Science, Technology, Engineering and Math:

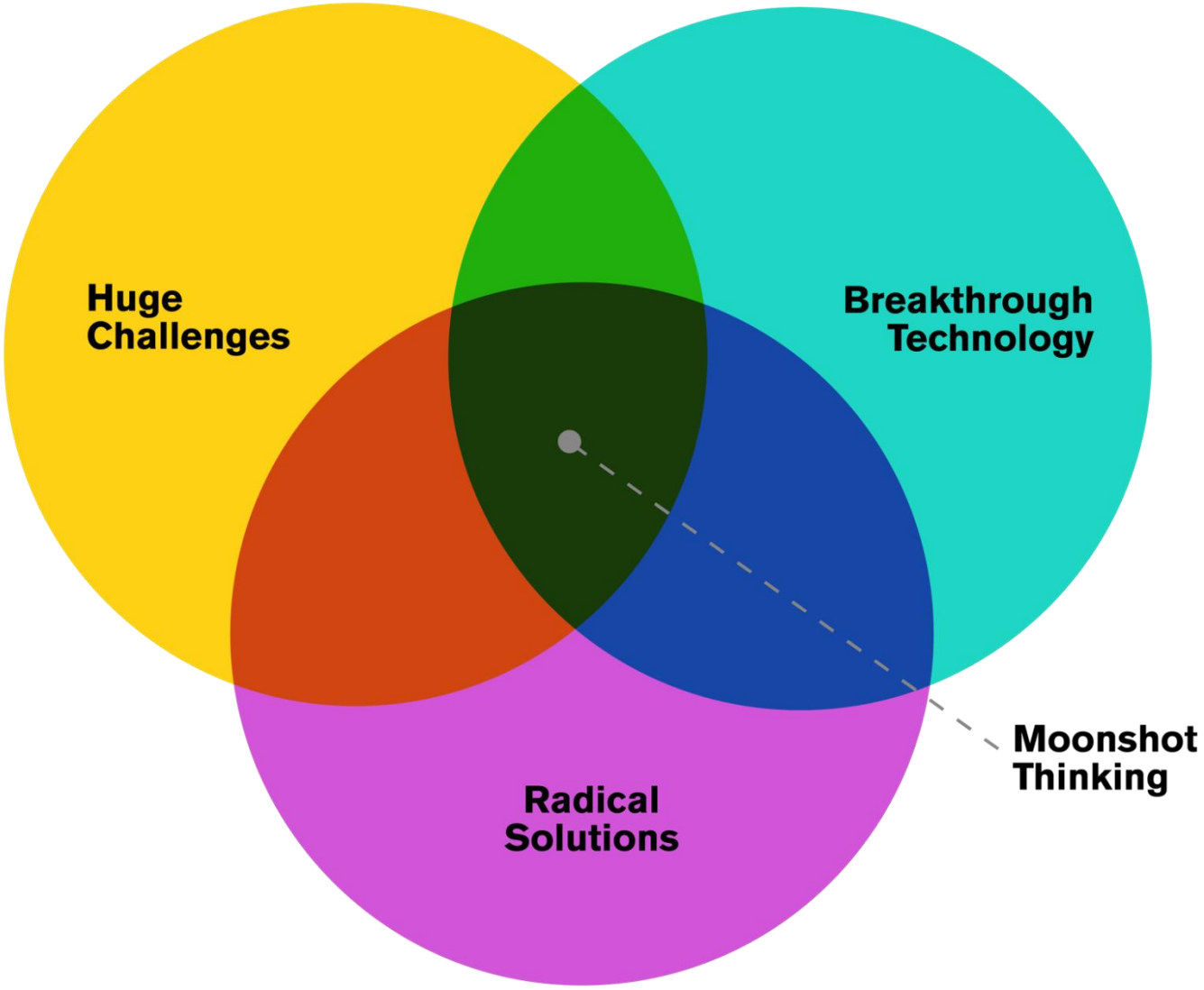
What STEM can help us achieve

Michael M. Crow

Erich Bloch Lecture

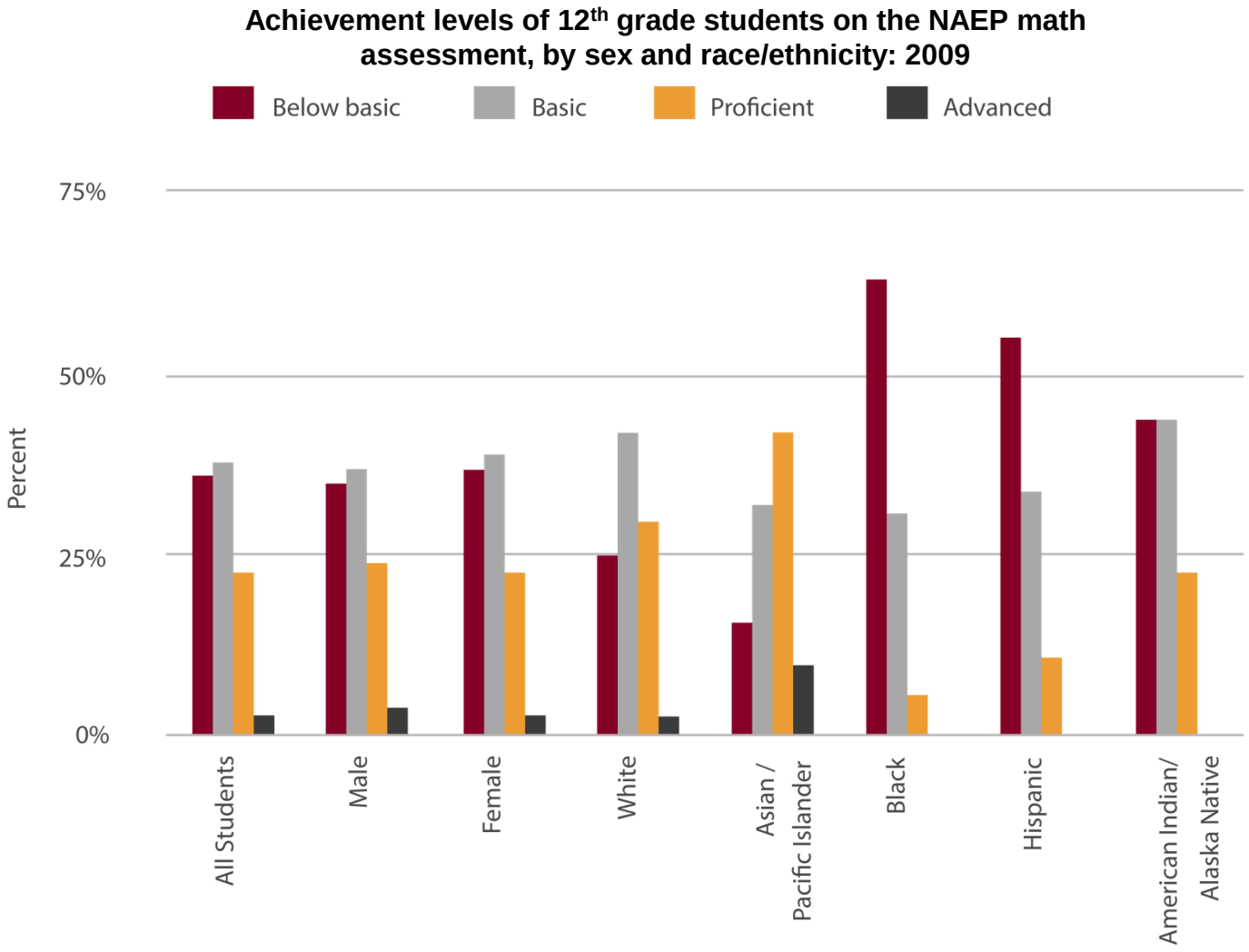
December 1, 2015

Moonshot Thinking



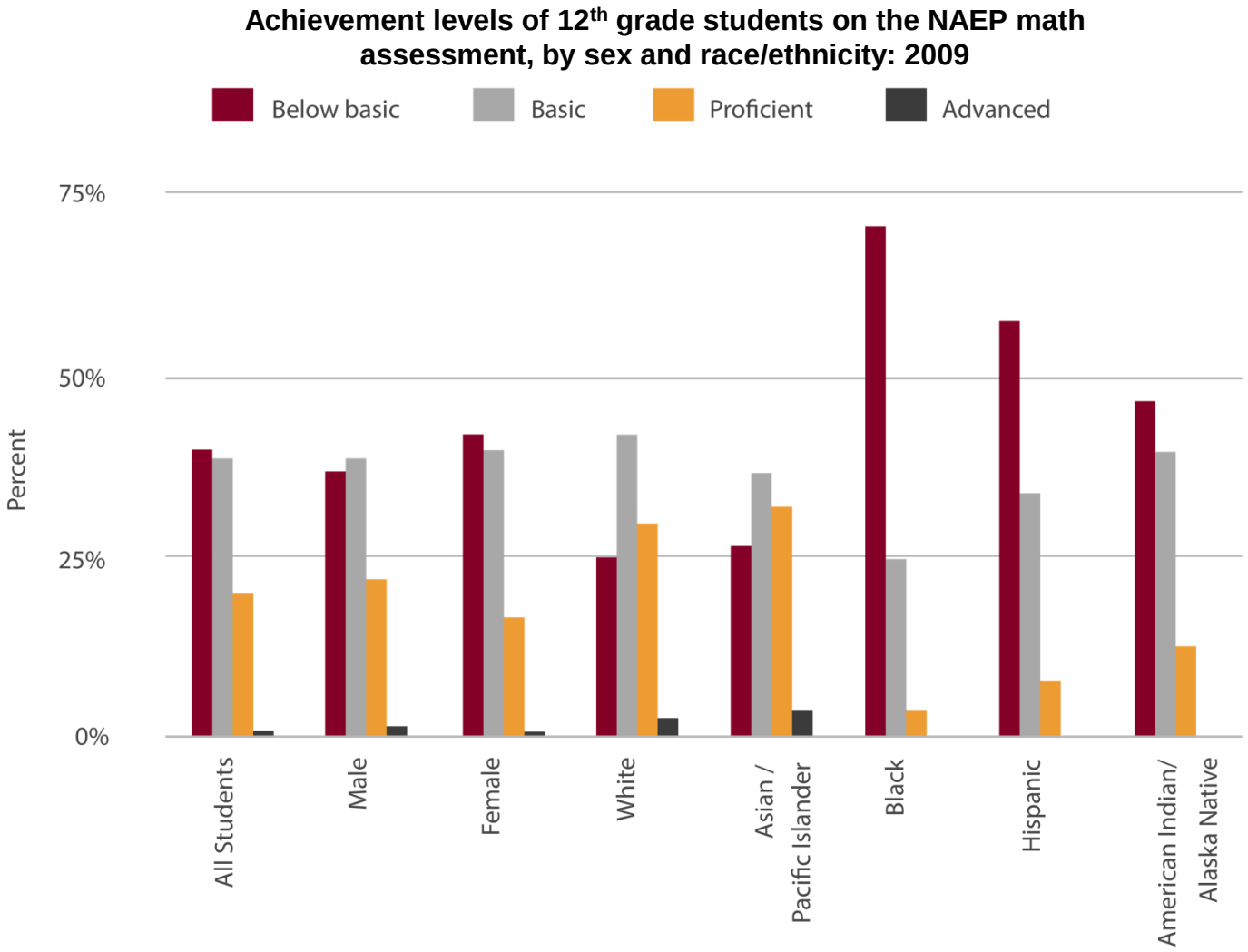
Who will solve these challenges?

U.S. Math Performance: Grade 12



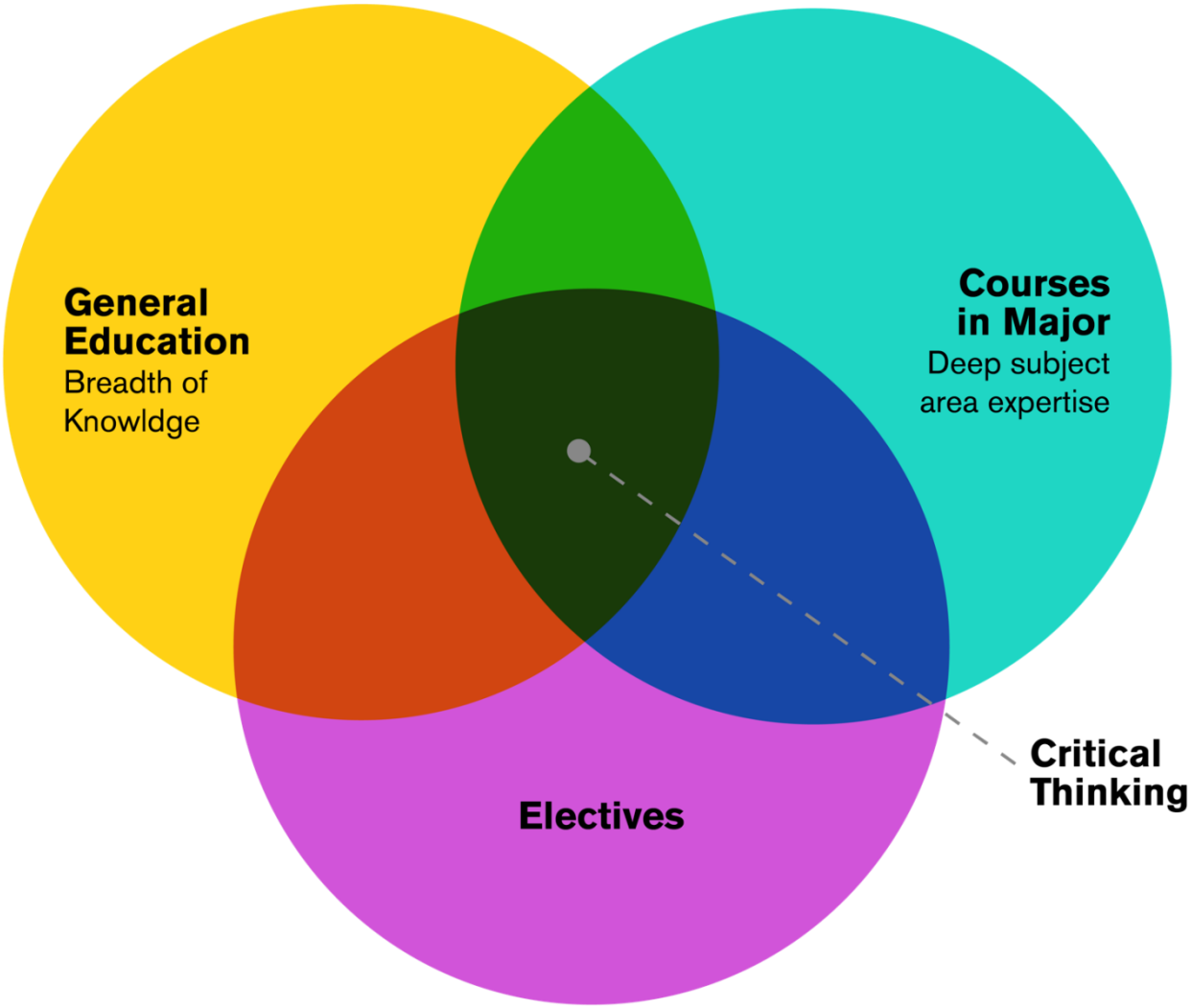
NAEP: National Assessment of Educational Progress (The Nation's Report Card)

U.S. Science Performance: Grade 12

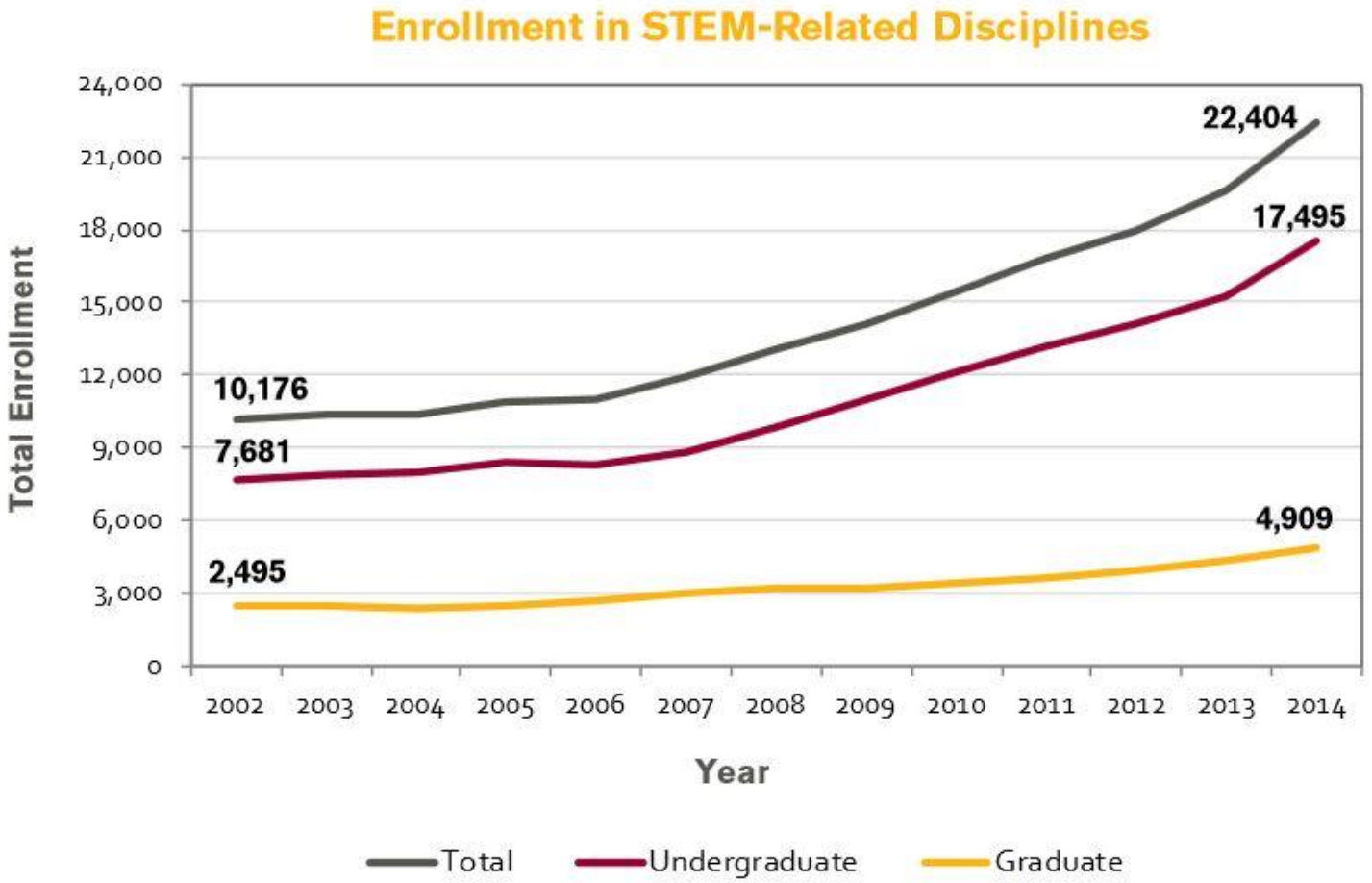


NAEP: National Assessment of Educational Progress (The Nation's Report Card)

Master Learner

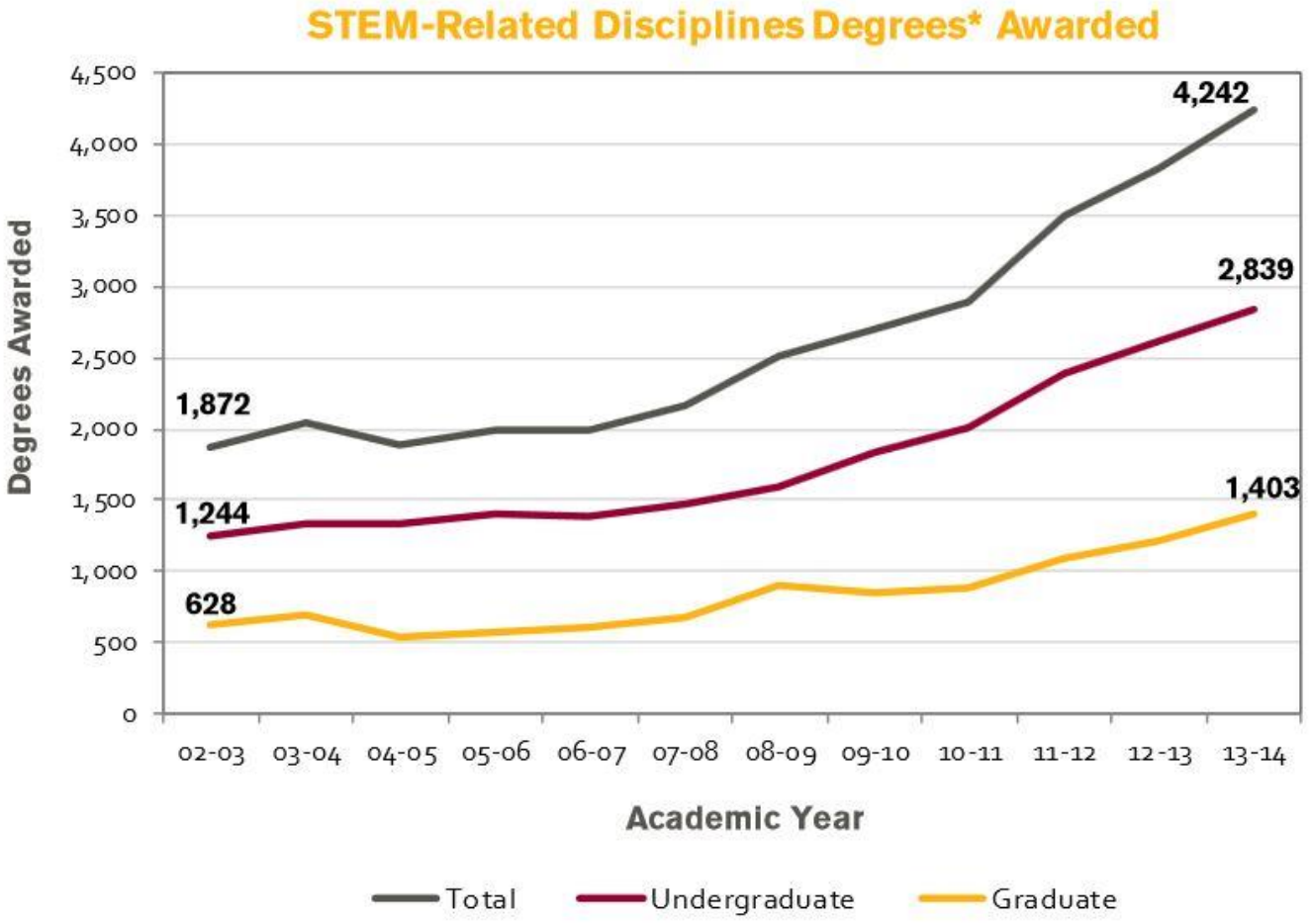


ASU STEM Enrollment Trends



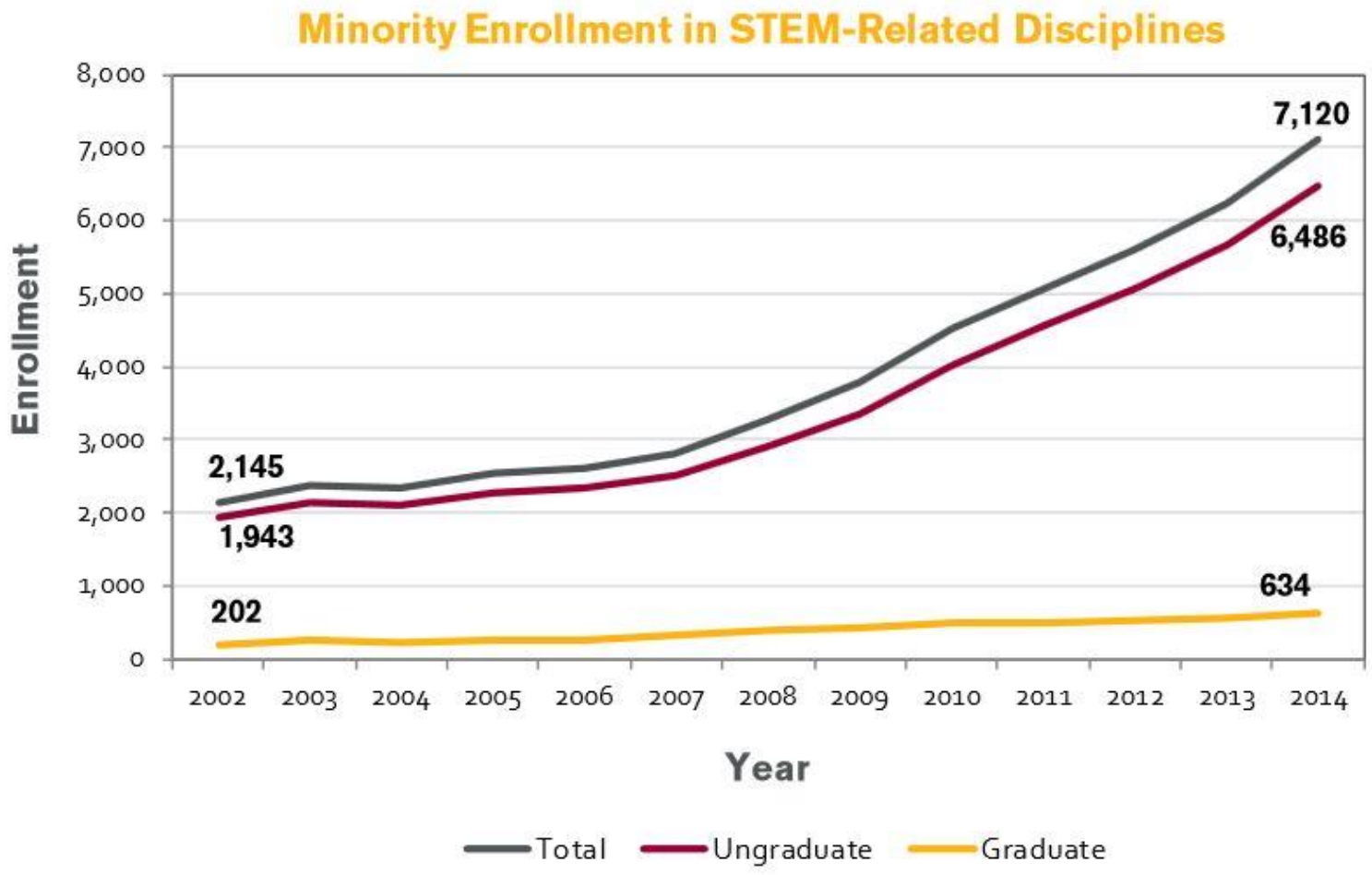
*ABOR defined STEM degrees

ASU STEM Degrees Awarded



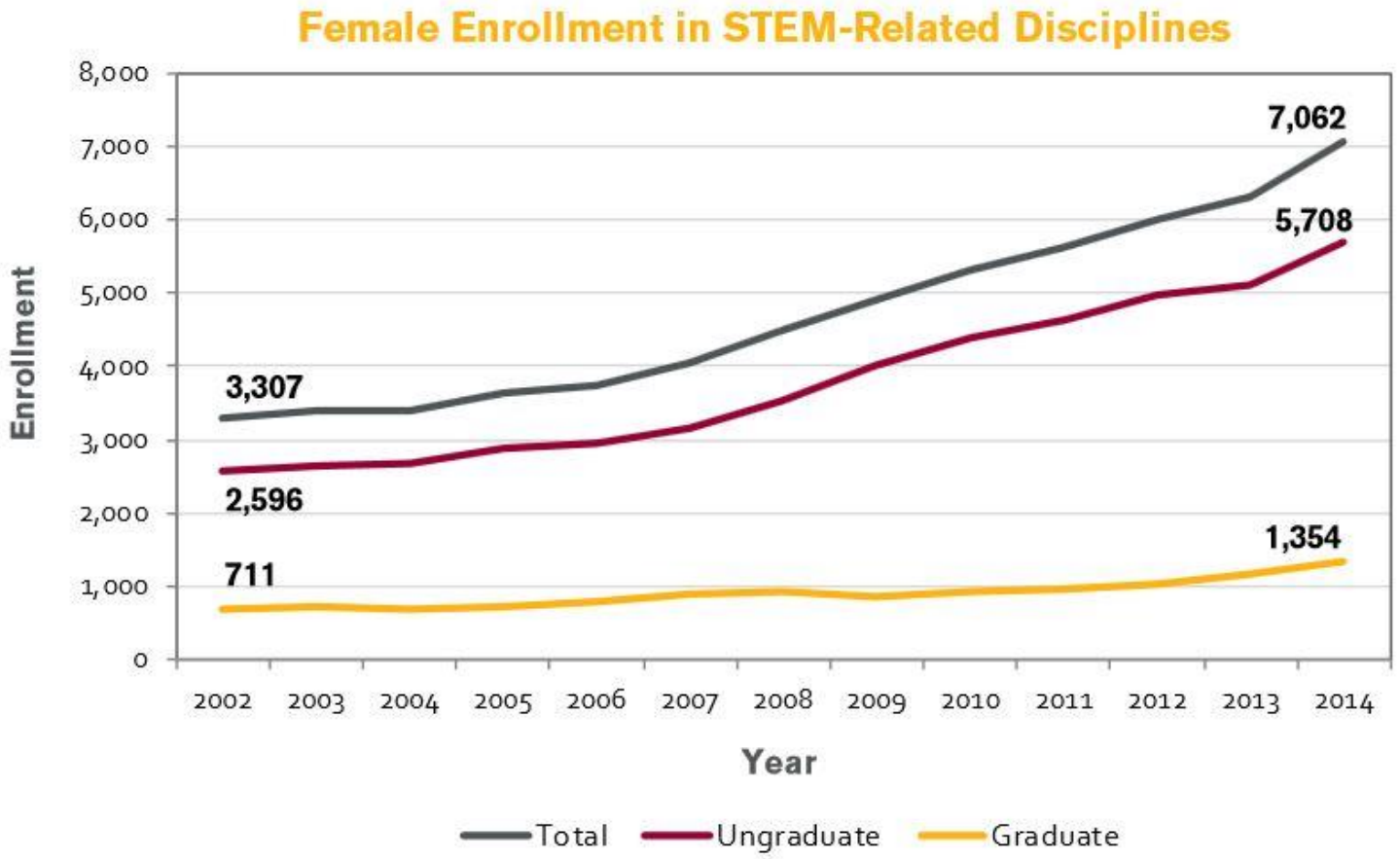
*ABOR defined STEM degrees

ASU STEM Minority Enrollment



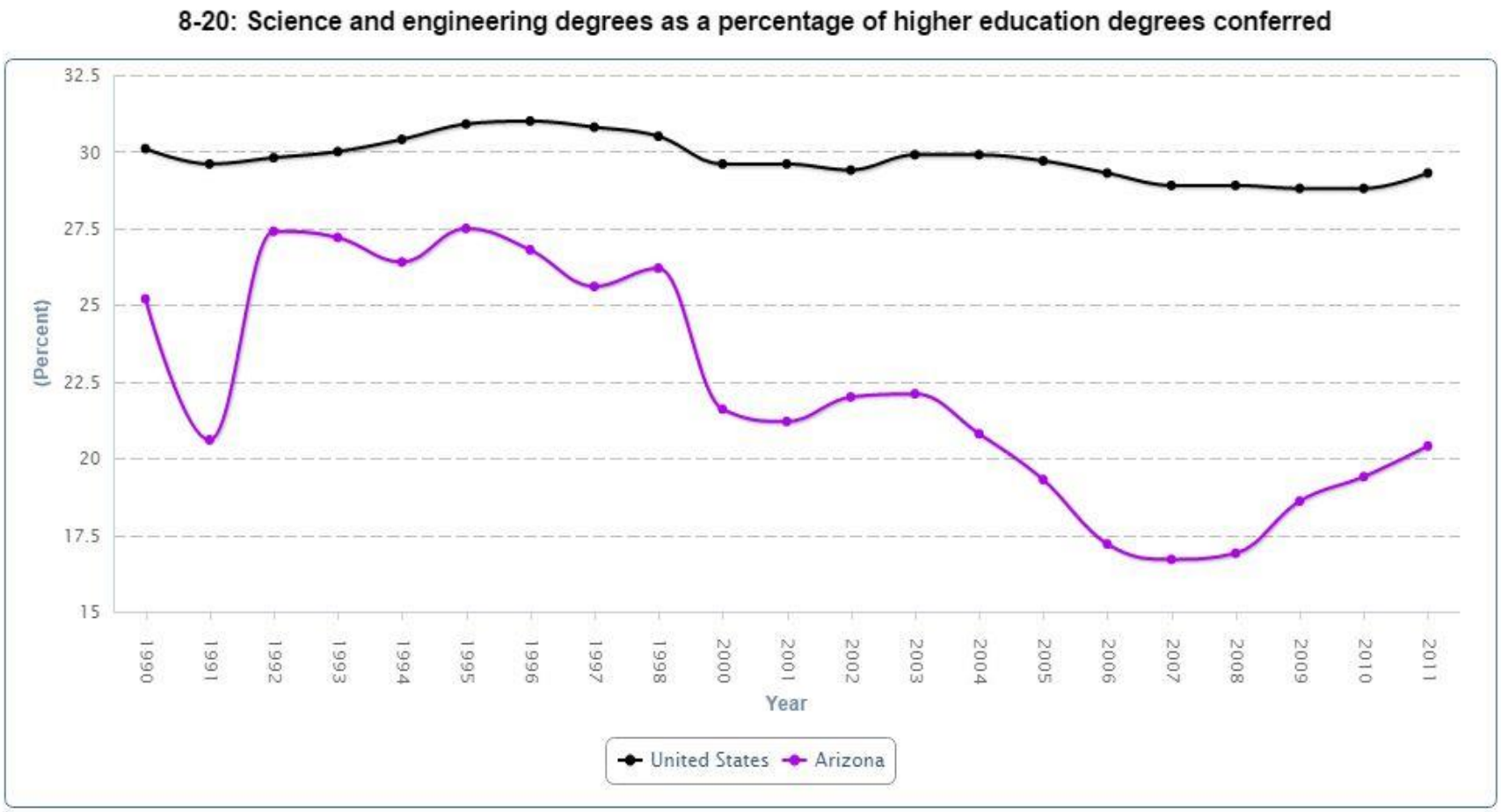
*ABOR defined STEM degrees

ASU STEM Female Enrollment



*ABOR defined STEM degrees

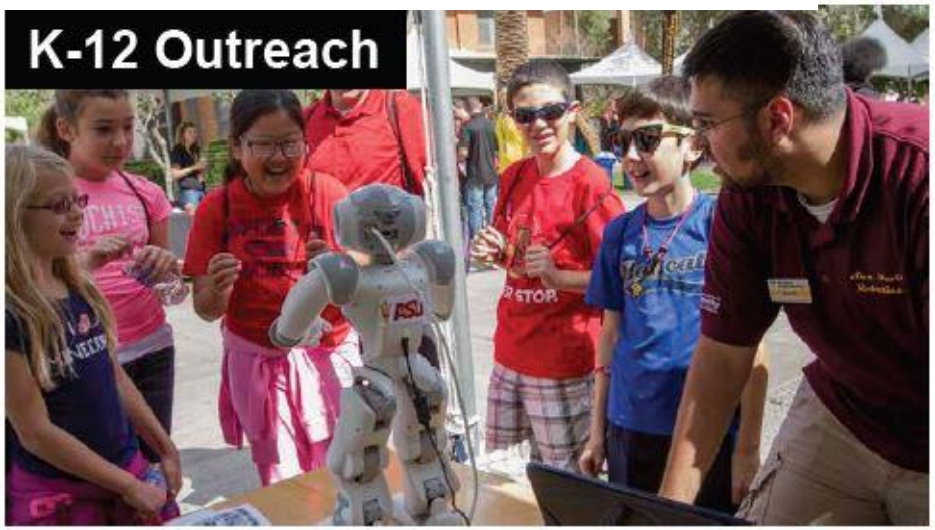
Arizona: Science and Engineering

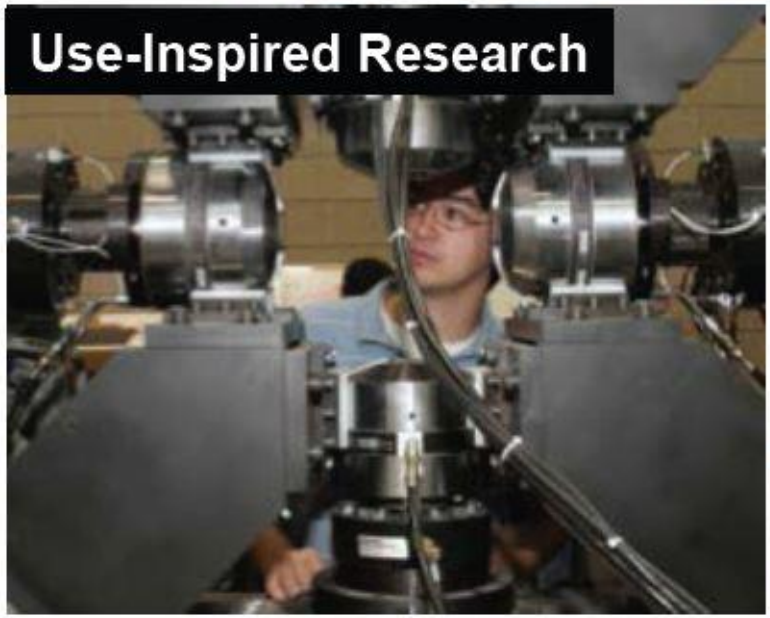


ASU Outcomes

Among Arizona public universities, ASU confers **52%** of all STEM undergraduate degrees and **67%** of all STEM graduate degrees.

Ira A. Fulton Schools of Engineering





ASU IRA A. FULTON SCHOOLS OF engineering

ARIZONA STATE UNIVERSITY

SCHOOL OF ARTS, MEDIA AND ENGINEERING
in association with Herberger Institute for Design and the Arts

SCHOOL OF EARTH AND SPACE EXPLORATION
in association with the College of Liberal Arts and Sciences

SCHOOL OF SUSTAINABILITY

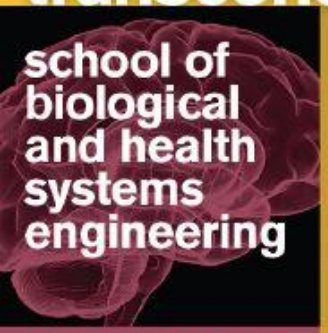
TRANSDISCIPLINARY PARTNERS

THE BIODESIGN INSTITUTE

GLOBAL INSTITUTE OF SUSTAINABILITY

SECURITY AND DEFENSE SYSTEMS INITIATIVE

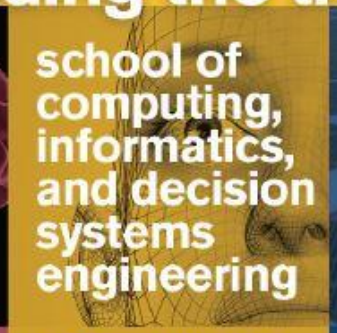
transcending the traditional



school of biological and health systems engineering

1,066 students
881 undergraduate
185 graduate

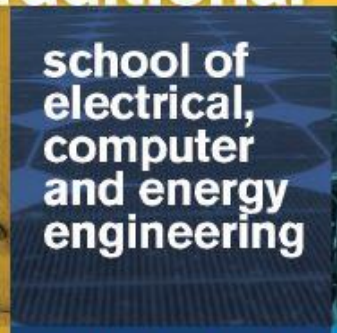
- biomedical engineering
- biological design



school of computing, informatics, and decision systems engineering

4,151 students
2,904 undergraduate
1,247 graduate

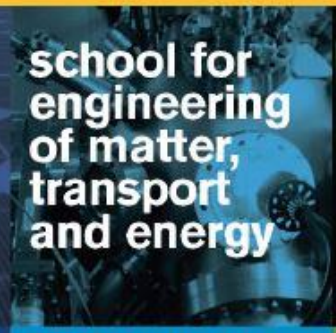
- computer engineering
- computer science
- computer systems engineering
- engineering management
- industrial engineering
- informatics
- software engineering



school of electrical, computer and energy engineering

2,490 students
1,382 undergraduate
1,108 graduate

- electrical engineering
- computer engineering



school for engineering of matter, transport and energy

3,520 students
2,778 undergraduate
742 graduate

- aerospace engineering
- chemical engineering
- materials science and engineering
- mechanical engineering
- solar energy engineering and commercialization

school of sustainable engineering and the built environment

1,414 students
1,068 undergraduate
346 graduate

- civil, environmental and sustainable engineering
- construction engineering
- construction management

the polytechnic school

3,277 students
3,030 undergraduate
247 graduate

- aviation
- human systems engineering
- engineering (integrated concentrations)
- manufacturing engineering
- environmental and resource management
- graphic information technology
- information technology
- technological entrepreneurship and management

Current academic programs and schools structure (6 schools, 2 campuses, 20+ degree programs)

New Faculty, New Ideas, More Capacity

2012

Spring Berman, Ph.D., University of Pennsylvania
Mariana Bertoni, Ph.D., Northwestern University
Dan Bliss, Ph.D., University of California, San Diego
Srabanti Chowdhury, Ph.D., University of California, Santa Barbara
Scotty Craig, Ph.D., University of Memphis
Mounir El Asmar, Ph.D., University of Wisconsin-Madison
Ashraf Gaffar, Ph.D., Concordia University
David Grau, Ph.D., University of Texas-Austin
Zachary Holman, Ph.D., University of Minnesota
Yang Jiao, Ph.D., Princeton University
Jennifer Kitchen, Ph.D., Arizona State University
Oliver Kosut, Ph.D., Cornell University
Jeffrey La Belle, Ph.D., Arizona State University
Micah Lande, Ph.D., Stanford University
Amy Landis, Ph.D., University of Illinois-Chicago
Yongming Liu, Ph.D., Vanderbilt University
Abdel Mayyas, Ph.D., Clemson University
Kristen Parrish, Ph.D., University of California-Berkeley
Matthew Peet, Ph.D., Stanford University
Yulia Peet, Ph.D., Stanford University
Yueming Qiu, Ph.D., Stanford University
T. Agami Reddy, Ph.D., University of Perpignan, France
Soroush Saghafian, Ph.D., University of Michigan
Lalitha Sankar, Ph.D., Rutgers University
Angela Sodemann, Ph.D., Georgia Institute of Technology
Sohun Sohoni, Ph.D., University of Cincinnati
Hyunjin Song, Ph.D., University of Michigan
Pingbo Tang, Ph.D., Carnegie Mellon University
Shane Underwood, Ph.D., North Carolina State University
Erin Walker, Ph.D., Carnegie Mellon University
Liping Wang, Ph.D., Georgia Institute of Technology
Carole-Jean Wu, Ph.D., Princeton University
Lei Ying, Ph.D., University of Illinois at Urbana-Champaign

2013

Vosa Berisha, Ph.D., Arizona State University
Wai “Oswald” Chong, Ph.D., University of Texas-Austin
Bradley Greger, Ph.D., Washington University, St. Louis
Ximin He, Ph.D., University of Cambridge
Keng Hao Hsu, Ph.D., University of Illinois
Nathan Johnson, Ph.D., Iowa State University
Yingyan Lou, Ph.D., University of Florida
Bin Mu, Ph.D., Georgia Institute of Technology
Mehdi Nikkhah, Ph.D., Virginia Polytechnic Institute and and State University
Umit Ogras, Ph.D., Carnegie Mellon University
Greg Raupp, Ph.D., University of Wisconsin-Madison
Rod Roscoe, Ph.D., University of Pittsburgh
Konrad Rykaczewski, Ph.D., George Institute of Technology
Rosalind Sadleir, Ph.D., University of Western Australia
Jae-sun Seo, Ph.D., University of Michigan
Shimeng Yu, Ph.D., Stanford University
Xuesong Zhou, Ph.D., University of Maryland

We will hire more than 400 new faculty over the next 10 years.

2014

Steven Ayer, Ph.D., Penn State
David Brafman, Ph.D., University of California-San Diego
John Brunhaver II, Ph.D., Stanford University
Samantha Brunhaver, Ph.D. Stanford University
Adam Doupé, Ph.D., University of California, Santa Barbara
Heather Emady, Ph.D., Purdue University
Robert David Gray, Ph.D., York University, Toronto
Matthew Green, Ph.D., Virginia Polytechnic Institute and State University
Alex David Groce, Ph.D. Carnegie Mellon University
Jingrui He, Ph.D., Carnegie Mellon University
Owen Hidreth, Ph.D., Georgia Institute of Technology
Claire Honeycutt, Ph.D., Georgia Intitute of Technology
Sharon Hsiao, Ph.D., University of Pittsburgh
Jaewon Jang, Ph.D., Georgia Institute of Technology
Nadia Kellam, Ph.D., University of South Carolina
Richard Kiehl, Ph.D., Purdue University
Klaus S. Lackner, Ph.D., Heidelberg University, Germany
Thurmon Lockhart, Ph.D., Texas Tech
Fengbo Ren, Ph.D., University of California, Los Angeles
Yi Ren, Ph.D., University of Michigan
Mohamed Sarwat, Ph.D., University of Minnesota
Anna Scaglione, Ph.D., Sapienza - Universitá di Roma
Paulo Shakarian, Ph.D., University of Maryland, College Park
Barbara Smith, Ph.D., Colorado State University
William “Jamie” Tyler, Ph.D., University of Alabama-Birmingham
Hanghang Tong, Ph.D., Carnegie Mellon University
Sefaattin Tongay, Ph.D., University of Florida
Qing Hua Wang, Ph.D., Northwestern University
Yu Yao, Ph.D., Princeton University
Yuji Zhao, Ph.D., University of California – Santa Barbara

Exemplar University Partnerships

- **US Army Flexible Electronics and Display Center**
  (10 years/$94M and 40+ industry partners)
- **NSF/DOE QESST Photovoltaic Engineering Research Center**
  (ASU lead + MIT, Cal Tech, GA Tech, UH, UNM, UA and 30+ industry partners)
- **NSF FREEDM Engineering Research Center**
  (NC State lead + ASU, MUST, FSU and 30+ industry partners)
- **NSF Engineering Research Center – Center for Bio-mediated and Bio-inspired Geotechnics**
  (ASU lead + GA Tech, NMS, UC-Davis and 12+ industrial partners)
- **5 NSF Industry-University Collaborative Research Centers**
  (IUCRC's, 4 with ASU leads, more than GA Tech, Michigan, UC Berkeley, and 50+ industrial partners)
- **Higher Engineering Education Alliance Program**
  (HEEAP + USAID, Intel, Siemens, National Instruments and other industry partners)

Areas of Strength and Growth

Advanced Manufacturing
Flexible hybrid electronics, integrated photonic devices, 3D additive manufacturing

Next Gen Computing
Fully networked existence, new computing paradigms, human-centered multi-media computing, data analytics, embedded systems

Technology for Sustainable Regions
Bio-inspired and bio-mediated systems, nanotech-enabled water treatment, resource recovery from waste, carbon capture, intelligent urban systems

Powering Society
Smart power grid, high-power electronics, microgrid technologies

Materials
Adaptive & intelligent materials and systems, 3D & 4D shape-changing materials, wide band-gap semi-conductors, bio-inspired materials, materials for energy & the environment

Rehabilitation and Performance
Movement and motion, the Brain, replacements parts, diagnostics and devices, performance

Next Gen Electronics
Mobile low power electronics, flexible hybrid electronics, integrated photonic devices, nanoscale electronics, sensors and signal processing.

Global Security and Defense
Autonomous robotic systems, information assurance and security, health security, social network security, experiential data analytics

Solar-Fueled Technology
Photovoltaics, algae-based products, solar-thermal systems, alternative and efficient energy systems

STEM Education
Personalized and adaptive learning systems, enabling technologies, learning environments, STEM pipeline

Future Trajectory:
World-class Engineering Schools

Recognized internationally for:

- **Production** of talent for the workforce
- **Innovation** in engineering education
- **Translation** of engineering innovations to societal and economic impact
- **Entrepreneurial activities**, including IP, spinouts, student entrepreneurs
- **Partnerships** with industry, agencies and governments
- **Recruitment** of students, faculty and staff