Program

• Younger students mentored by older peers
• When mentor graduates, the younger student is ready to become a mentor
• Peer mentoring consultants (perhaps through a centralized research center) help to train students to be effective mentors and receptive mentees
  – Takes the burden off of faculty members
  – Work-study opportunity?
Some ideas from Carnegie Mellon CS Program

• Summer institute for AP teachers in your discipline
  – Prepare HS teachers to teach important components of the AP Exam
  – Incorporate discussions about gender gaps in STEM/inclusivity in STEM – what can they do about it?

• Create learning communities for underrepresented groups
  – Women @SCS Advisory Council – weekly meetings, top priority is community building
  – Supportive peer environment and academic and social community in all levels of the program
  – Communicate with faculty regarding needs and concerns of marginalized groups
  – Organize outreach activities for girls/women at various levels with the hopes of increasing women in the CS pipeline

Source: https://www.cs.cmu.edu/~lblum/PAPERS/women_in_computer_science.pdf
Systemic Institutional Change Model

• AAC&U – Keck/PKAL Model
  – Project Kaleidoscope is AAC&U’s STEM higher education reform center
  – Programming
    • https://www.aacu.org/pkal
    • https://www.aacu.org/pkal/events

• Resources:
  https://www.aacu.org/peerreview/2015/spring/elrod-kezar,
  http://secure.aacu.org/store/detail.aspx?id=E-PKALSTSS,
  https://www.aacu.org/pkal/publications
Resources

• Course-based Undergraduate Research Experience
  – https://curenet.cns.utexas.edu

• Alure Project
  – http://www.alure-project.net

• Classroom Undergraduate Research Experience Survey
  – Assessment Tool
  – https://curenet.cns.utexas.edu/content/classroom-undergraduate-research-experience-cure-survey

• National Alliance for Partnerships in Equity
  – https://www.napequity.org
  – Webinars: https://www.napequity.org/professional-development/webinars/

• Project Kaleidoscope (PKAL)
  – https://www.aacu.org/pkal