

# Breaking through Barriers for Women & Girls in Science, Technology, Engineering & Math



Betsy Dell

Assistant Professor- Mechanical  
Engineering Technology  
& Paul A. Miller Professor  
Director- Women in Technology  
Rochester Institute of Technology



# Overview



- ❧ AAUW's 2010 Report: Why so Few?
- ❧ RIT's AAUW Campus Action Programs
- ❧ Fairport School District's Single Gender Technology Courses
- ❧ Conclusions
- ❧ Q&A and General Discussion

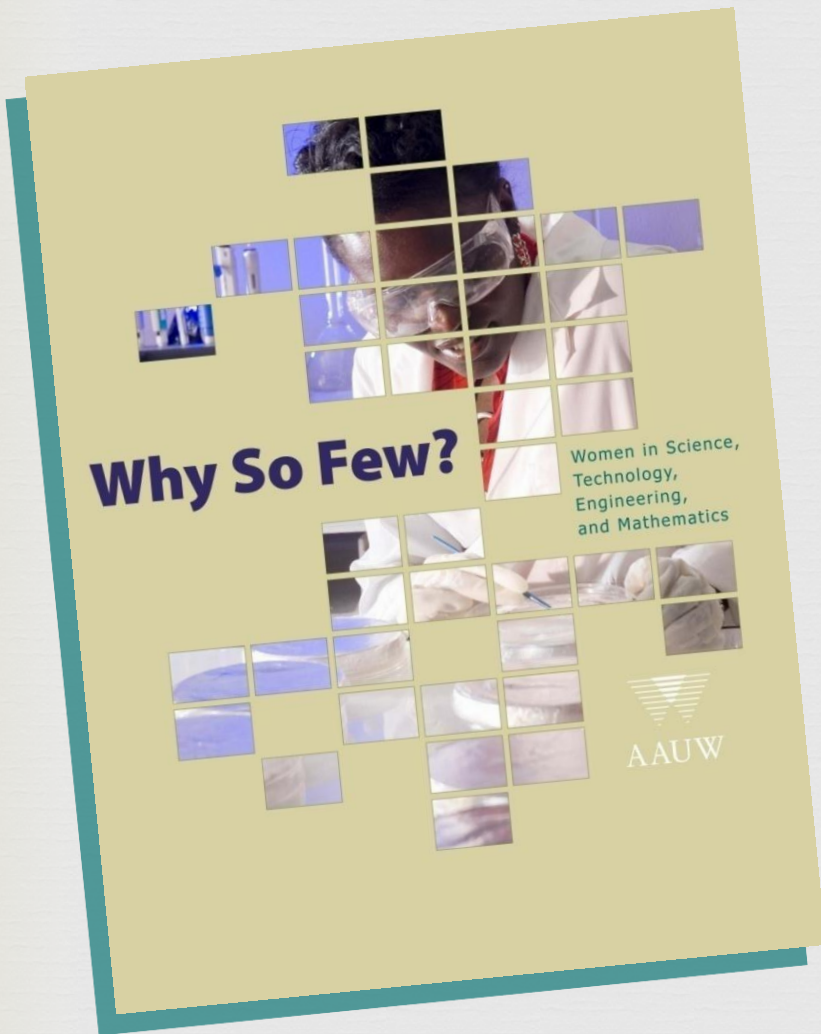




AAUW

**Breaking through Barriers**

**for Women and Girls**



***Why So Few?  
Women in Science,  
Technology,  
Engineering, and  
Mathematics***



This report was made possible by the generous contributions of



The National Science Foundation

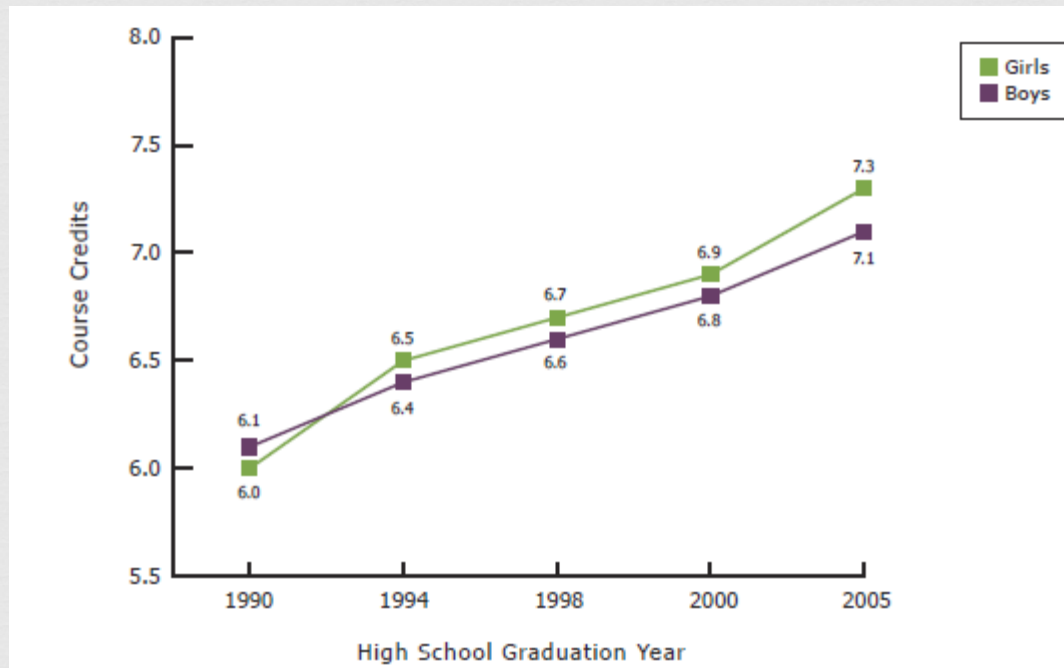
The Letitia Corum Memorial Fund

The Mooneen Lecce Giving Circle

The Eleanor Roosevelt Fund

Girls' performance and participation in math and science subjects in high school has improved over time and, in some cases, has surpassed that of boys.

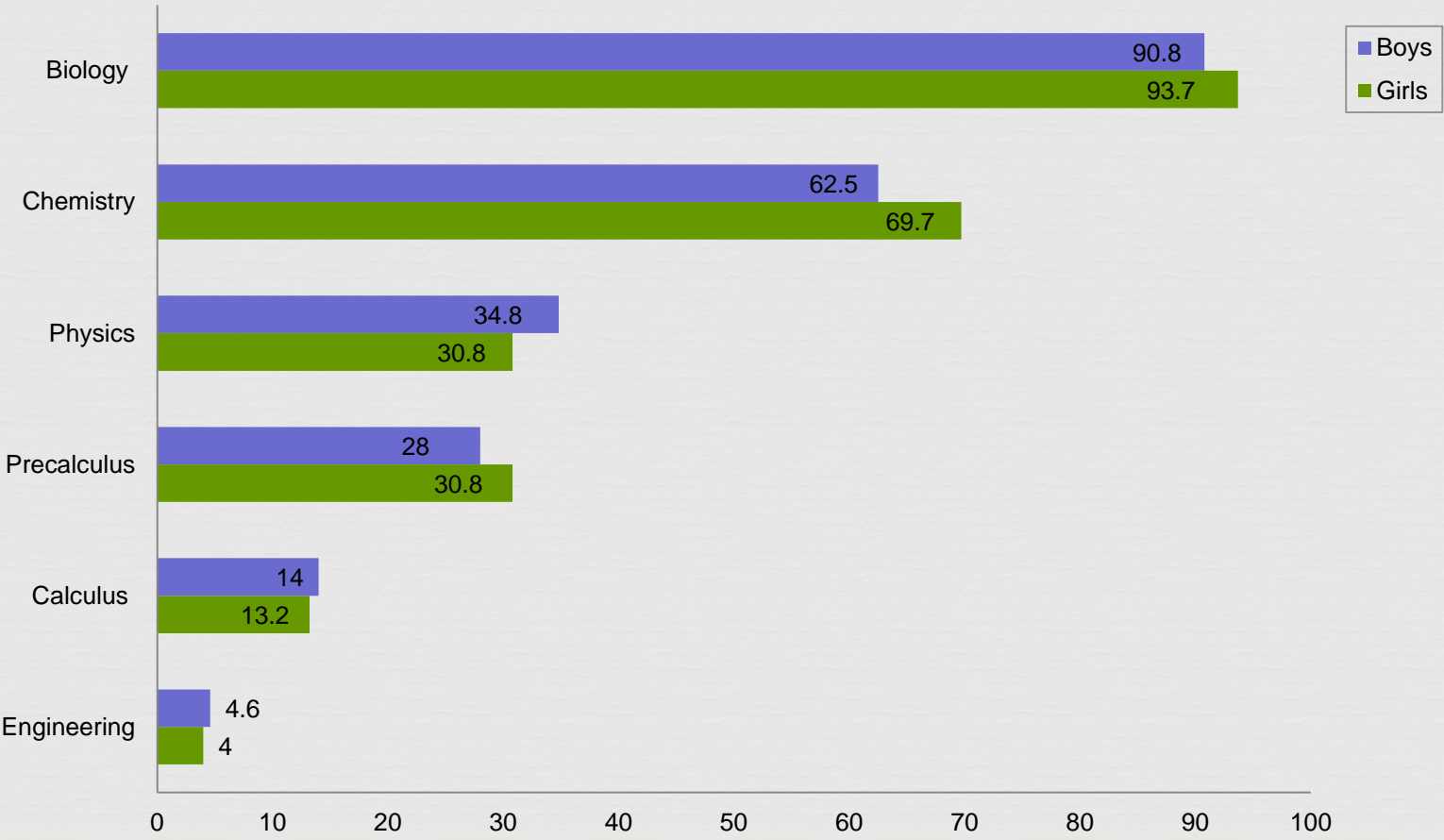
In high school, both boys and girls are earning more credits in math and science over time, and girls earn more credits than boys do.



## High School Credits Earned in Math and Science, by Gender, 1990-2005

High school girls are more likely to take biology, chemistry, and pre-calculus than boys are, but girls are less likely to take physics.

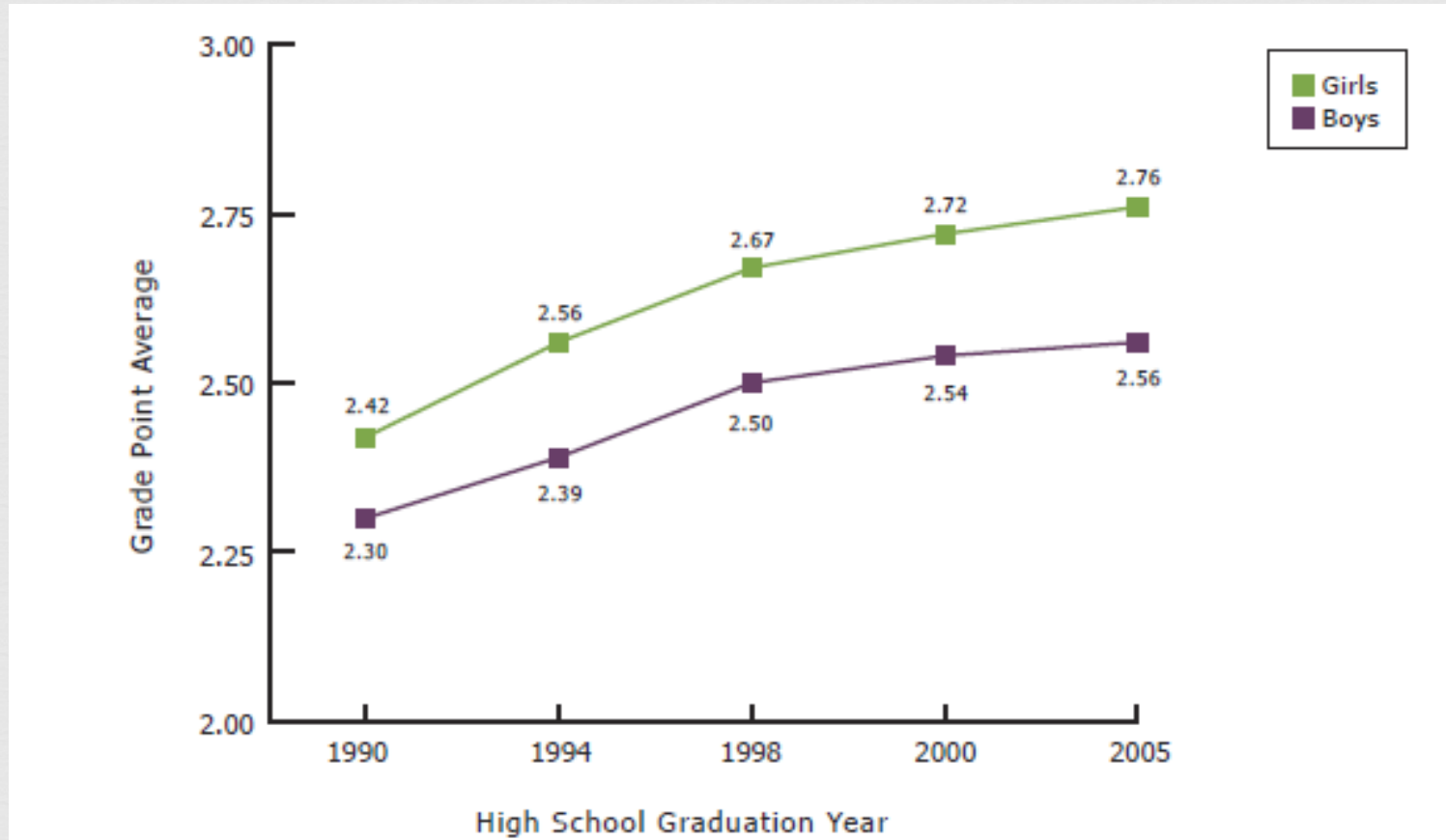
Percentage of High School Graduates Who Took Selected Math and Science Courses in High School, by Gender, 2005



Source: National Center for Education Statistics. (2007). *Digest of Education Statistics*.



Female high school graduates now also earn higher GPAs, on average, in math and science, than their male peers do.

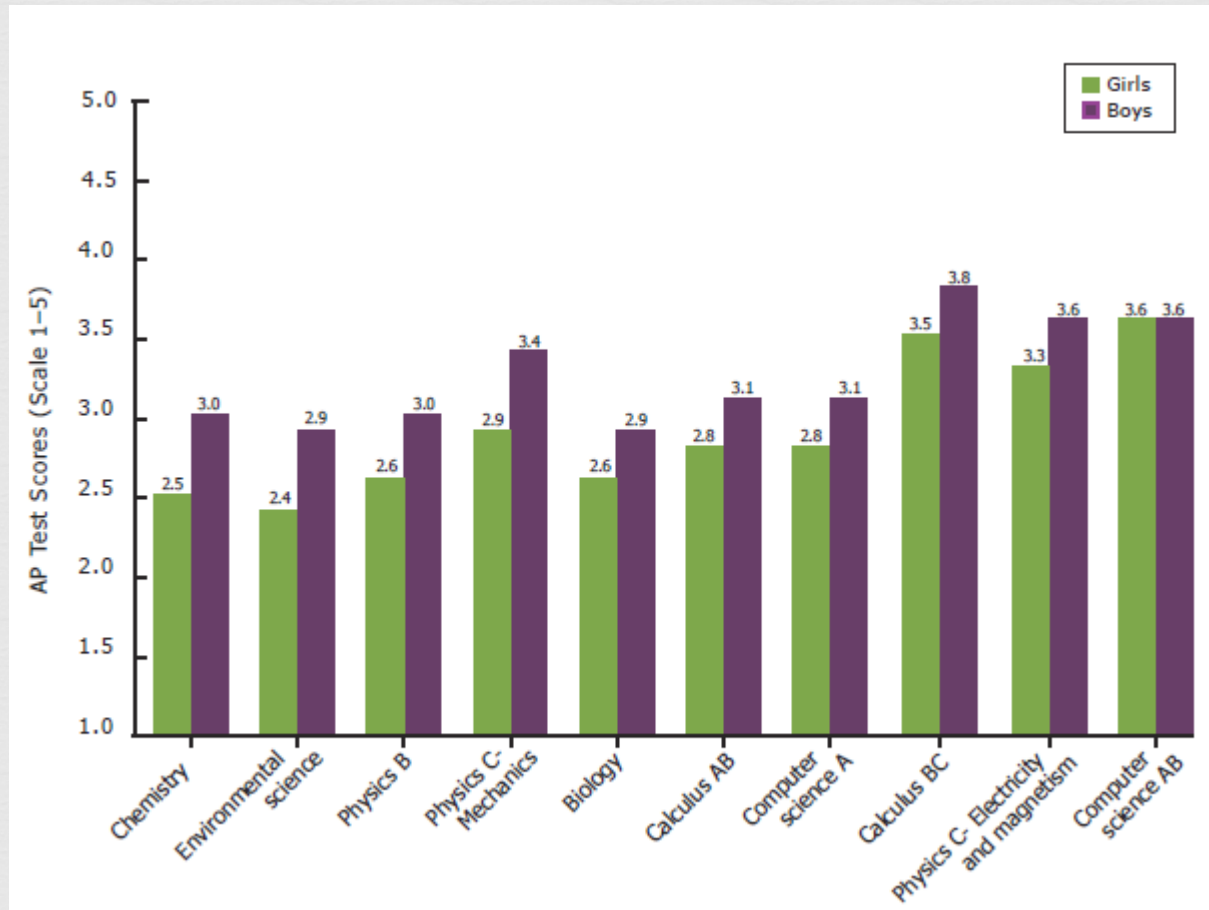


Grade Point Average in High School Mathematics and Science (Combined), by Gender, 1990–2005



Girls' participation and performance on high-stakes tests in math and science in high school are also improving over time, although boys perform better on average.

On average, boys perform better than girls do on Advanced Placement (AP) tests in math and science.

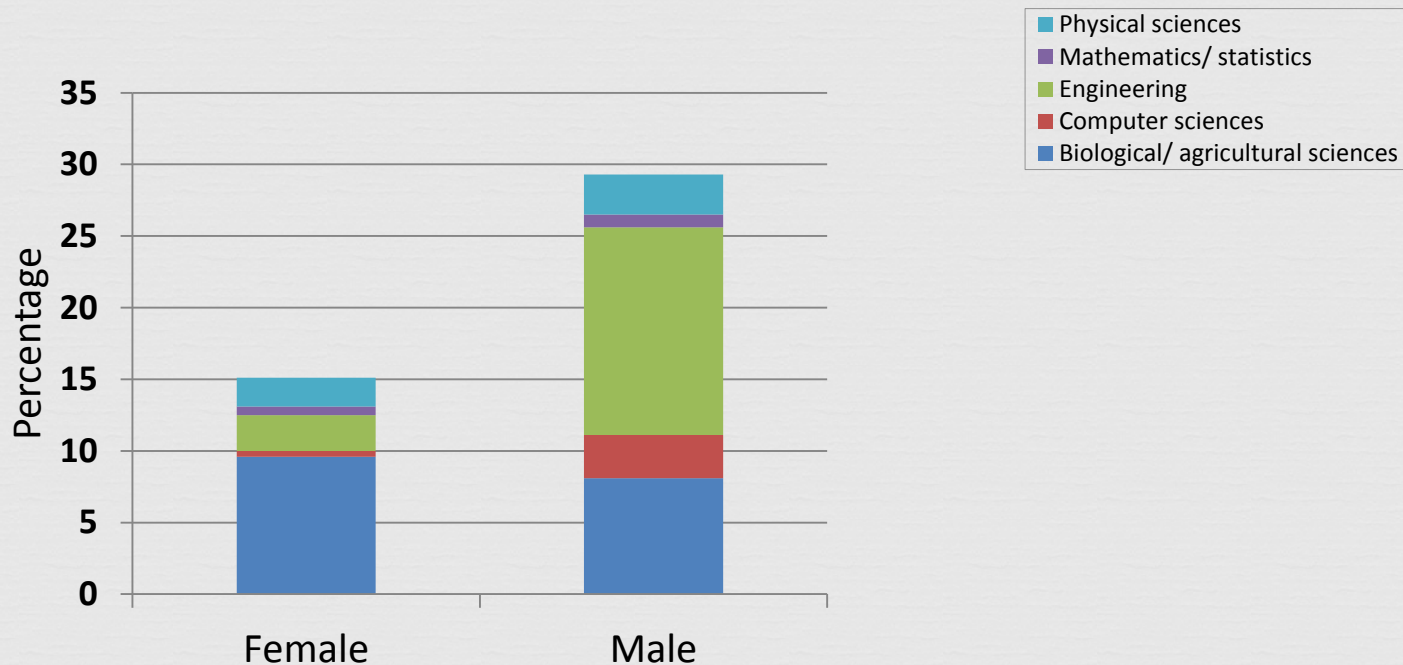


Average Scores on Advanced Placement Tests in Mathematics and Science Subjects, by Gender, 2009

Despite the positive trends in high school, the transition from high school to college is a critical time for young women in STEM (science, technology, engineering, and mathematics).

# Women are less likely than men are to declare a STEM major in college.

## Intent of First-Year College Students to Major in Science and Engineering Fields, by Gender, 2006

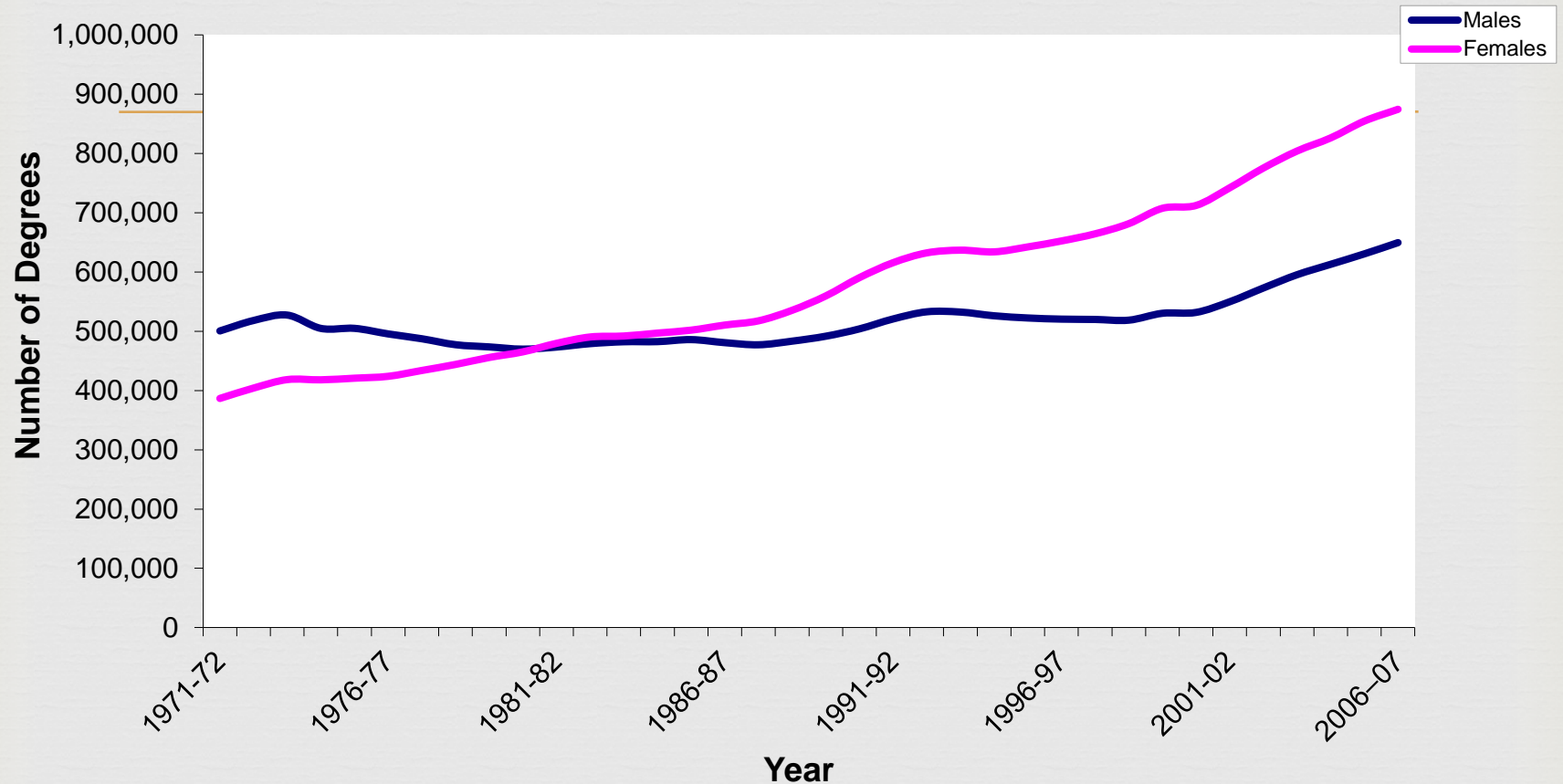


Source: Commission on Professionals in Science and Technology. Data derived from Cooperative Institutional Research Program, Higher Education Research Institute, Graduate School of Education and Information Studies, University of California, Los Angeles, *The American Freshman: National Norms for Fall 1990 through Fall 2006*, [www.gseis.ucla.edu/heri/heri.htm](http://www.gseis.ucla.edu/heri/heri.htm).



# Women have earned the majority of bachelor's degrees since 1982.

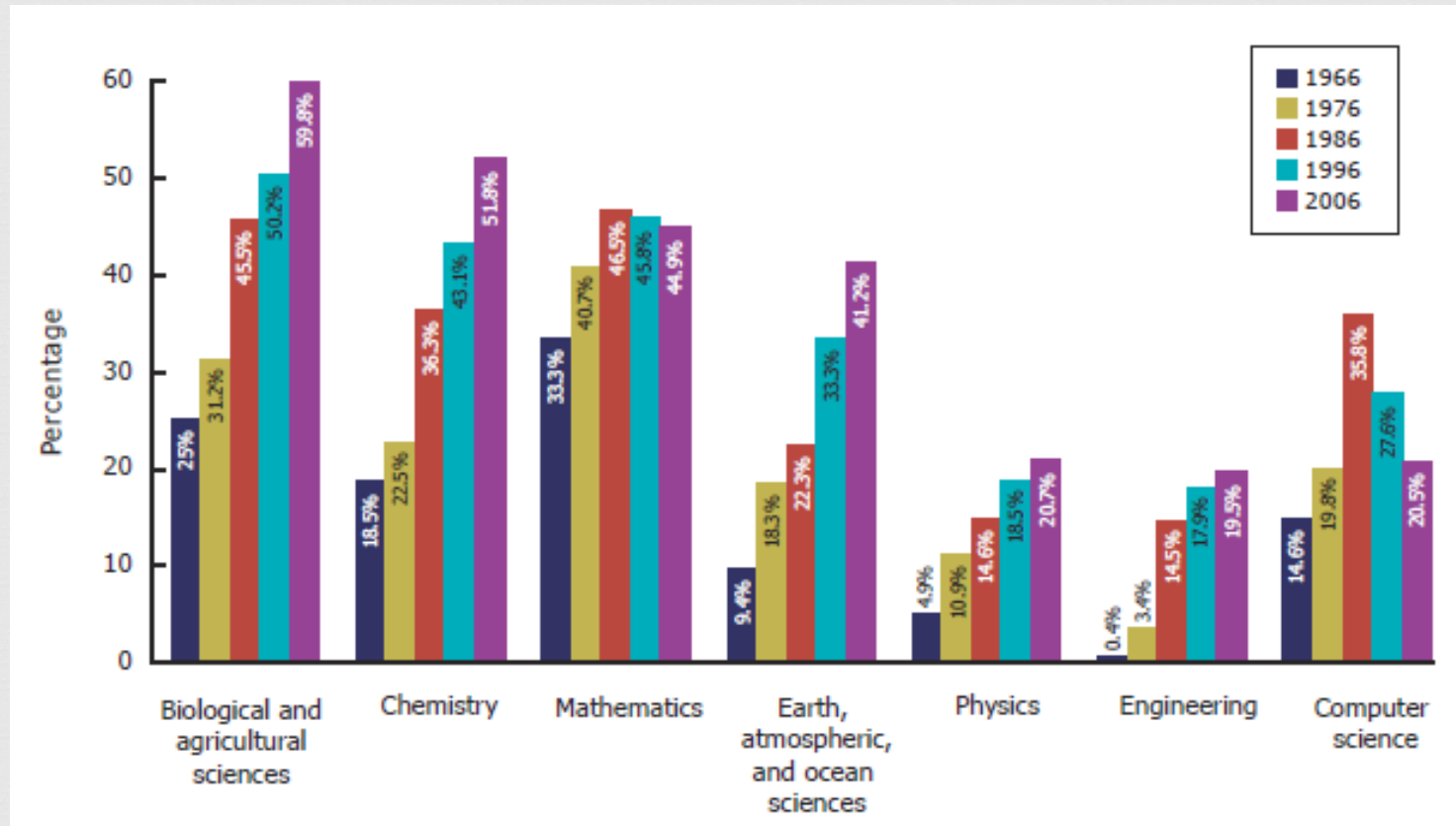
Bachelor's Degrees Conferred, by Gender, 1971-72 to 2006-07



Source: Snyder, T.D., Dillow, S.A., and Hoffman, C.M. (2009). *Digest of Education Statistics 2008 (NCES 2009-020)*. National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

# Women's representation among STEM bachelor's degree holders has improved over time but varies by field.

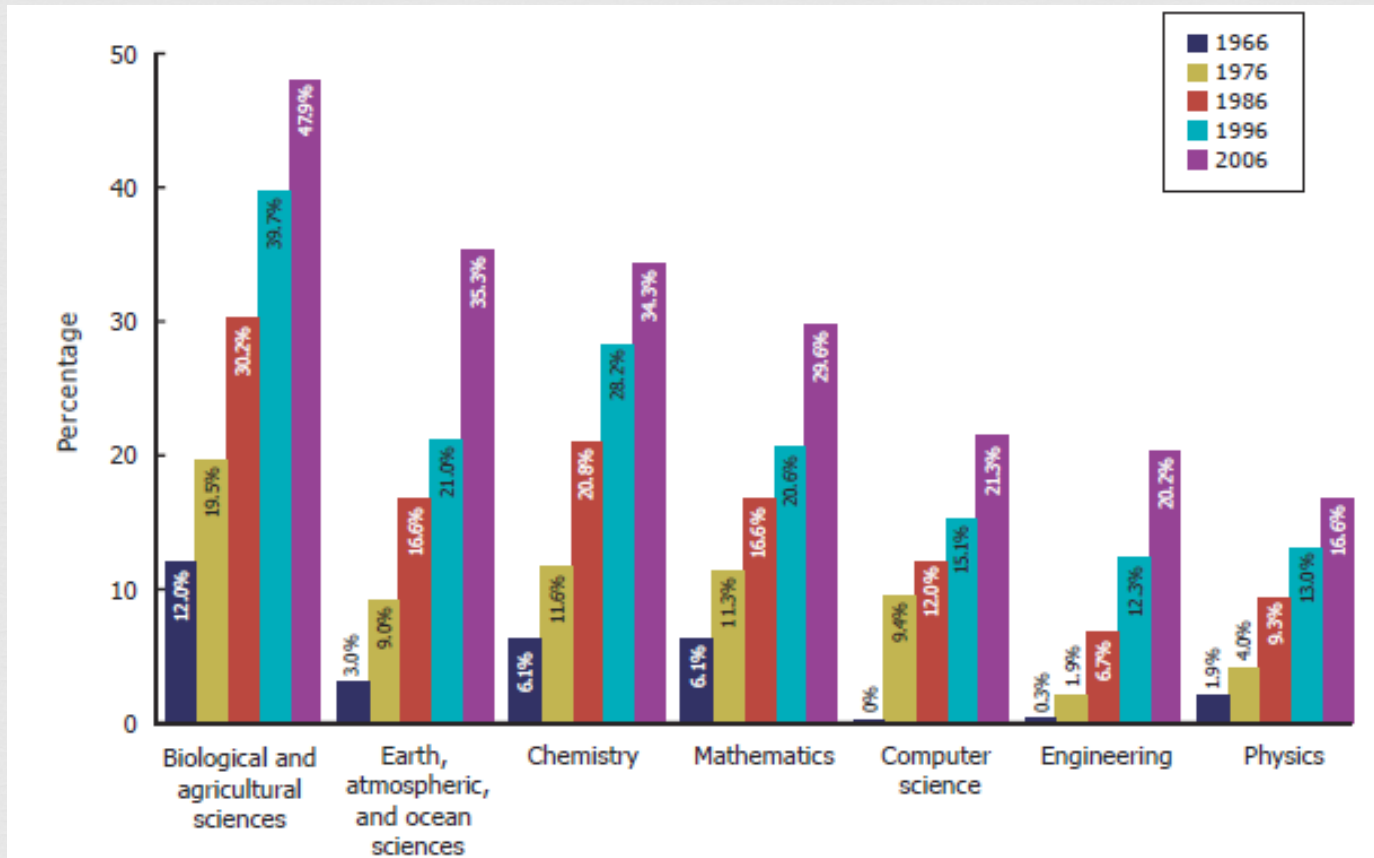
Bachelor's Degrees Earned by Women in Selected Fields, 1966–2006



Source: National Science Foundation, Division of Science Resources Statistics, 2008, *Science and engineering degrees: 1966–2006* (Detailed Statistical Tables) (NSF 08-321) (Arlington, VA), Table 11, Author's analysis of Tables 34, 35, 38, & 39.

# Women's representation among STEM doctorates has also increased dramatically over time, although it varies by field.

Doctorates Earned by Women in Selected STEM Fields, 1966–2006

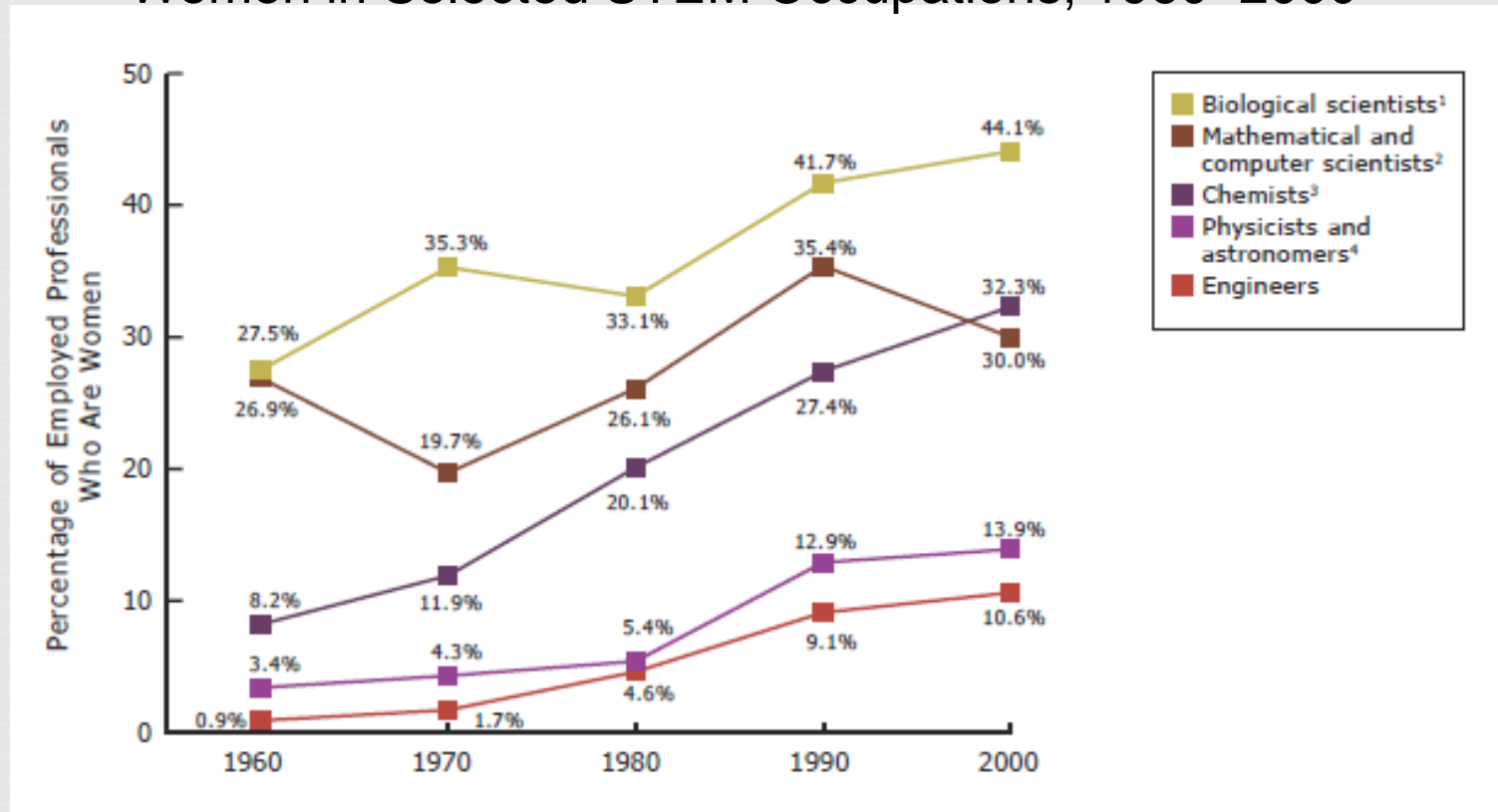


Source: National Science Foundation, Division of Science Resources Statistics, 2008, *Science and engineering degrees: 1966–2006* (Detailed Statistical Tables) (NSF 08-321) (Arlington, VA), Table 25, Author's analysis of Tables 34, 35, 38, & 39.

Women's representation in the  
STEM workforce is also uneven.

Women are well represented among biological scientists but makeup a small minority of engineers.

## Women in Selected STEM Occupations, 1960–2000

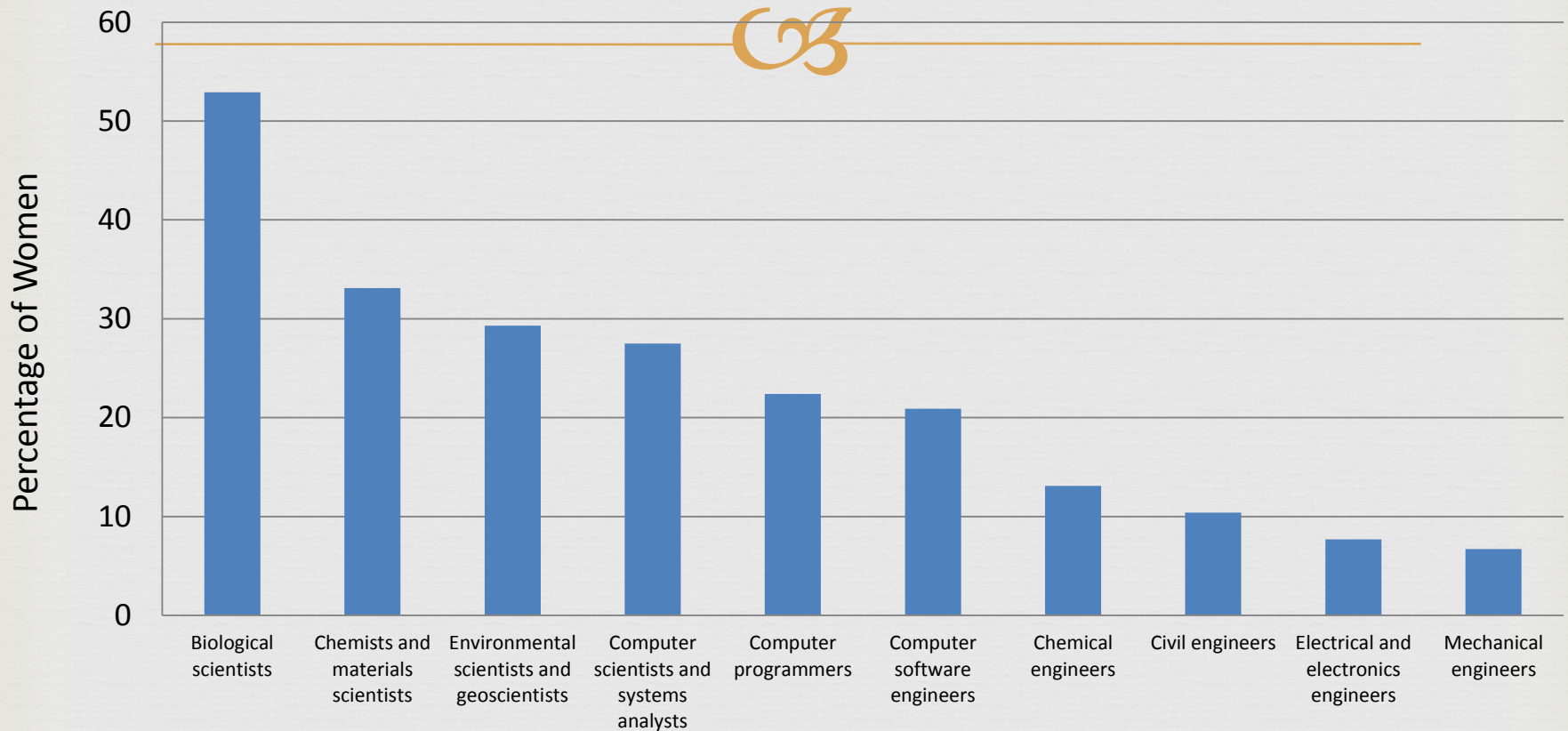


Source: U.S. Census Bureau, 1960, 1970, 1980, 1990, & 2000, Census of the population (Washington, DC).



# Women are underrepresented in many science and engineering occupations.

Percentage of Employed STEM Professionals Who Are Women, Selected Professions, 2008



Source: U.S. Department of Labor, Bureau of Labor Statistics, 2009, *Women in the labor force: A databook* (Report 1018) (Washington, DC), Table 11.

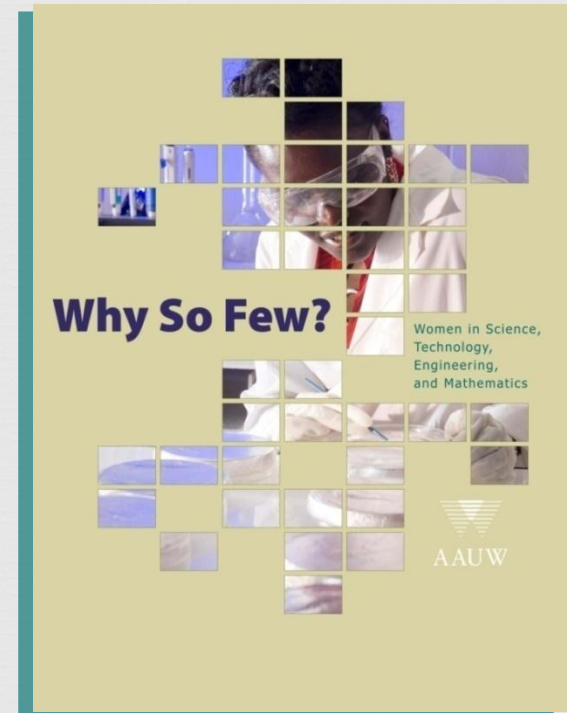
AAUW drew on the large body of academic research on gender in science in a number of fields and identified eight research findings that help to explain the underrepresentation of women and girls in STEM.

# *Why So Few?* presents evidence that social and environmental factors contribute to the underrepresentation of women and girls in STEM.



## Eight research findings in three areas:

- How social and environmental factors shape girls' achievements and interests in math and science
- The climate of college and university science and engineering departments
- Continuing influence of bias



Girls' achievements and interests in math and science are shaped by the environment around them.

Believing in the potential for intellectual growth, in and of itself, improves outcomes.



# In math and science, a growth mindset benefits girls.

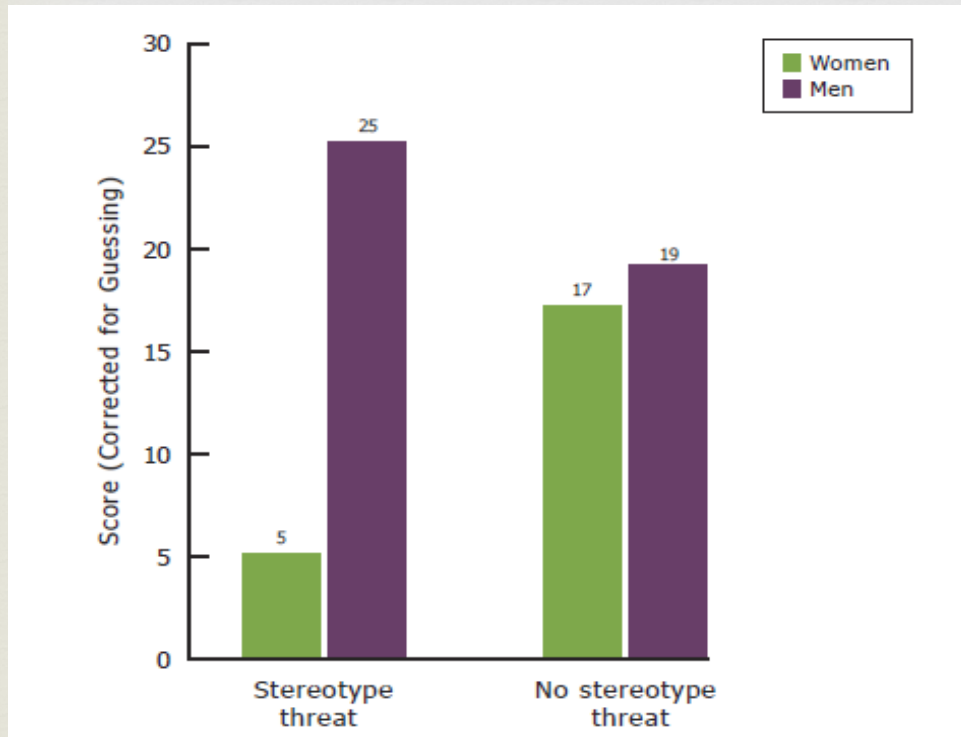
Fixed Mindset	Growth Mindset
<b>Intelligence is static.</b>	<b>Intelligence can be developed.</b>
Leads to a desire to <i>look smart</i> and therefore a tendency to	Leads to a desire to <i>learn</i> and therefore a tendency to
<b>• avoid challenges</b>	<b>• embrace challenges</b>
<b>• give up easily due to obstacles</b>	<b>• persist despite obstacles</b>
<b>• see effort as fruitless</b>	<b>• see effort as path to mastery</b>
<b>• ignore useful feedback</b>	<b>• learn from criticism</b>
<b>• be threatened by others' success</b>	<b>• be inspired by others' success</b>

- ❧ Teach children that intellectual skills can be acquired.
- ❧ Praise children for effort.
- ❧ Highlight the struggle.
- ❧ Gifted and talented programs should send the message that they value growth and learning.

Negative stereotypes about girls' and women's abilities in math and science persist despite girls' and women's considerable gains in these areas in the last few decades.

Negative stereotypes about girls' and women's abilities in math and science adversely affect their performance in these fields.

## Performance on a Challenging Math Test, by Stereotype Threat Condition and Gender

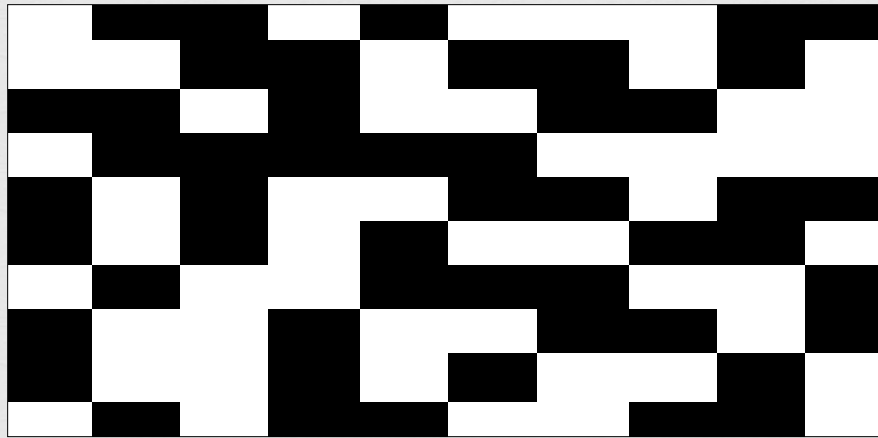


- ✎ Expose girls to successful female role models in math and science.
- ✎ Teach students about stereotype threat.

“Boys do not pursue mathematical activities at a higher rate than girls do because they are better at math. They do so, at least partially, because they think they are better.”

—Shelley Correll, professor

Women are “harder on themselves” when assessing their abilities in “male” fields like math and science.

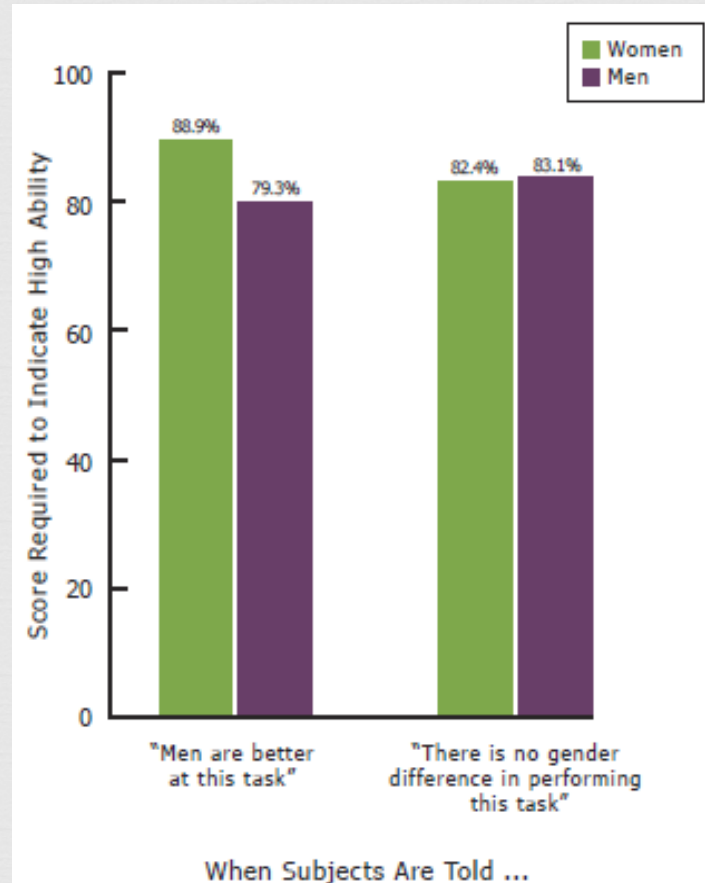


Does this rectangle have more black or more white?



# Women hold themselves to a higher standard compared with men in “masculine” fields.

Students' Standards for Their Own Performance, by Gender



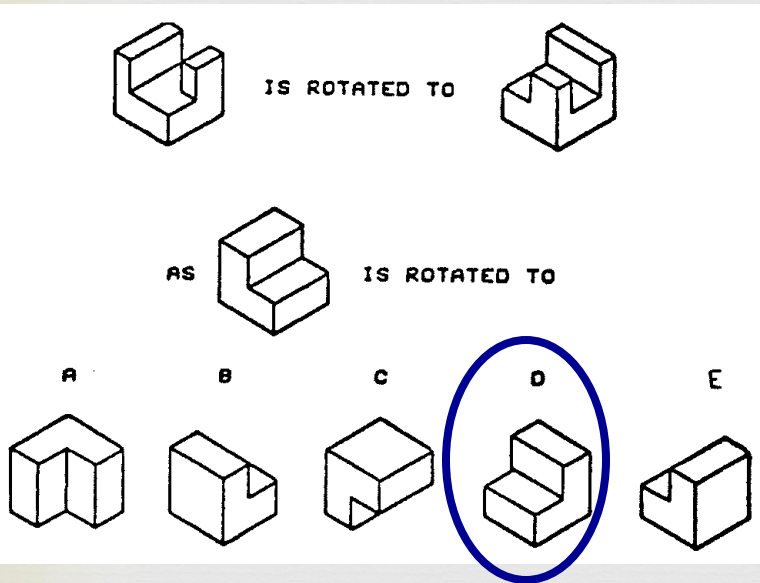
- Set clear performance standards.
- Help girls recognize their career-relevant skills.

Note: Respondents were asked, "How high would you have to score to be convinced that you have high ability at this task?"

Source: Correll, S.J., 2004, "Constraints into preferences: Gender, status, and emerging career aspirations," American Sociological Review, 69, p. 106, Table 2.

One of the largest and most persistent gender gaps in cognitive skills is found in spatial skills, where boys consistently outperform girls.

Spatial skills are not innate and can be improved with training.



This is a sample question on mental rotation.

Do you know the right answer?

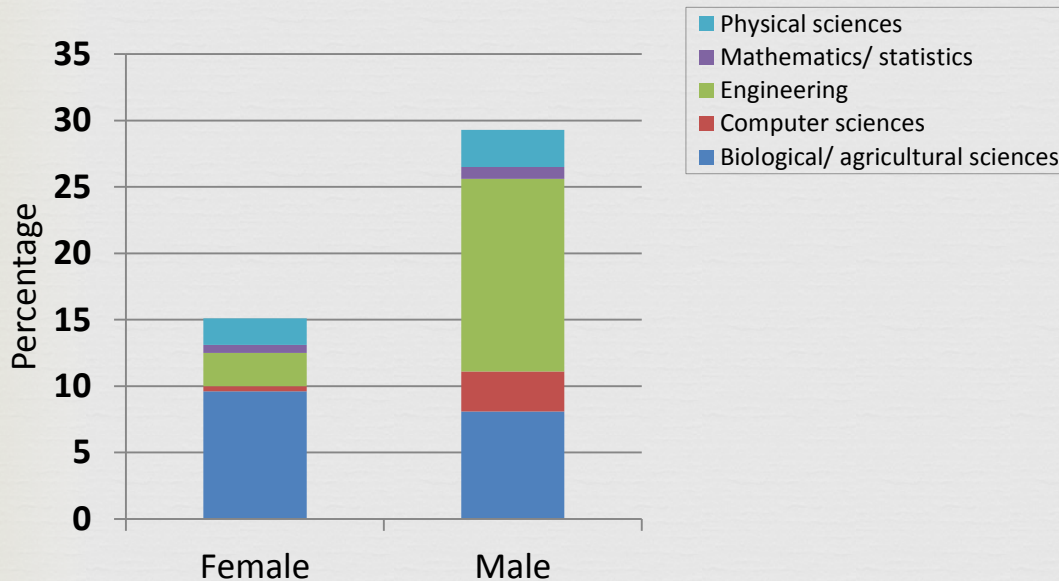
Playing with building toys as well as drawing can help children develop spatial skills.



The climate of science and engineering departments at colleges and universities is especially important for women—both students and faculty.

# At colleges and universities, small changes can make a big difference in attracting and retaining women in STEM.

Intent of First-Year College Students to Major in Science and Engineering Fields, by Gender, 2006

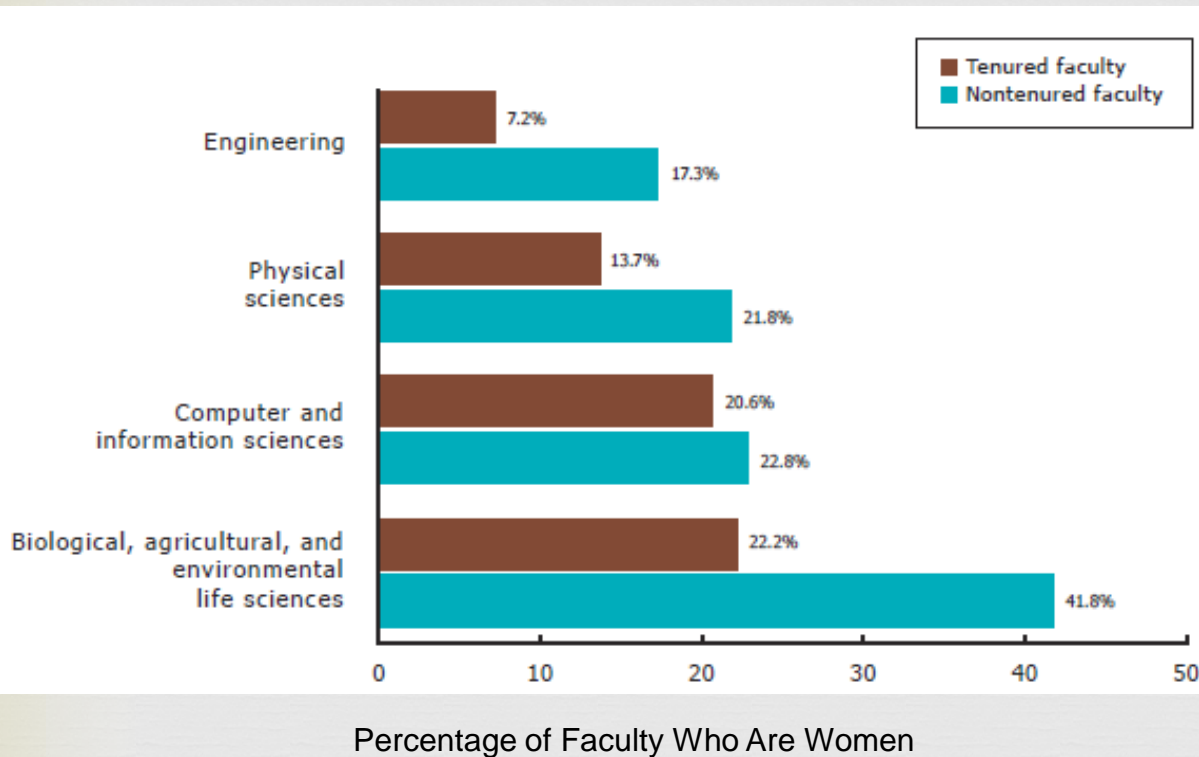


- Actively recruit female students.
- Emphasize broad applications of science and engineering in introductory courses.
- Review admissions policies to ensure that departments are not unintentionally “weeding out” potentially successful students.

Source: Higher Education Research Institute, 2007, *Survey of the American freshman: Special tabulations* (Los Angeles, CA), cited in National Science Foundation, Division of Science Resources Statistics, 2009, *Women, minorities, and persons with disabilities in science and engineering: 2009 (NSF 09-305)* (Arlington, VA), Table B-8.



# STEM departments in colleges and universities should focus on “fit” to improve female faculty satisfaction.



- Provide mentoring for junior faculty.
- Implement effective work-life balance policies to support faculty.

Source: National Science Foundation, Division of Science Resources Statistics, 2009, *Characteristics of doctoral scientists and engineers in the United States: 2006 (Detailed Statistical Tables) (NSF 09-317)* (Arlington, VA), Authors' analysis of Table 20.

Bias, often unconscious, limits women's progress in scientific and engineering fields.

Even people who consciously reject negative stereotypes about women in science can still hold those beliefs at an unconscious level.

Most people associate science and math fields with “male” and humanities and arts fields with “female.”

- 
- Take a test to learn about your unconscious bias at <https://implicit.harvard.edu>.
  - Take steps to address your biases.

# Women in nontraditional fields can find themselves in a “double bind.”

- Women in “male” jobs are viewed as less competent than their male peers.
- When women are clearly competent, they are often considered less “likable.”

- 
- Raise awareness about bias against women in STEM fields.
  - Create clear criteria for success.





# Why are women needed in STEM?



- ❧ Predicted shortage of technical talent
- ❧ Diverse viewpoints and experiences are needed to develop innovative solutions
- ❧ High paying, in demand careers

# Why so few?



Women want careers that...

☞ Make the world a better place

☞ Help people

☞ Involve working with others

# STEM stereotypes



- Media influence
- Don't feel they fit in
- Social pressures during adolescence

Disparity between men and women in STEM not present in some countries.

# RIT's Efforts to “Break through Barriers”



# AAUW's Campus Action Projects

---

Enable student leaders and campus faculty to design and implement effective programs that:

- + enhance campus offerings
- + promote leadership
- + improve academic and career outcomes





2009-2010 and 2010-2011 Topic



Breaking through Barriers  
in Science, Technology,  
Engineering and Mathematics  
for Women & Girls



# What is WIT?



- ✘ Increase representation of women in engineering and science fields through retention and recruitment programs
  
- ✘ Provides academic and social support to female Engineering Technology students
  - + Networking with professional women
  - + Tutoring
  - + Mentoring
  - + Tours
  - + Outreach
  - + Community building



# 2010 CAP Grant Award



- ❧ **EMPOWER** -Engineering Technology Mentoring & Professional Skills Workshops for Enhanced Retention
- ❧ Addresses barriers women students face in persisting in the engineering disciplines.
  - ❧ lack of self-confidence in their ability to succeed in the STEM fields
  - ❧ a limited peer group
  - ❧ limited female role models



# EMPOWER



- ✘ A Series of workshops for female engineering technology students
  - + Build self-confidence in professional skills
    - ✘ Etiquette Lunch
    - ✘ Networking with portfolio building
    - ✘ Dress for Success
  - + Build a community of women
    - ✘ Students
    - ✘ Faculty
    - ✘ Alumnae
    - ✘ Professional Women





# Workshops and Events



- ❧ Plant Tours
- ❧ Professional Development Workshops
- ❧ Women's Career Achievement Dinner
- ❧ EMPOWER Certificate





# Plant Tours









# Constellation Energy Ginna power plant tour

---



# Professional Skills Workshops



# Etiquette Lunch

## What is Etiquette?

- Conventional requirements as to social behavior...
- “The goal of etiquette is to bring out the best in the people you encounter and make them feel comfortable in your presence.”

*-Polished Professional*

Bread on the Left, Drink on the Right

## Names

- If you are unable to remember someone's name, it's o.k. to say, “Please tell me your name again.”
- If someone has a difficult name ask them to pronounce it again





# Dress for Success



# Dress for success





# Networking 101



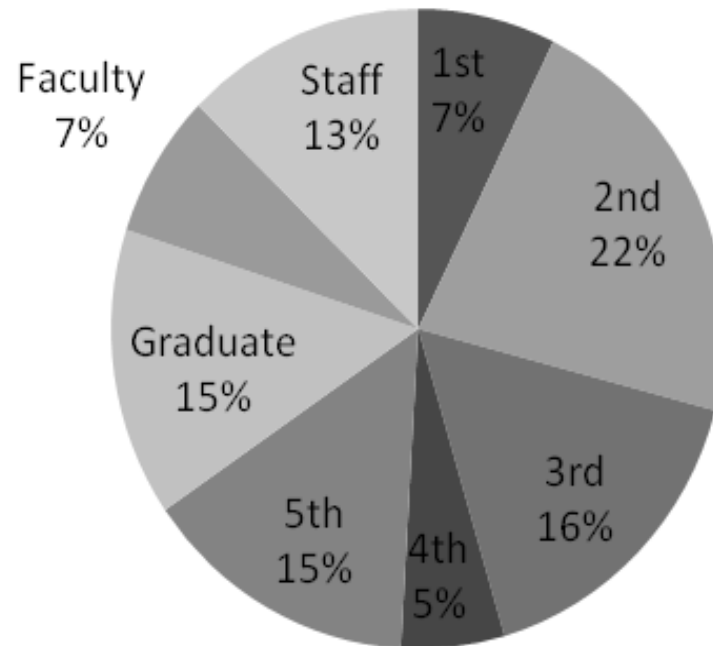
# Networking 101





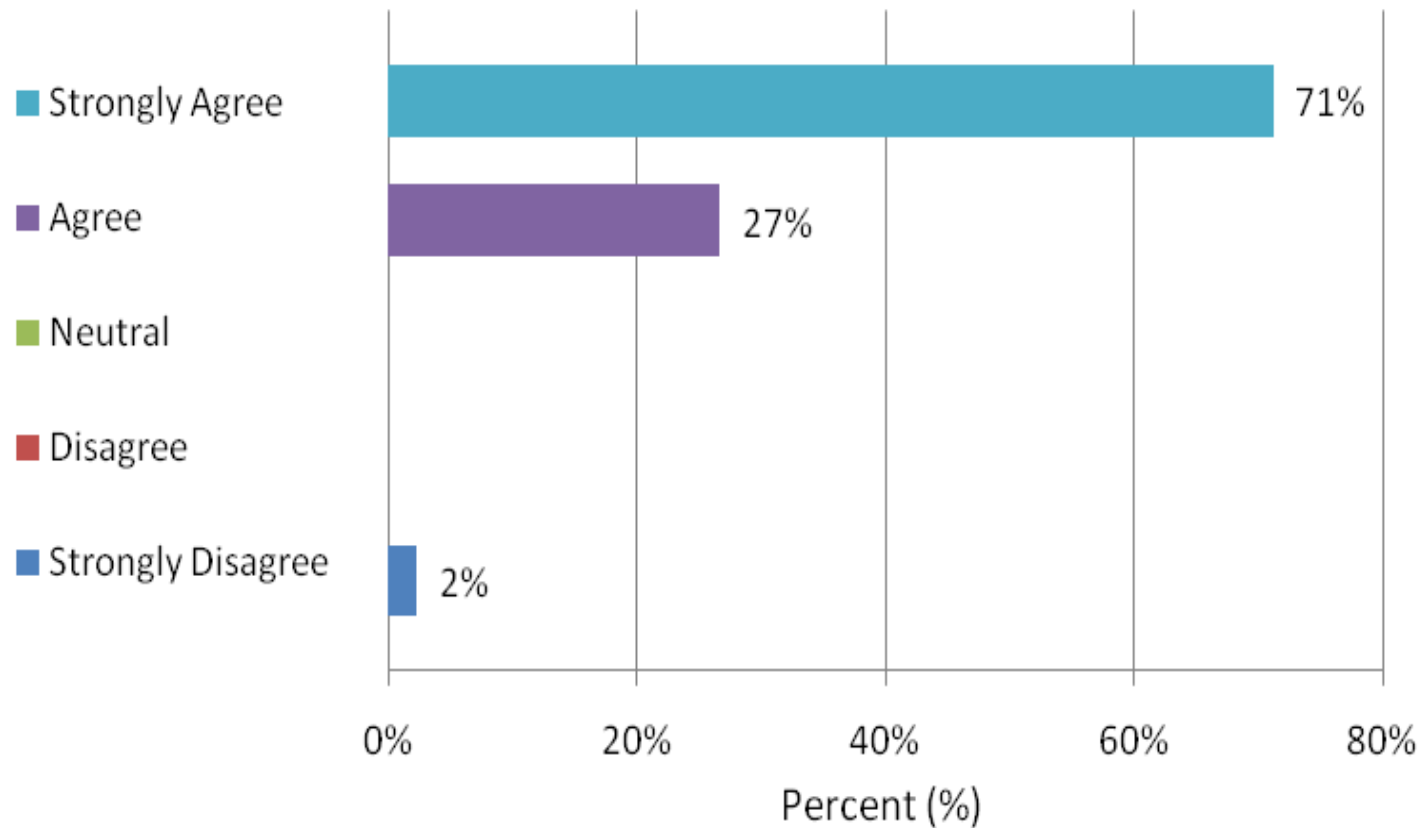
58 Women attended the event

## Networking 101 Attendees





S 4: I will use techniques presented at today's workshop.



# Other Events





# Equal Pay Day Awareness Event

Do men and women receive equal pay in the workforce?

Are talks of inequality in the work place myth or fact?

Do you want to voice in on the issue?



Should women speak out more about their lack of equality in pay?

Do women have the opportunity, the same as men do, to become top-paying CEO's?

How would Equal Pay effect you?

**Come find out more about the issues surrounding equal pay and women.**

**When: April 20<sup>th</sup>, 11am to 1pm**

**Where: Bdg 82, McGowan Commons**

**COOKIES AND PUNCH SERVED!!!!!!**



Come talk to other students and interested RIT community members about the issues of equal pay involving women and men.



This event is made possible by a grant from the American Association of University Women's Campus Action Programs





# Equal Pay Day – April 20<sup>th</sup>



# Women's Achievement Dinner



- ❧ Recognize participation in CAP programming
- ❧ Faculty, Professional Women and Students
- ❧ Opportunity to showcase professional skills:
  - ❧ Etiquette
  - ❧ Dress for Success
  - ❧ Networking





# Women's Achievement Dinner – April 26<sup>th</sup>





## Certificate of Completion

This certificate is awarded to

***Name of Recipient***

In recognition of the completion of the requirements for the

# EMPOWER Professional Skills

## Workshop Series Certificate

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

Support for the EMPOWER Workshop Series was provided by a American Association of University Women's Campus Action Programs Grant



# EMPOWER Certificate



# Event Attendance

<b>Event</b>	<b>Students</b>	<b>Faculty/ Staff</b>	<b>Professional Women</b>	<b>Total</b>
<b>Etiquette Lunch</b>	5	1		<b>6</b>
<b>Constellation Tour</b>	13	3	2	<b>18</b>
<b>Dress for Success</b>	43	5		<b>48</b>
<b>Networking</b>	52	6		<b>58</b>
<b>Ginna Tour</b>	22	3	2	<b>27</b>
<b>Equal Pay Day Awareness Event</b>	22	10		<b>32</b>
<b>Networking Event</b>	24	10	11	<b>45</b>
<b>Senior Send Off</b>	6	6		<b>12</b>
<b>EMPOWER Certificate Earned**</b>	27			<b>27</b>





2011 CAP Grant

Empower II-

Operation Tech Squad





# EMPOWER II



❧ RIT's 2009 CAP grant, EMPOWER, successfully aided in the development of students' professional skills and a strong community of women.

❧ EMPOWER II will utilize these skills toward an outreach program to encourage young women to consider careers in Science, Engineering and Technology.



# Empower II Objectives



- ❧ Promote Engineering Technology to Middle and High School Female Students
  
- ❧ 4 Middle School outreach events
  - ❧ Develop engineering workshops for use at schools
  - ❧ Host Girls Tech Workshop on campus
  
- ❧ 2 High School outreach opportunities
  - ❧ Develop powerpoint, brochures and posters



# Middle School Events



- ❧ Two Girls Tech Workshop
- ❧ Tech Squad Middle School- On campus
- ❧ Tech Squad Middle School- Off campus



# Girls Tech Workshops



- ❧ 4-6<sup>th</sup> grade girls
- ❧ On campus 9-3
- ❧ Participants rotated between 4 workshops
  - ❧ Civil Engineering Technology
  - ❧ Mechanical Engineering Technology
  - ❧ Electrical Engineering Technology
  - ❧ Packaging Science





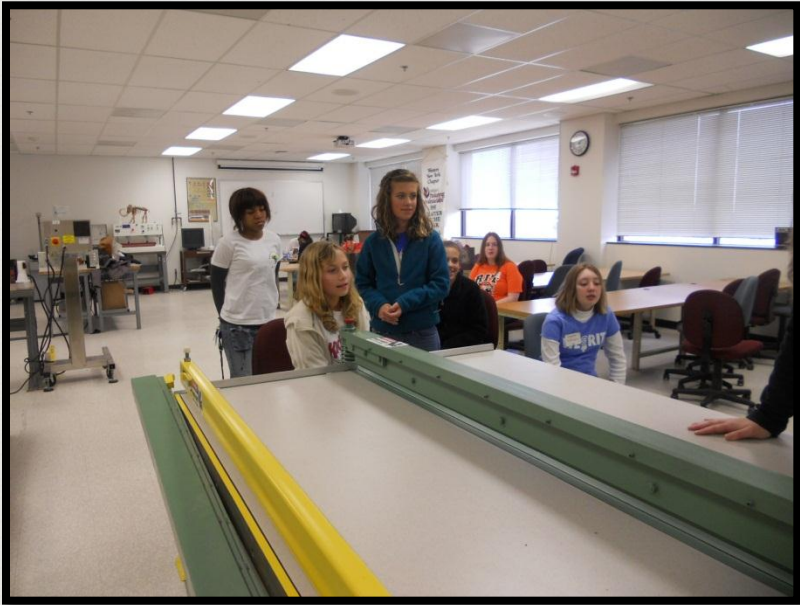
# Girls Tech Workshops



## Civil and Mechanical Workshops



# GIRLS TECH WORKSHOPS



## Packaging Science and Electrical Workshops





# Middle School Outreach-on campus



## ☞ Middle School Students Visit RIT

### ☞ 4 Workshops

☞ Sand Filters

☞ Telegraph

☞ Desalinated Water

☞ Engineering Rescue Mission

### ☞ Toured Engineering Technology Labs



# Middle School Outreach



Sand Filters





# Middle School Outreach

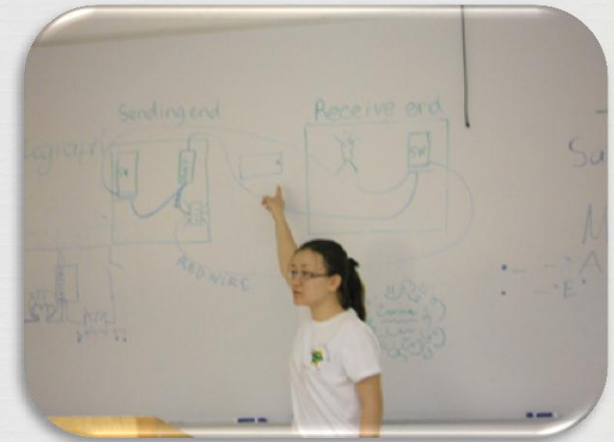


**Desalinating Water**



**Engineering Rescue Mission**

**Telegraph**



# Middle School Outreach- Off Campus



## ☞ Tech Squad Visits Middle School

☞ 2 Workshops

☞ Telegraph

☞ Wind Turbine group project

☞ Visited inner city 7<sup>th</sup> grade class



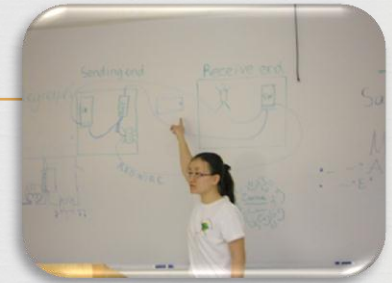
# Middle School Outreach



**Wind Turbine**



**Telegraph**





# High School Outreach



## Robotics Team Visit

- All girl FIRST robotics team
- Described various engineering technology programs and career options
- Explained the difference between Engineering and Engineering Technology





# High School Outreach



Robotics Team Visit

# High School Outreach



Robotics Team  
Visit





# High School Outreach



## ❧ Freshman Girls Technology Class Visit to RIT

- ❧ PowerPoint presentation on the programs at RIT
- ❧ Toured the labs of the engineering technology programs
- ❧ Explained the difference between engineering and engineering technology



# Outreach Impact

Event	Target No. Participants	Actual Participants
Girl's Technology Workshop	80	86
Tech Squad- High School	50	105
Tech Squad- Middle School	100	74
RIT students volunteers	30	32
<b>TOTALS</b>	<b>260</b>	<b>297</b>





# College Student Feedback



- It helped me to advance my speaking skills to other age groups. The girls asked a lot of questions that I may not have thought about so it helped me to think outside the box and learn how to develop an answer to their questions.*
- I love helping out the girls that come. It's fun to see how they light up during the activities and come to realize that anyone can become an engineer. I also love to stay connected with both Girl Scouts and WIT, so this is a wonderful program for me to participate in. I have also made friends through the program.*



# Sponsor recognition



AAUW

# Fairport Single Gender Technology Classes



Pilot Program 2009-2010



# Gender Gap in Technology Education in Fairport



- ❧ Low enrollment of female students in technology courses
- ❧ Research shows
  - ❧ different educational approaches can make these courses more appealing to female students
  - ❧ girls may feel more comfortable in single gender technology courses
- ❧ Desire to increase interest in high-demand, well paying careers



# 2009-2010 Technology Course Registrations in Fairport

---



Class	Total registration	Male Registration	Female Registration
Architecture I	32	30	2
Pre-Engineering	25	21	4
Networking	12	12	0
Computer Science	45	45	0
DDP	46	44	2

# Implementation



## 2010-2011 Single Gender Offerings

- Single-Gender 8<sup>th</sup> grade Tech. (MB) – 23
- Single-Gender 8<sup>th</sup> grade Tech. (JP) – 21
- Single-Gender DDP (MD) – 19
- Single-Gender Computer Science –  
dropped due to low enrollment

# RIT's involvement



- ❧ Faculty from Computer Science and Engineering Technology serve on Oversight Committee
  
- ❧ RIT faculty led professional development seminars
  - ❧ Why so Few? Report
  - ❧ Teaching Technology to Girls
  
- ❧ Workshop and Tour at RIT

# Activities





# Fairport-East Rochester Post

## Fairport students explore computing and technology at RIT

« Previous 3 of 10 Next »

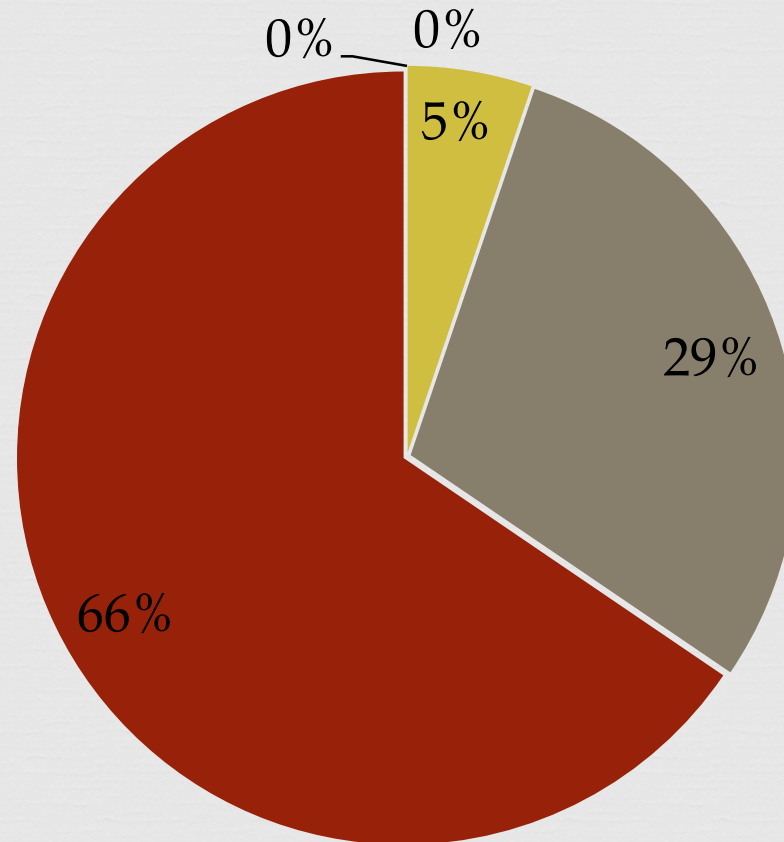
Jan 12, 2011 @ 02:13 PM

Eighth graders from the pilot gender-only technology class at Martha Brown and Johanna Perrin Middle Schools visited RIT on Wednesday, Jan. 9 to tour the College of Applied Science and Technology and participate in hands-on activities while learning about career opportunities. The field trip was hosted by Women in Computing and Women in Technology - outreach organizations at the college.



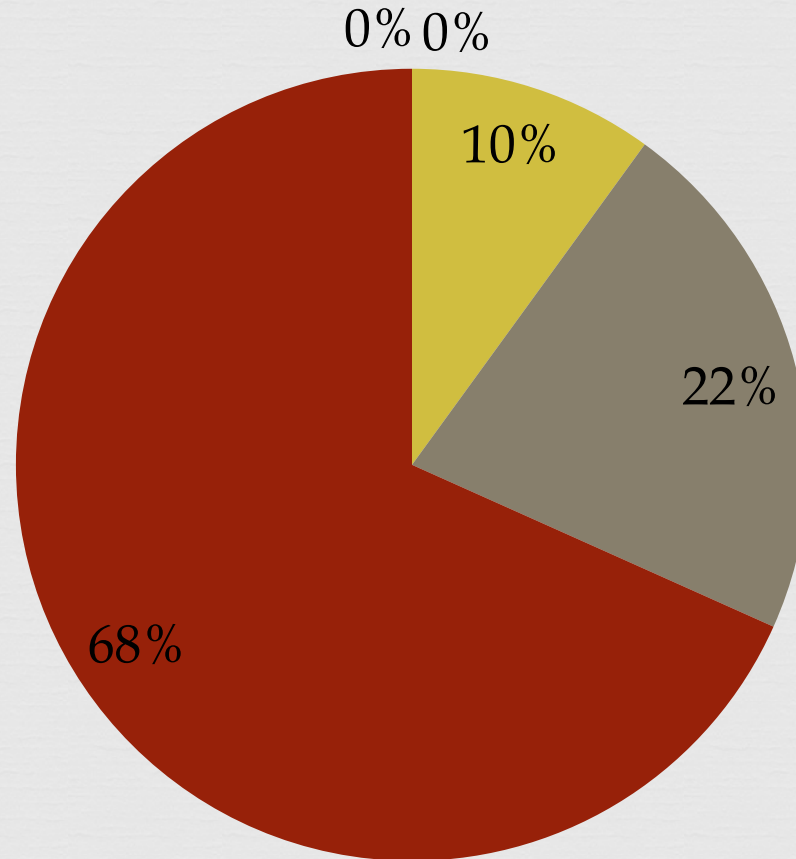
# Being in a single gender class was a worthwhile experience

■ Strongly Disagree ■ Disagree ■ Undecided ■ Agree ■ Strongly Agree



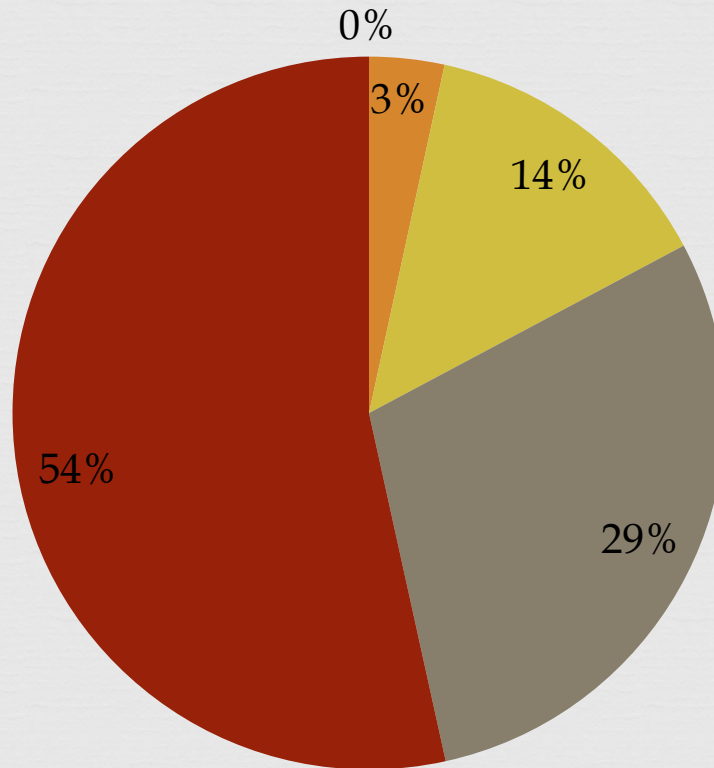
# I enjoyed this class

■ Strongly Disagree ■ Disagree ■ Undecided ■ Agree ■ Strongly Agree



# I participated more in this class than I do in missed gender classes.

■ Strongly Disagree ■ Disagree ■ Undecided ■ Agree ■ Strongly Agree





# Feedback



❧ *"In an all-girls class, you see them immediately get started in class, work faster and pay better attention. It's a special sight to see."*

-Liz Brown Martha Brown Technology teacher

❧ *"In middle school, boys and girls become an incredible distraction to each other. It's not even that middle school boys are smarter, because they're not. They're just more aggressive in the classroom than girls."*

- David Dunn, Martha Brown principal.

*"It is amazing how much faster girls get the information. In 27 years of teaching, I have never had an entire classroom hand in every assignment on time until I taught this all-girl class.*

*They're smart and they just don't judge each other. A girl who might be struggling could ask a few questions in class without being ridiculed."*

-Dan Johnson  
a Minerva DeLand technology teacher,  
who has taught in Fairport, Webster  
and the Rochester school districts.

# Student Comments



- ☞ I loved that you could just be yourself because when you're with boys you never want to embarrass yourself.*
- ☞ I like that if we have a question, we can ask it without the boys thinking we are stupid.*
- ☞ I learned girls can do anything boys can do and that companies want to have girls work in this area.*
- ☞ Most boys don't put as much time and effort into their work and so the class speeds along, leaving me behind.*

# Future Plans



- ❧ Continue Single Gender
  - ❧ 8<sup>th</sup> grade technology courses with courses full within days of the opening of registration
  - ❧ Single Gender DDP in 9<sup>th</sup> Grade
  
- ❧ New Single Gender Architecture I offered in the high school
  
- ❧ No plans to add more single gender course in the high school



# Questions ?

