# The STEM Equity Pipeline:
# Understanding the Issues and Strategies for Opening it!

**Mimi Lufkin**
Executive Director
National Alliance for Partnerships in Equity

Oklahoma Career Technical Education Summer Conference
Tulsa, Oklahoma
Friday, August 3, 2007

# So Why Do We Care if Women and Minorities Become Scientists and Engineers?

- As a consequence of a lack of diversity we pay an opportunity cost, a cost in designs not thought of, in solutions not produced.

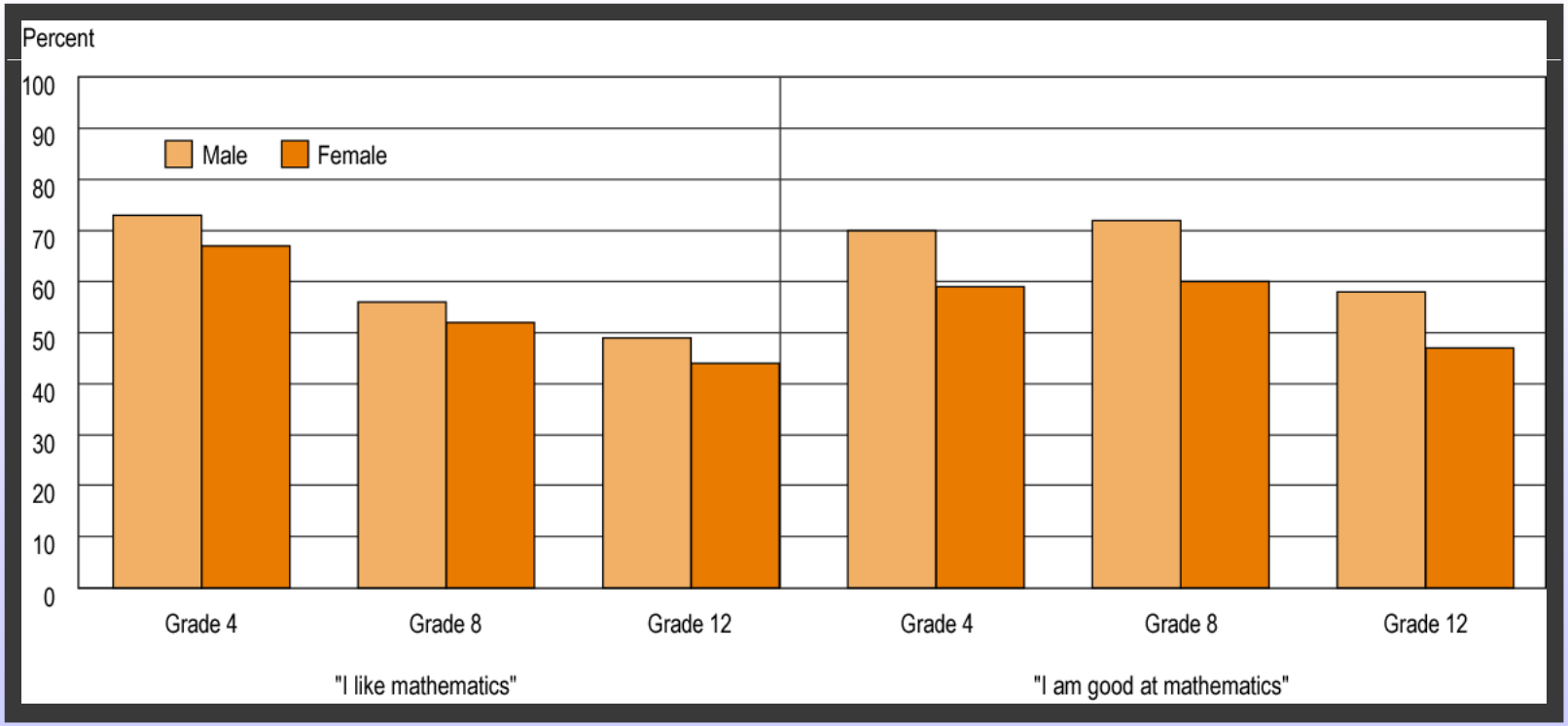
  *Dr. William Wulf ,President*
  *National Academy of Engineering*

- By the year 2050, 85% of the entrants into the workforce will be people of color and women.

  *BostonWorks.com*

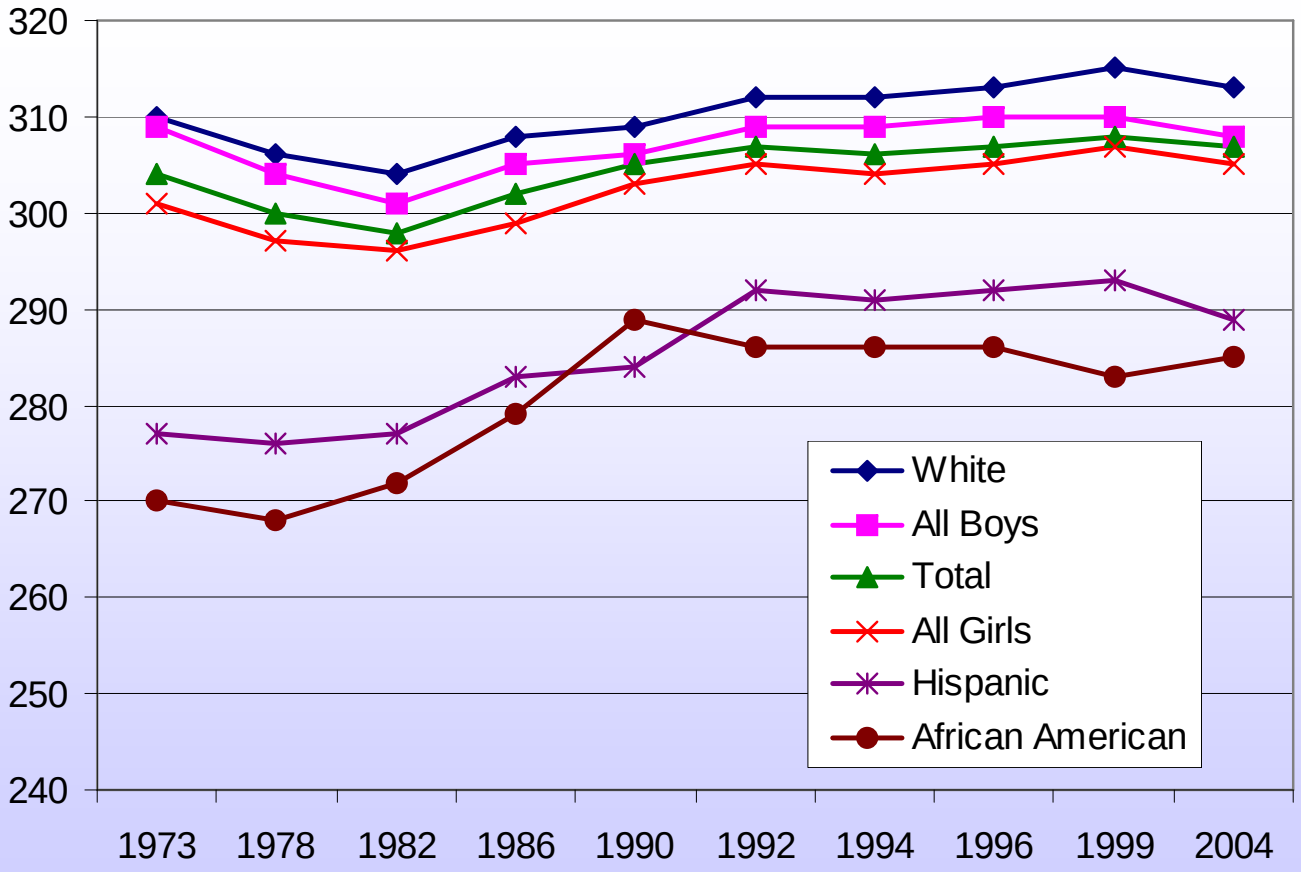
- If we do not engage women and minorities in the science and engineering enterprise, we are ignoring more than 50% of America's intellectual talent.

# Percentage of 4th, 8th, and 12th graders agreeing with the statements “I like mathematics” and “I am good at mathematics,” by sex: 2000



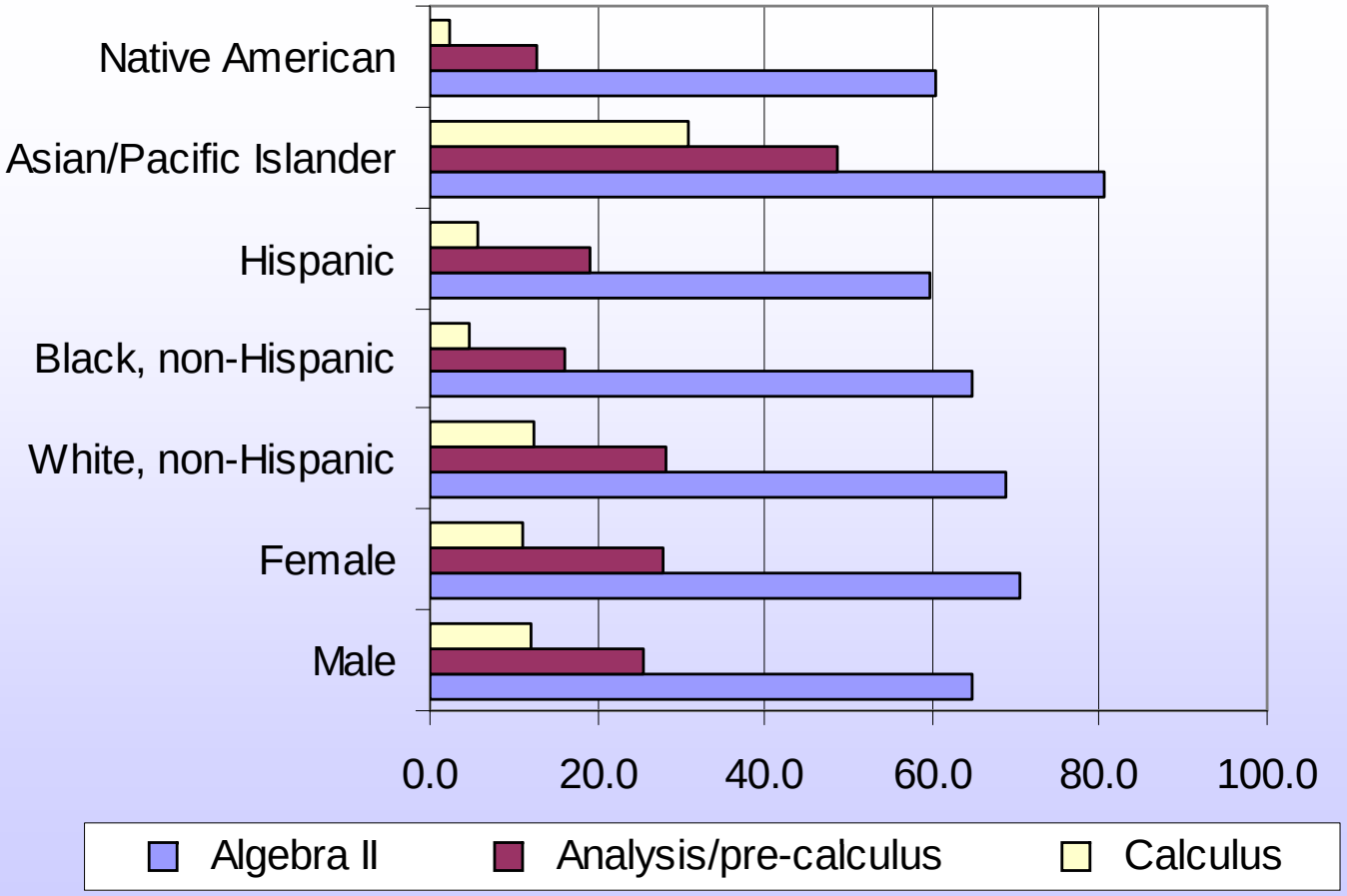

Source: Women, Minorities and Persons with Disabilities in Science and Engineering, 2002 National Science Foundation

# Trends in NAEP Math Scores by Sex and Race/Ethnicity, Age 17, 1973-2004



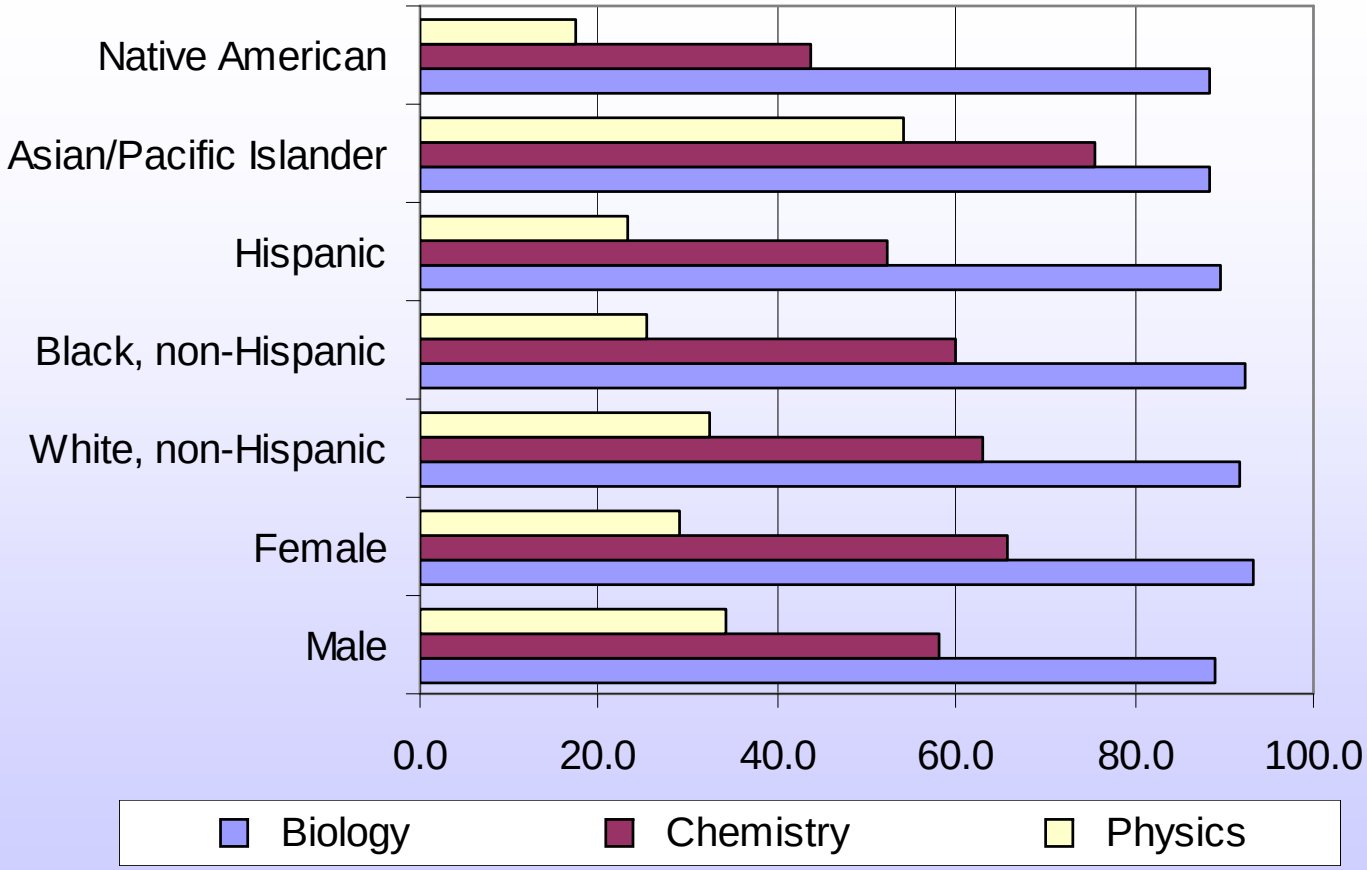

Source: CPST, data derived from National Center for Education Statistics

# What Mathematics Courses Are U.S. High School Students Taking?



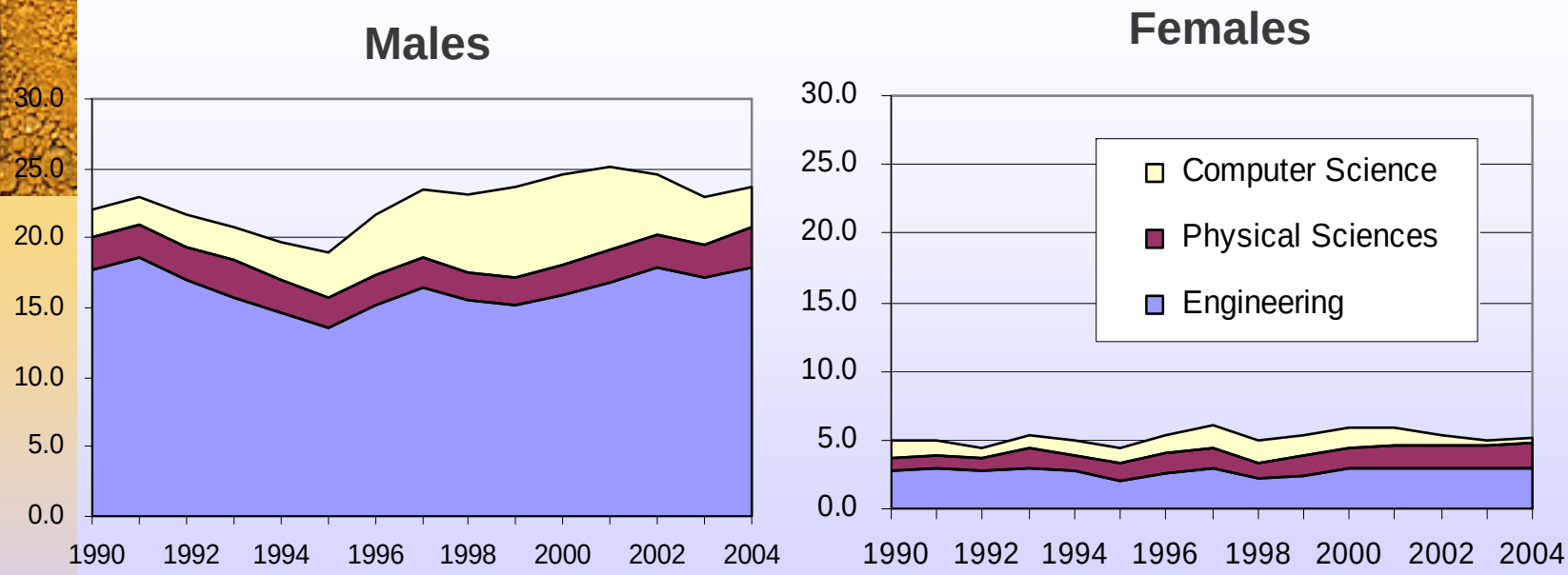

Source: CPST, data derived from National Center for Education Statistics

# What Science Courses Are U.S. High School Students Taking?



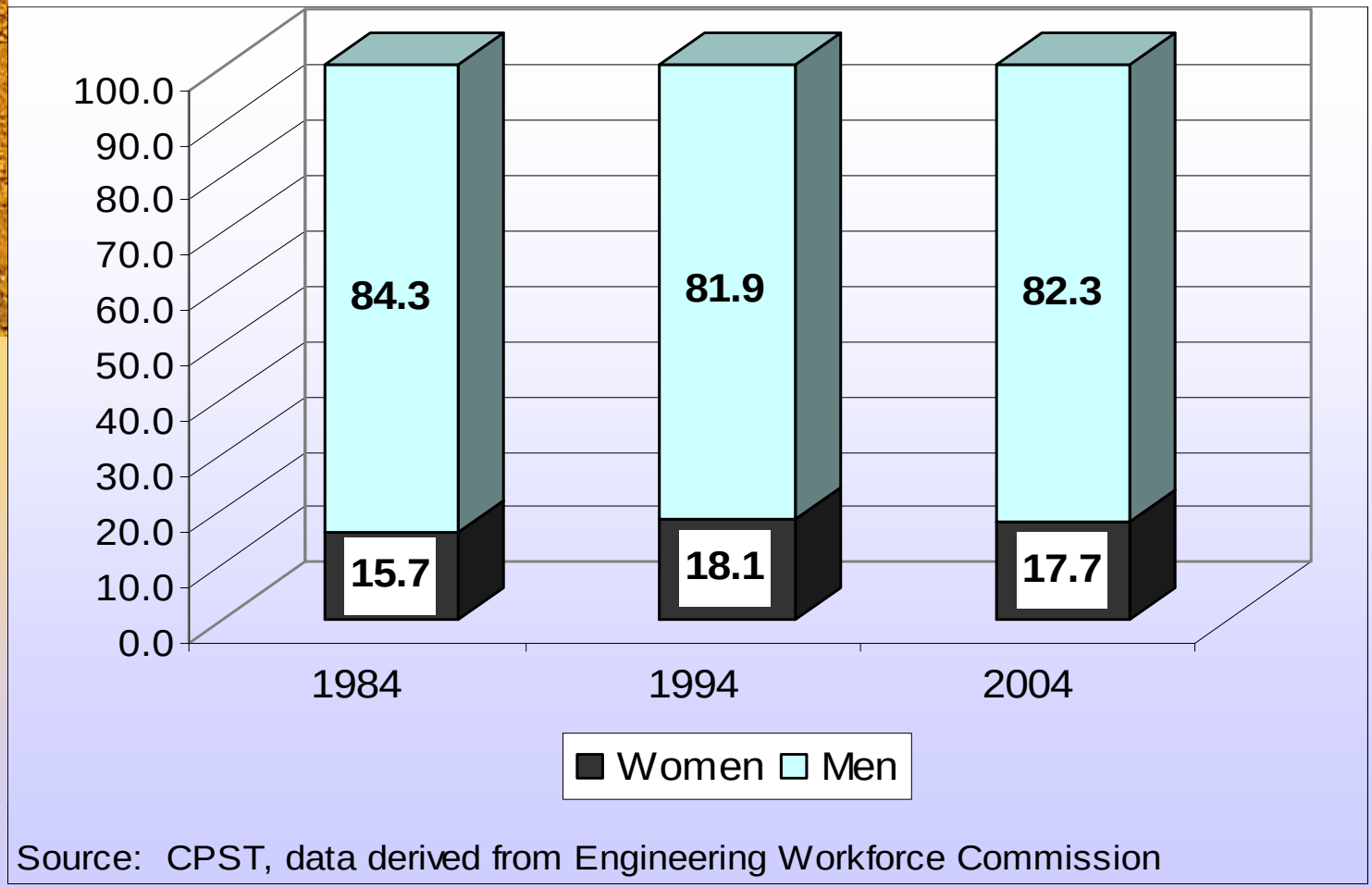

Source: CPST, data derived from National Center for Education Statistics

# Males Far More Likely to Plan to Major in Technical Fields Than are Females



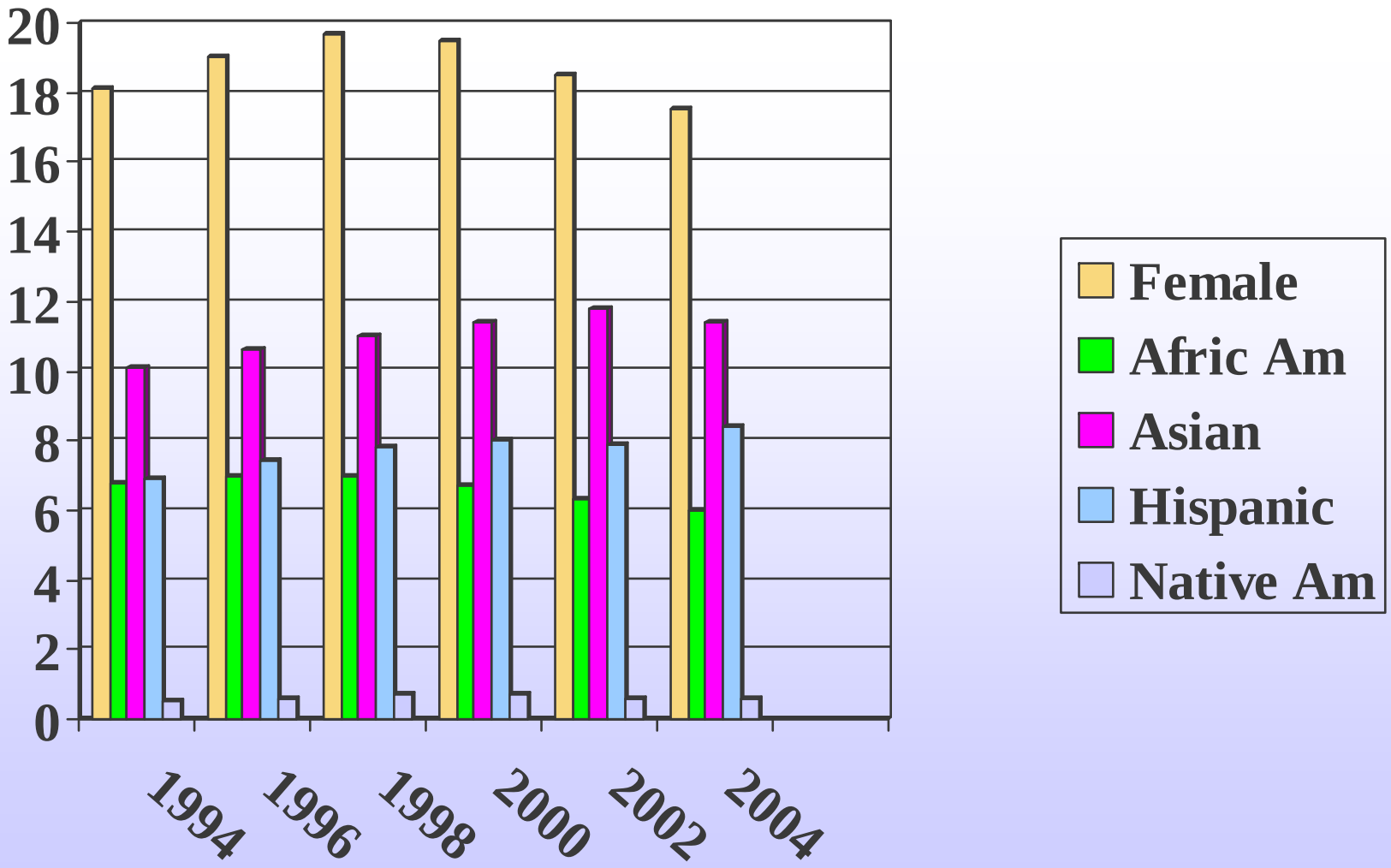

Source: CPST, data derived from Higher Education Research Institute

# Total U.S. Engineering Enrollment of Women – Gains and Losses



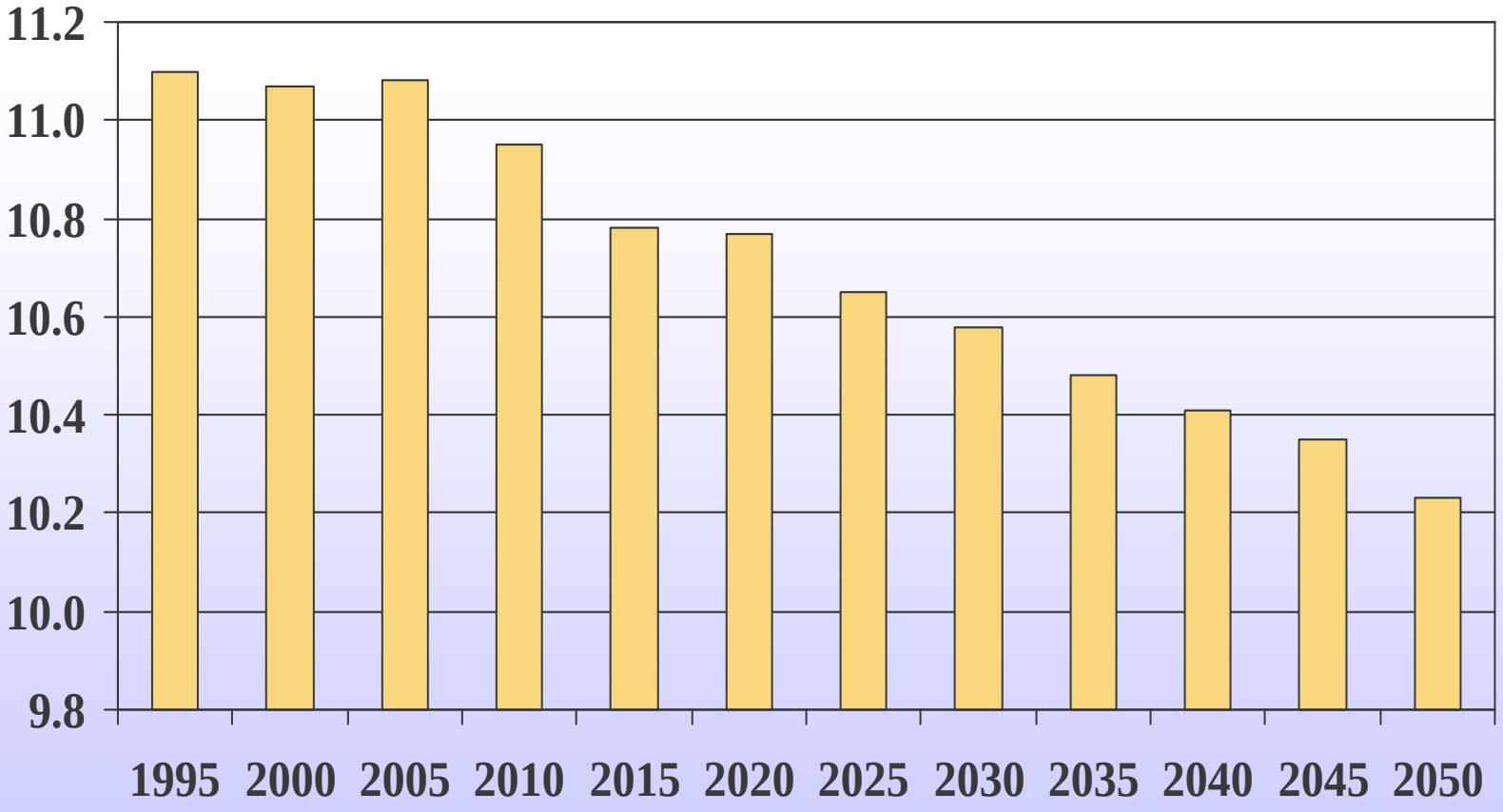

Source: CPST, data derived from Engineering Workforce Commission

# U.S. Undergraduate Engineering Enrollment by Gender/Race/Ethnicity



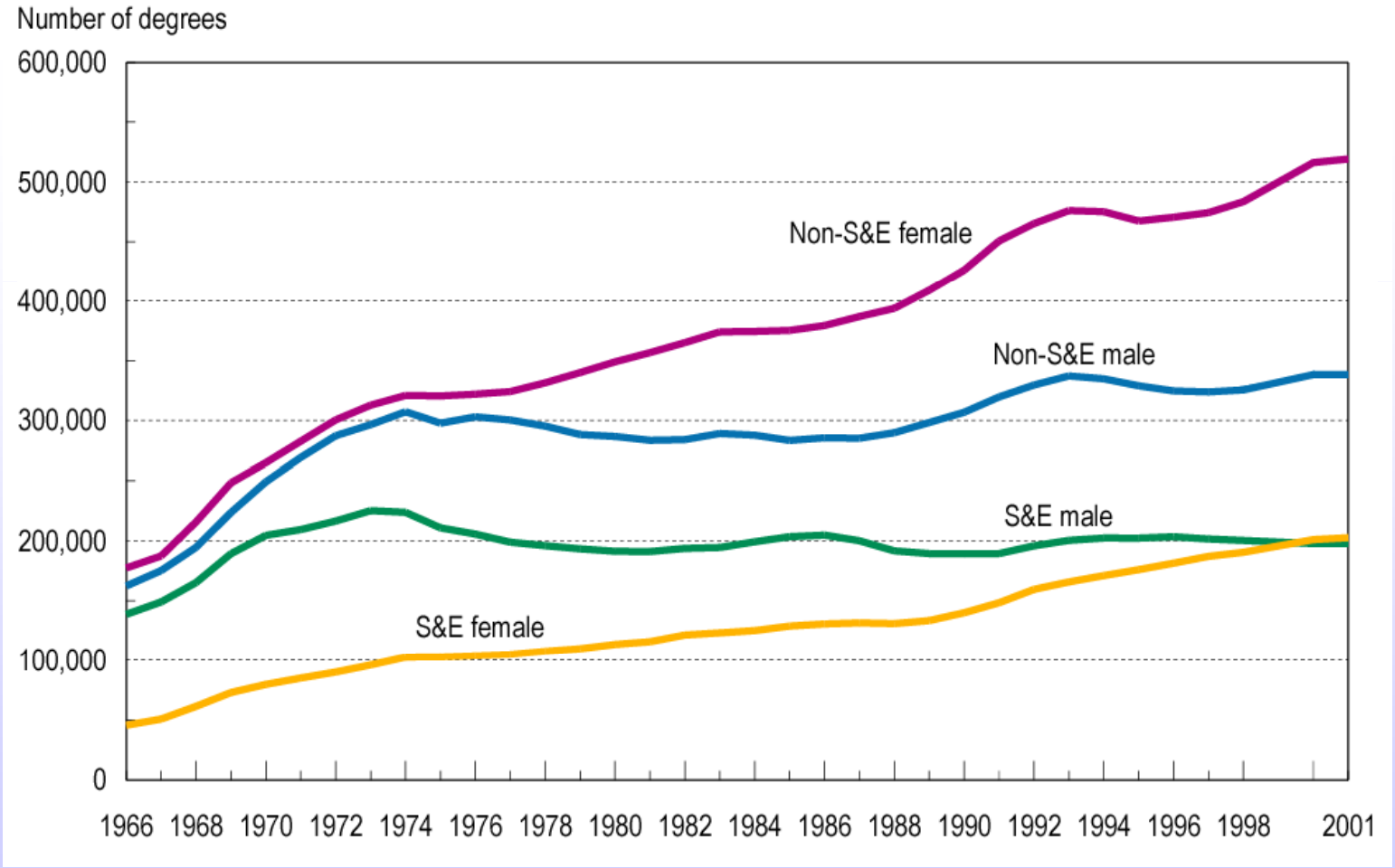

Source: CPST, data derived from Engineering and Technology Enrollments: Engineering Workforce Commission

# Calculated % of 22 Year-Olds Who Would Earn S&E Bachelor's Degrees if Status Quo Remains




**Source: Ensuring A Strong US Scientific, Technical and Engineering Workforce in the 21st Century National Science and Technology Council, April 2000.**

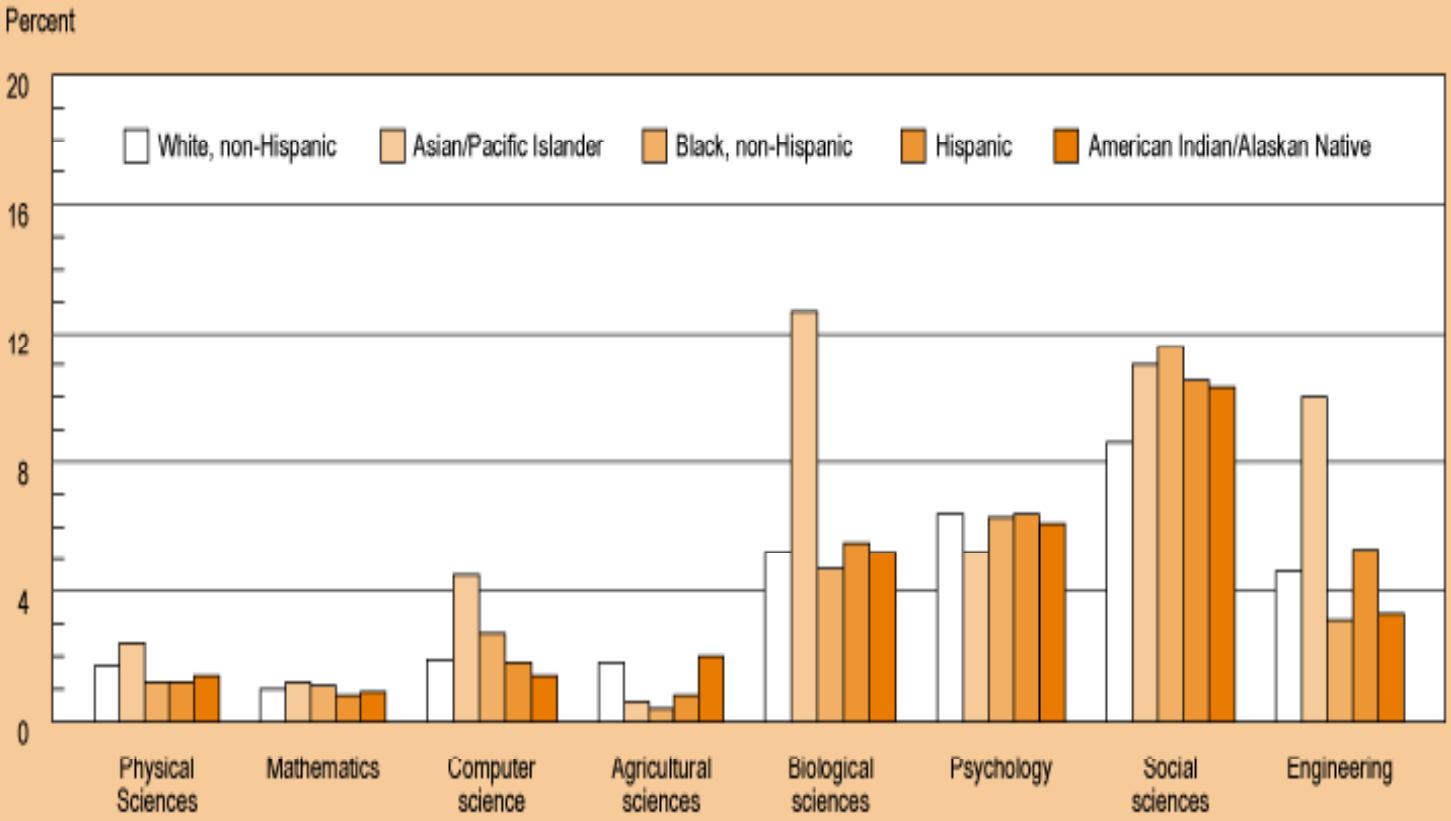
# Bachelor's degrees awarded in S&E and non-S&E fields, by sex: 1966–2001




Source: Women, Minorities and Persons with Disabilities in Science and Engineering, 2002
National Science Foundation

Figure 3-4

**Percentage of all bachelor's degrees awarded in various S&E fields, by race/ethnicity: 1998**

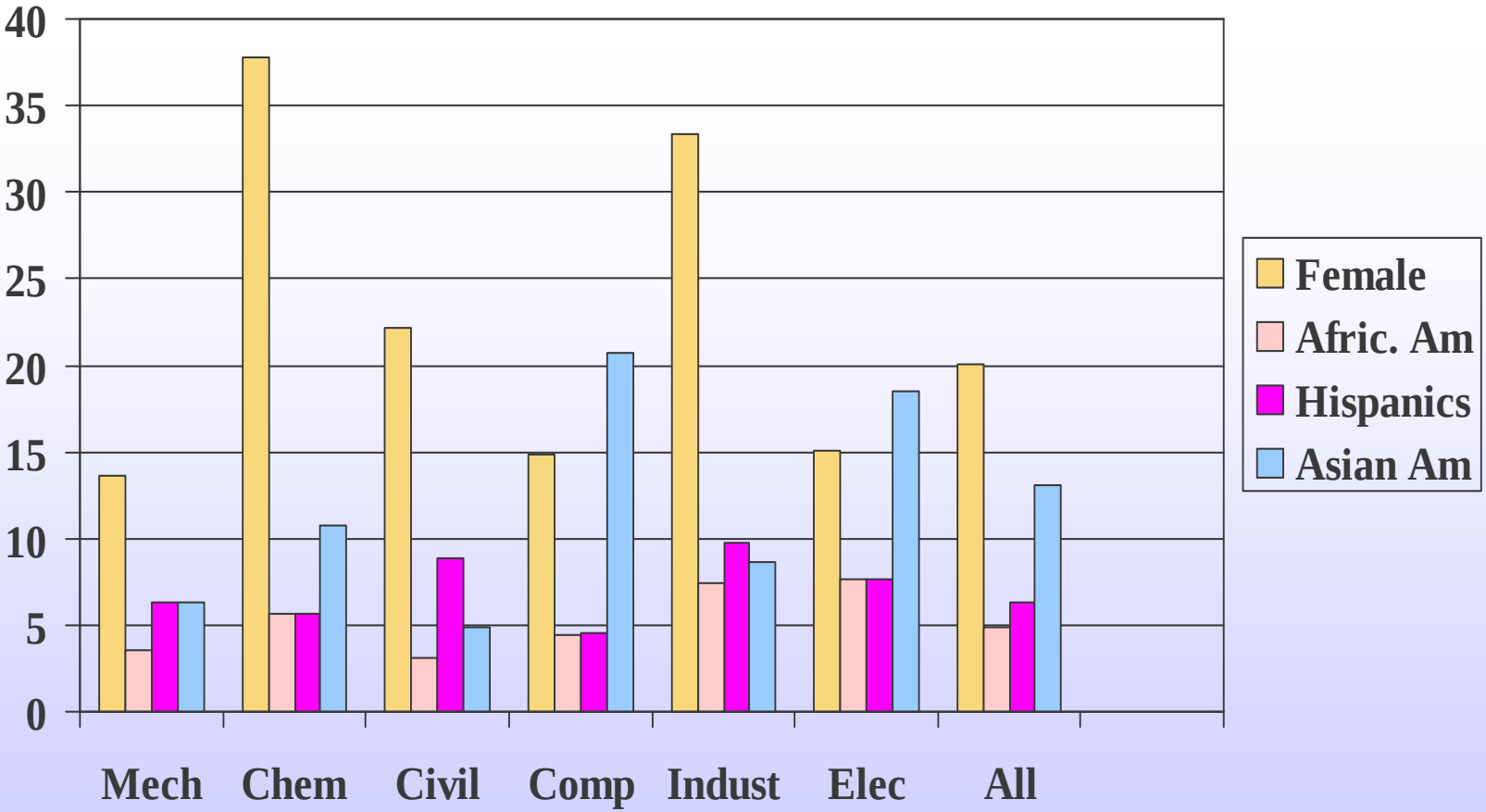



**NOTE:** Data on race/ethnicity are for U.S. citizens and permanent residents only and do not include students on temporary visas.

**SOURCE**: Tabulations by National Science Foundation, Division of Science Resources Statistics; data from U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, various years.

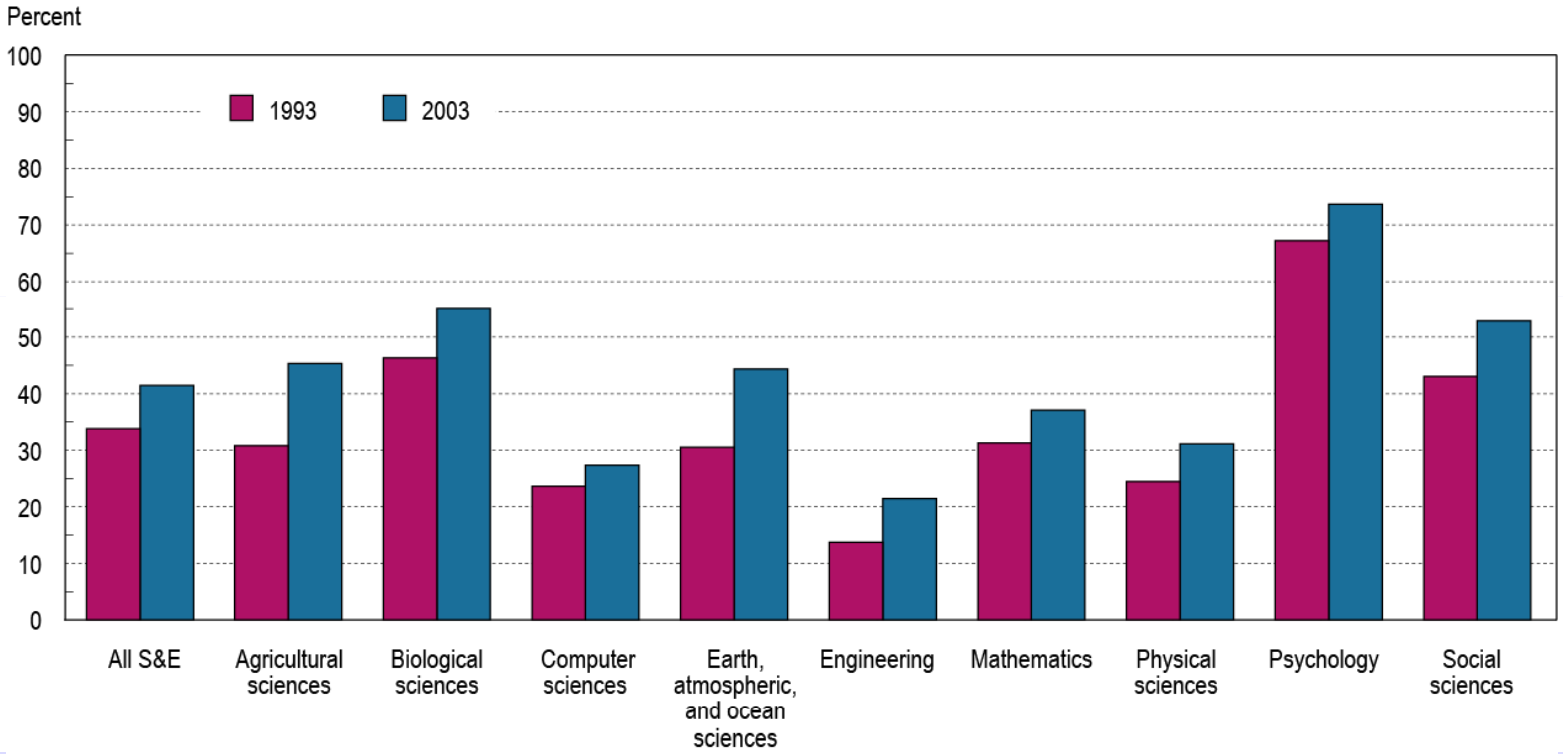
*Women, Minorities, and Persons With Disabilities in Science and Engineering: 2002*

# Bachelor's Degrees Granted by Engineering Discipline 2004



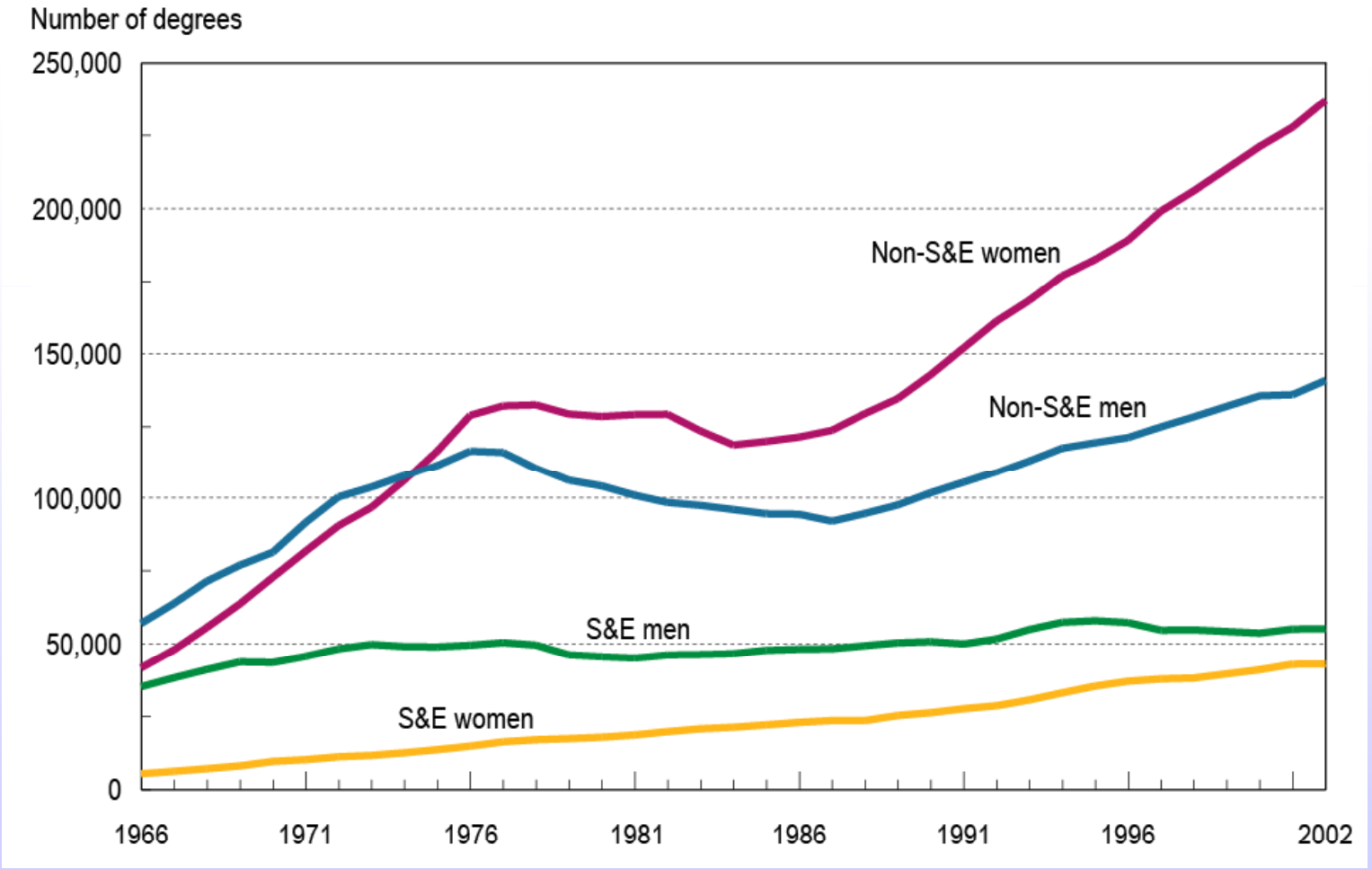

Source: CPST, data derived from Engineering and Technology Enrollments: Engineering Workforce Commission NOTE: Native Americans less than 1% in all categories.

# Female share of S&E graduate students, by field: 1993 and 2003



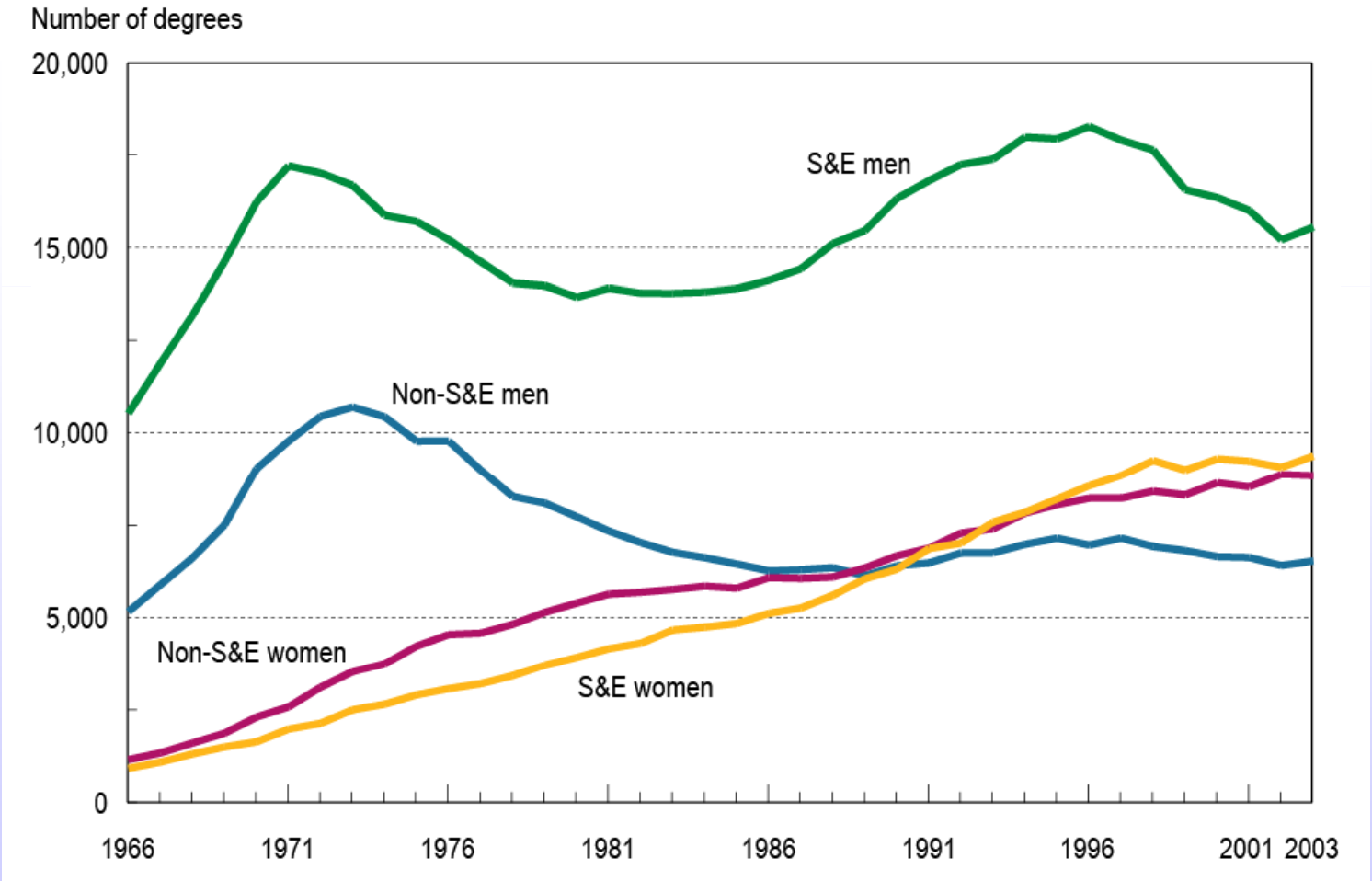

Source: Women, Minorities and Persons with Disabilities in Science and Engineering, 2002 National Science Foundation

# Master's degrees awarded in S&E and non-S&E fields, by sex: 1966–2002



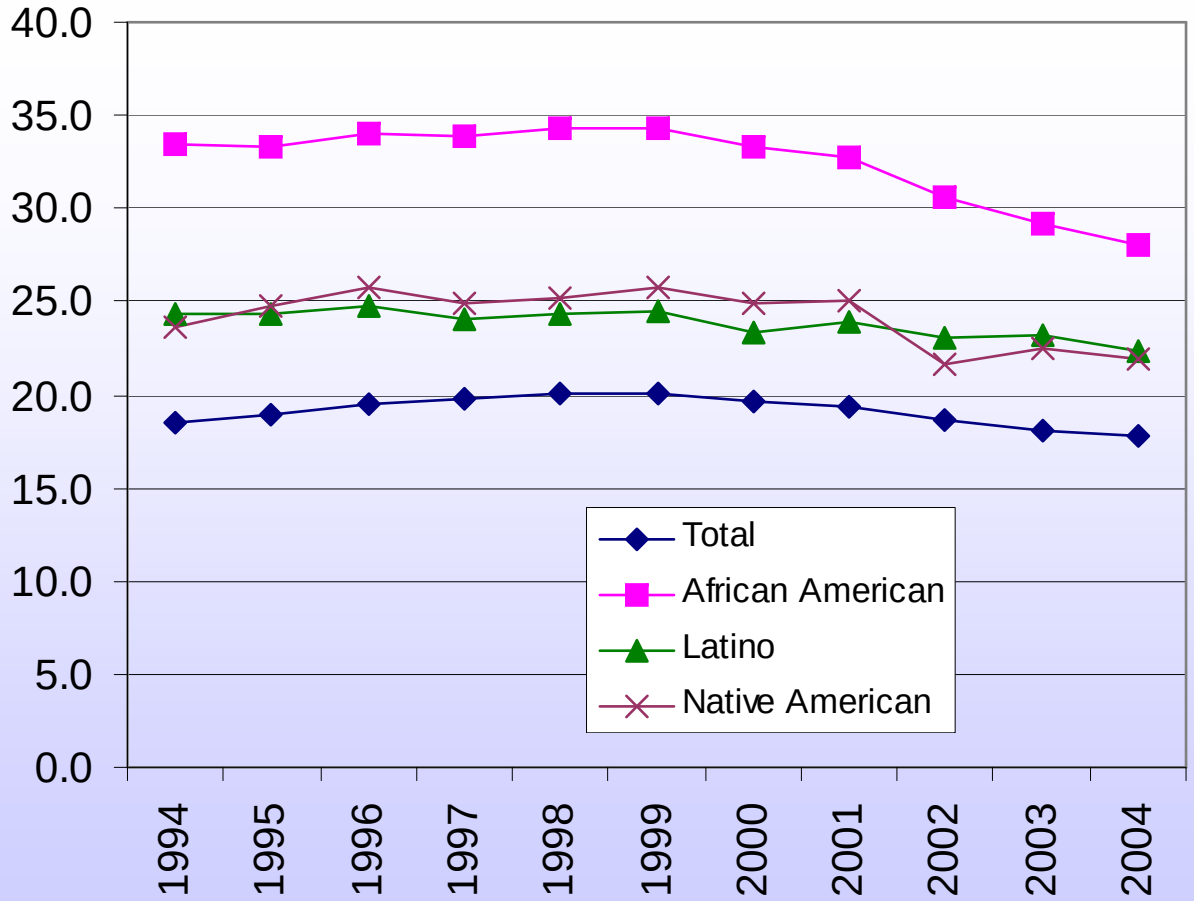

Source: Women, Minorities and Persons with Disabilities in Science and Engineering, 2002 National Science Foundation

# Doctoral degrees awarded in S&E and non-S&E fields, by sex: 1966–2003




Source: Women, Minorities and Persons with Disabilities in Science and Engineering, 2002 National Science Foundation

# The Decline of Women in Engineering Evident for all Races/Ethnicities




Source: CPST, data derived from Engineering Workforce Commission

# What is Engineering?
# What Do Engineers Do?

- 42% Americans feel they are “not **very well** informed about engineering and engineers”.
- 24% Americans feel they are “not **at all** well informed about engineering and engineers”.

**Source: Harris Poll Commissioned by American Association of Engineering Societies, AAES 2003**

**Chronicle of Higher Education**
**February 17, 2006**
**Full Page Ad: CDW-G**

***The Right Technology  Right Away***

# Time Magazine Feb. 06, 2006

## Looking for a Lab-Coat Idol

- In the U.S., about 50,000 take part in the fairs. Stanford University president John Hennessy is worried about a lack of role models, among other things. "We have [TV] shows about doctors, lawyers, politicians. Where are our role models of scientific innovation?" asks Hennessy. "We need Eddie the Engineer or Sam the Scientist."

# Evaluate your potential future as a mechanical engineering major by asking yourself these questions:(WorldWideLearn.com)

- How are your grades in math and science? If you struggle, choose another specialty. If you do well and ask for more, mechanical engineering might be the right choice.

- Do you have a curiosity about how things work? Have you found yourself taking things apart and putting them back together? This curiosity is a natural attribute of the mechanical engineer.

- If you live to discover new or better ways to do things, you are definitely in the right track.

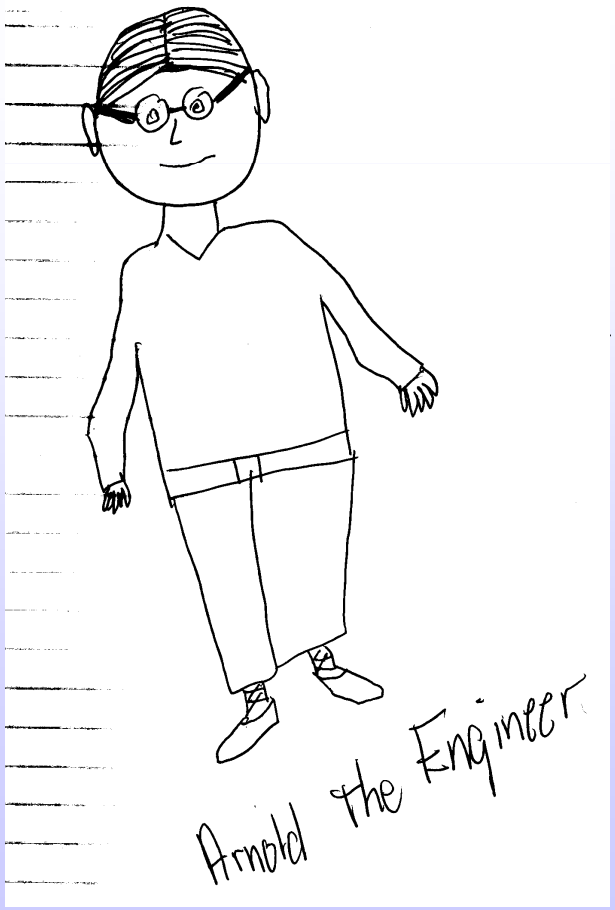
# COLLEGE BOARD WEBSITE

## Search for Majors: Electrical Engineering

- As an electrical engineering major, you'll study electricity: how it works, how it's generated, and how it's used to power everything from light bulbs and radios to cell phones and robots. You'll also learn how to design your own electric-powered projects.

**Source: http://www.collegeboard.com/csearch/majors_careers/profiles/**

# Draw-an-Engineer, adapted from Draw-A-Scientist Test (DAST) first developed by D.W.Chambers, 1983.




Artist:
4th grade
girl, 2002

# High School Girls' Perception of Engineering

**According to a recent study conducted by WGBH in Boston for the American Society of Civil Engineers……**

- High school girls believe that engineering is for people who love math and science. They don't have an understanding of engineering, show an interest or think it is for them. They perceive engineering as a profession for men.

**Source: Extraordinary Women Engineers Final Report, 2005**

# High School Girls and Engineering Key Issues and Findings

- Engineering is portrayed as very challenging and stress importance of superior math and science skills. Messages do not include benefits and rewards of being an engineer.
- Professional interests for girls hinge on relevance - the job is rewarding and the profession is for someone “like me.”
- Career motivators for high school girls: enjoy their job, have a good work environment, make a difference, earn a good salary, and have flexibility.
- High school girls react positively to personal and informational stories. How does engineering align with their career motivators?

**Source: Extraordinary Women Engineers Final Report, 2005**

# Key Messages to Convey *High School Girls Tell Us To:*

- Share more stories of how people's lives have been affected by engineers.
- How engineering is not just about drafting and cars..it can be about social issues, and third-world countries becoming better and citizens happier.
- Talk about hands-on fun, that it's not sitting in a cubicle all day, but it's traveling the world, making a difference, seeing your creations come to life.
- Tell us that engineers not only make good money, but contribute to the well-being of the human race.

**Source: Extraordinary Women Engineers Final Report, 2005**

# Challenge: To Engage Students *Convert Perception of Engineering*

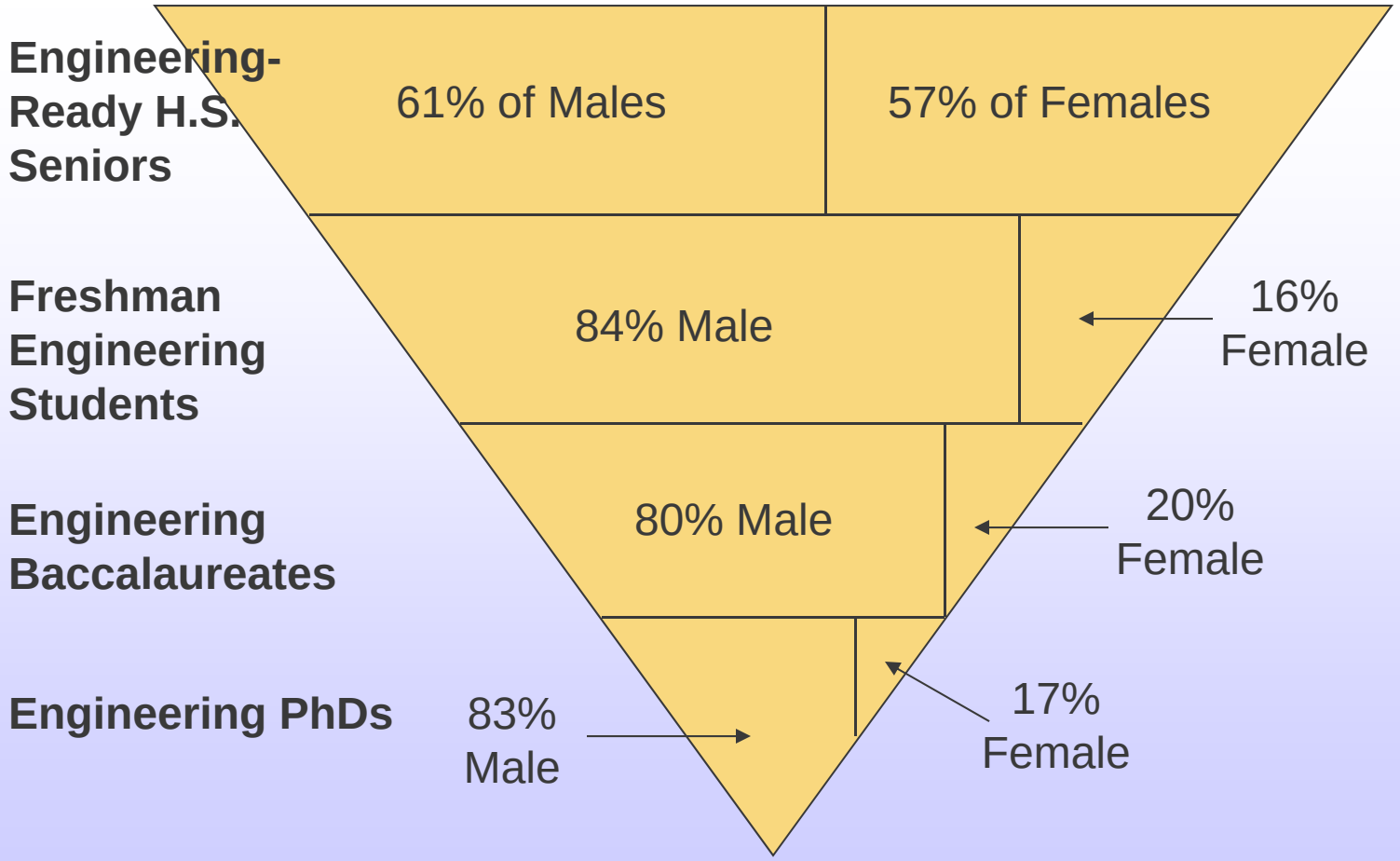
FROM THIS…….

- Nerd
- Math and science geek
- Must be brilliant
- White male
- Primarily works with machines
- Communicates poorly
- Boring
- Rigid

TO THIS……

- Creative
- Enjoys and does well in math and science
- Likes to solve problems
- Works in teams
- Helps people
- Improves the quality of life
- Curious

# Educational Pathway for Engineering




Source: CPST derived from National Center for Education Statistics

# You Make a Big Difference!!

- "My lab partner never let me do things with the equipment. He told me I was better at writing than he was which was true. But, my teacher made us switch (roles). That was good because I wouldn't have asked even though I wanted to."

  ***10th grade female***

- "I wouldn't have even thought about engineering if my math teacher didn't give me the ECOES (engr. summer program) brochure. My parents can't believe it, but I'm going to major in engineering in college."

  ***11th grade female***

- "I always worked hard and did pretty well in math and science, but never thought I was smart enough to study engineering. I'm an engineering major because my science teacher told me I could do it and I'm doing amazingly well."

  ***College female sophomore***

# Strategies

- Conduct middle school programs

  Programs and Practices That Work

  Award Winners

  Minot Public Schools

  Minot, North Dakota

  High Tech Girls Society

  Minneapolis Public Schools

# Strategies

- Conduct pre-technical training programs

Rosies Girls

Northern New England Tradeswomen

IGNITE

Seattle Public Schools

Programs and Practices That Work 2007 Award Winner

# Strategies

- Conduct targeted recruitment activities

Summer Camps

Cisco Gender Initiative Strategies

I am an Engineer

Cisco Systems, Inc.

# Strategies

- Provide role models, mentors and job shadowing

Girls E-Mentoring in Science, Engineering and Technology GEM-SET

USDOL, Women's Bureau

Engineer Girl

National Academy of Engineering

MentorNet

# Strategies

- Invite, involve and educate parents

Talented Girls Bright Futures

Publication by Project Lead the Way

American Careers:

Expanding Career Options

Publication by the National Alliance for Partnerships in Equity

# Strategies

- Collaborate with community-based organizations

Operation SMART

Girls, Inc.

# Strategies

- Invite, involve, and educate business

Cisco Systems, Inc. Gender Initiative

Cisco Systems, Inc.

Society of Women Engineers

# Engineering Equity Extension Service

- Partnership of Project Lead The Way and the National Alliance Partnerships in Equity with the National Academies of Engineering
- Other participating organizations
  - Institute of Electrical and Electronics Engineers
  - American Society of Mechanical Engineers

National Alliance for Partnerships in Equity

EEES
Engineering Equity Extension Service

project lead the way

# EEES Project Goal

- To provide national extension services (similar to the agricultural community) to the pre-engineering and engineering communities, bringing together:
  - Expertise in gender studies
  - The research base on science and engineering education
  - Practical skills in project management

# EEES Project Objectives

- To increase teacher and faculty familiarity with the current and emerging knowledge bases on gender equity, engineering education, and project management in such a manner that they are inextricably linked in the minds of our target audiences.
- Emphasis will be placed on teachers and faculty who may not be actively engaged in/pursuing gender equity activities.

# PLTW/NAPE Partnership

- Constituencies
  - State Leaders
  - Affiliate Universities
  - Master Teachers
  - Guidance Counselors
  - Teachers

# PLTW/NAPE Partnership

- Objectives
  - Curriculum Review
  - Master Teacher Training
  - Implement Activities at Summer Training Institutes
  - Guidance Counselor Training
  - Develop Cadre of Turnkey Trainers/Extension Agents

# Curriculum Review

- Review PLTW Curriculum
  - Year 2 – GTT, IED and CIM
  - Year 3 – POE and DE
  - Year 4 – CEA, BE, AE, EDD
- EEES Experts submit recommendations to Curriculum review team

# Master Teacher Training

- Implement equity in engineering training at STI prep sessions
  - Year 1 – Awareness, Root Causes and Strategies for Recruitment and Retention
  - Year 2 – Recruitment and Inclusive Classroom Instructional Strategies
  - Year 3 – Best Practices in PLTW
  - Year 4 & 5 – Currently Being Planned

# Master Teacher Training Results

- Master Teacher Turnkey Trainer Group
- Activities being conducted at Summer Training Institutes
  - Increase the awareness of PLTW teachers to the diversity crisis in engineering
  - Highlight programs that have been successful in recruiting and retaining diverse students
  - Model inclusive instructional strategies and emphasize teachable moments
- NAPE/PLTW EEES Resource Website- www.napequity.org/eees.htm

# Guidance Counselor Conferences

- Train the Trainer Webinar
  - What is Engineering?
  - Aug. 30 – 2pm ET
  - Sept. 20 – 6:30pm ET
  - Contact cvogt@nae.edu to register
- Train PLTW and NAPE "extension agents" to be prepared to present
- Include this and other presentations at guidance counselor conferences

# Sample Resources

- National Academy of Engineering, Engineering Equity Extensions Service, Virtual Support Network

  http://eees.nae.edu/

- National Alliance for Partnerships in Equity

  www.napequity.org

# Additional Resources

Have your school become an Affiliate Member of the

National Alliance for Partnerships in Equity

P.O. Box 369

Cochranville, PA  19330

610-593-8038 phone

610-593-7283 fax

www.napequity.org

National Alliance for Partnerships in Equity