

# Gender Issues in Physics

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# Women and Science

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- Technological society
- Scientifically literate public
- Science for all, not just for white males
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# Is there a problem?

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- Look around!
- Under-representation of women in physical sciences
- Need to encourage women
- Need to determine what's wrong
- Need to determine barriers and incentives

# Overview

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- What are the numbers of women in physics?
- What are some of the barriers to women in physics at different levels?
- Gender and education

# Is there a problem?

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- “Here’s how my high school chemistry class was taught: Boys were seated by the male teacher on the side of the room with the teacher’s desk. Girls were seated on the far side of the room. Girls were told to be quiet and not cause trouble and they would not fail the class. When ‘dangerous’ experiments were conducted, the boys went into the lab while the girls watched through the windows.”

Failing at Fairness, 1994, pg. 121

# Women's Education

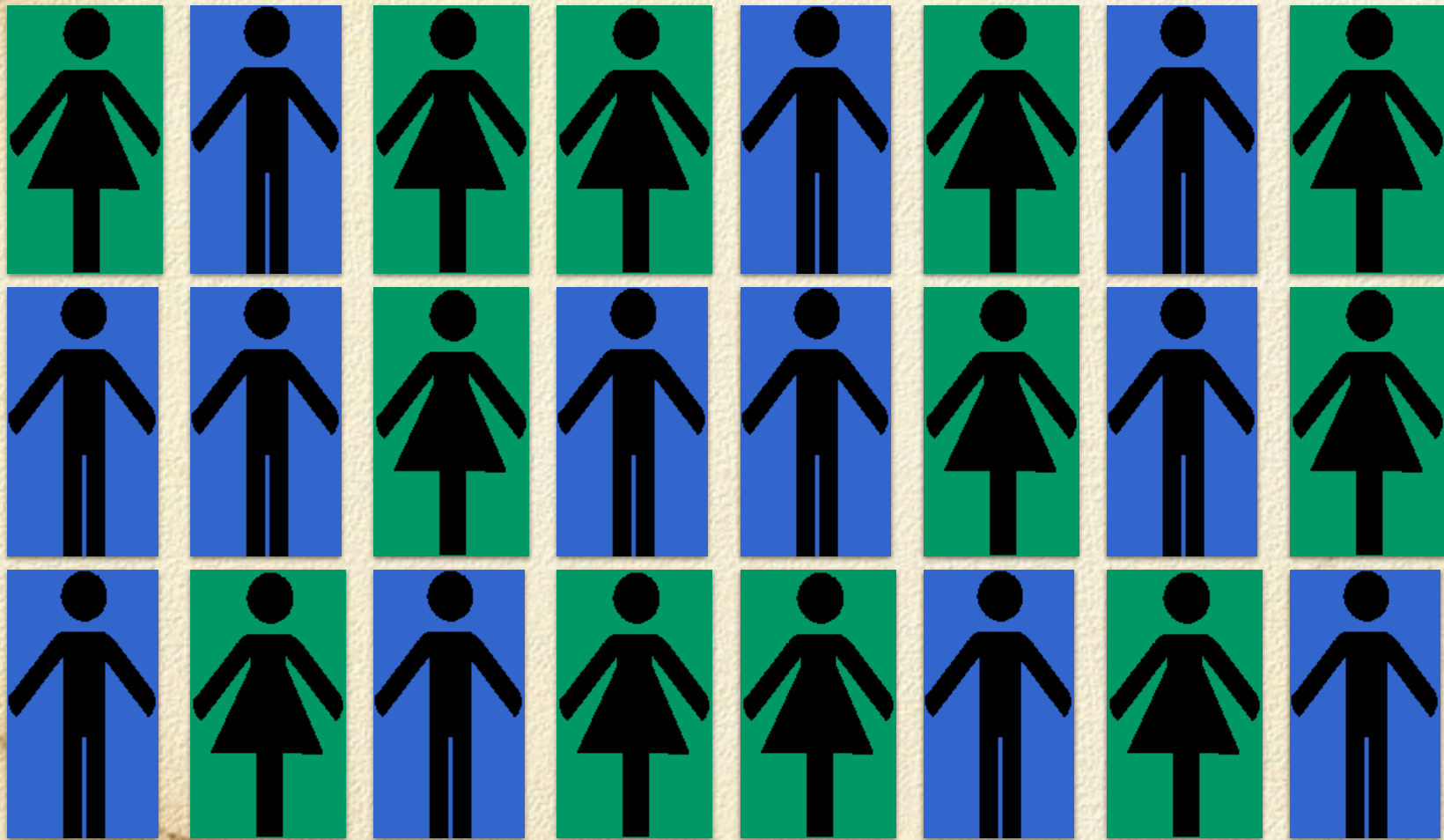
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Women receive

- about half of all high school diplomas,
- about half of all bachelor's degrees (56%),
- 57% of master's degrees, and
- 42% of doctorates

What about physics?

# High School Physics



# High School Physics

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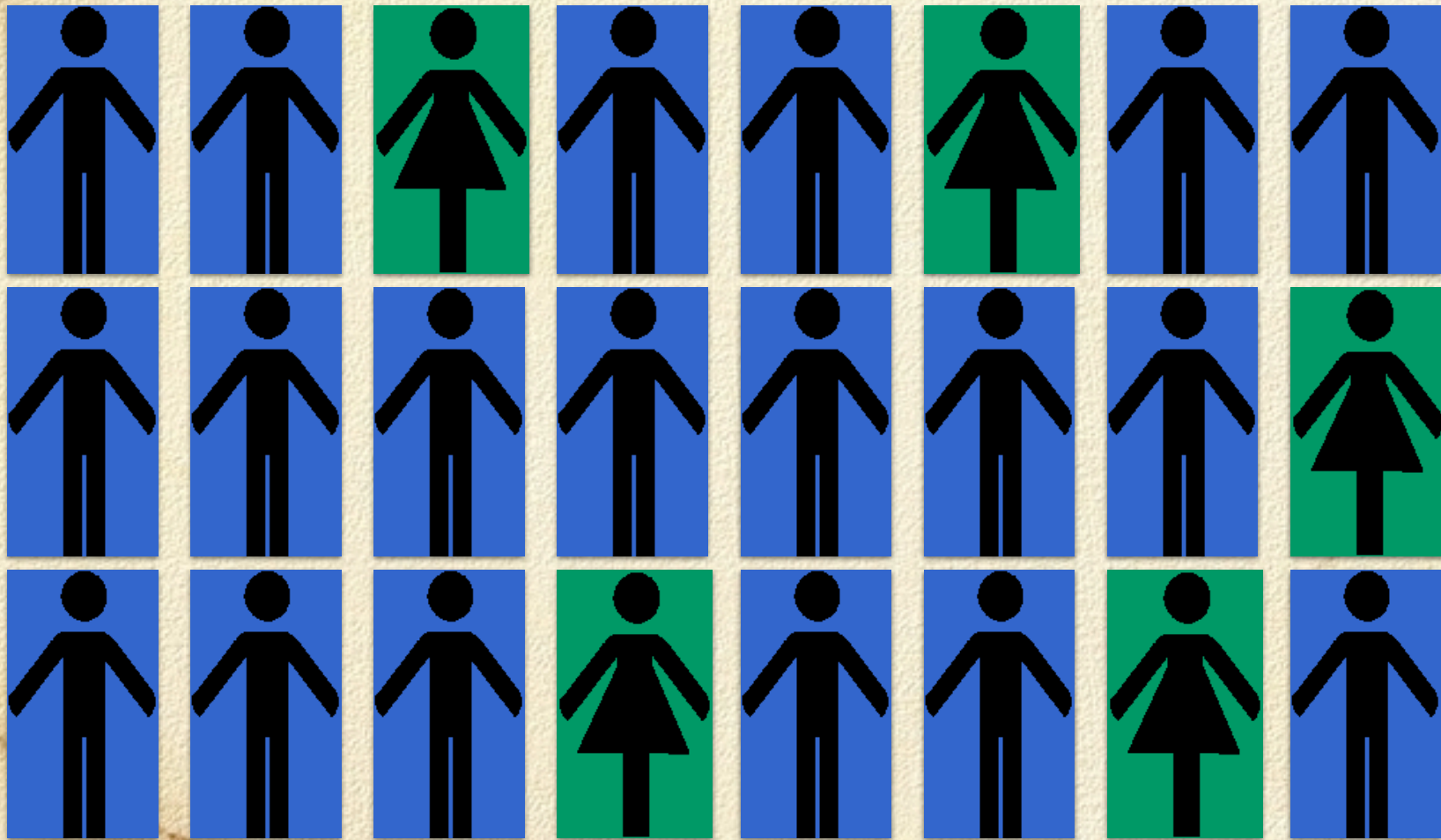
- 50 % of high school physics students are women! (28% of students take HS physics)

But...

- Women are still not found in the AP courses which are better preparation for college coursework



# Undergraduate Physics



# Undergraduate Physics

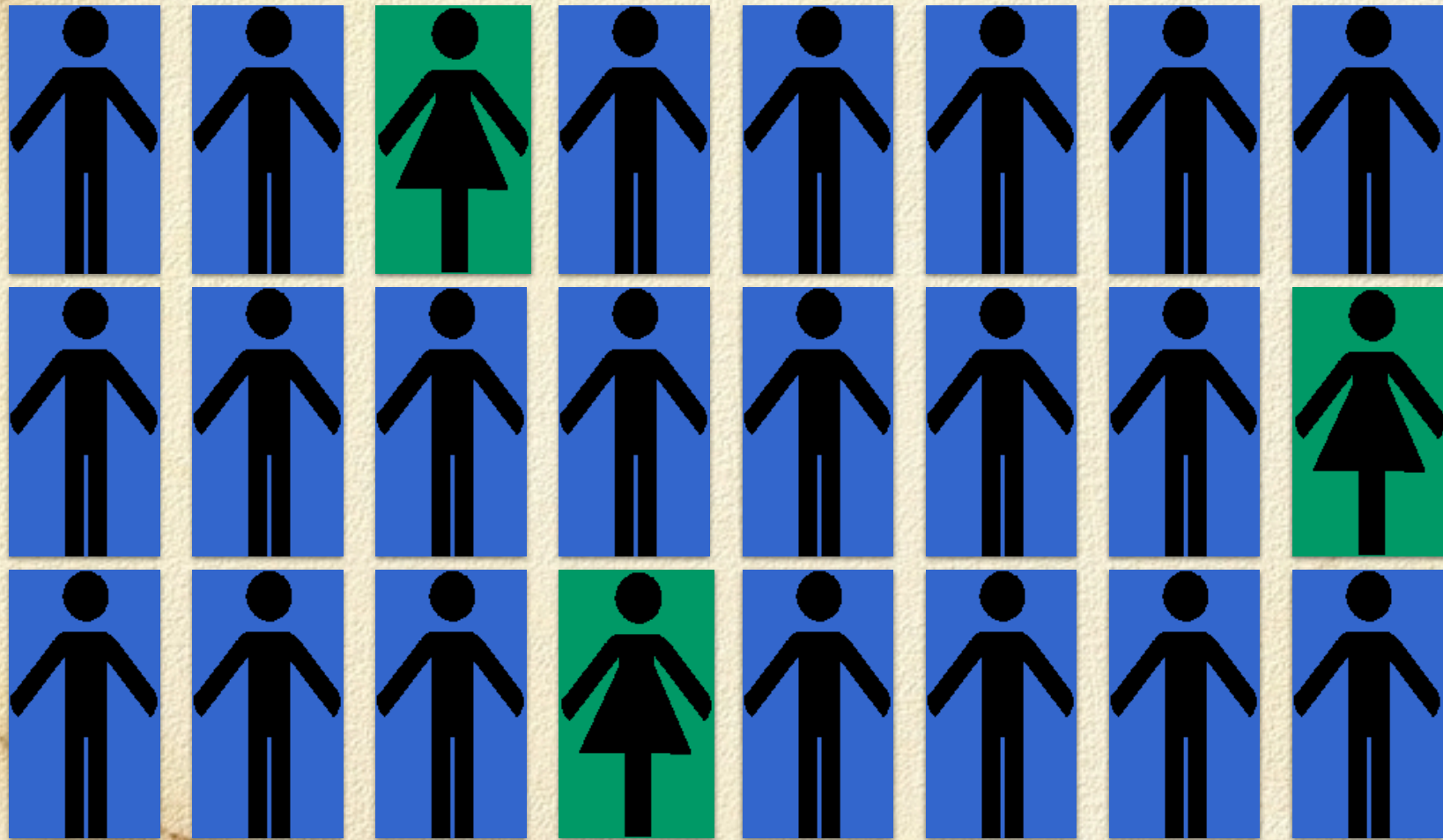
- Women make up 31% of two-year college physics students

- Women receive 19% of physics bachelors



# Graduate Physics

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# Graduate Physics

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- Women receive 21% of master's degrees in physics
- 13% of physics doctorates go to women

# Academic physics

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- 17% of assistant professors of physics are women
- 10% of associate professors of physics are women
- 3% of full professors of physics are women
- Is this a problem?

# Yes, there is a problem

- Severe under-representation of women in physics and most of the physical sciences
- Need to be encouraging women
- Need to stop discouraging women
- What's causing women to leave?

# The Problem: Primary and Middle School

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- By 5th grade, boys and girls have significantly different in-school and out-of-school science experiences
- By 6th grade, girls' attitudes towards science are more negative than boys'
- By 6th grade, girls score lower on science achievement tests than boys do

# The Problem: High School


## Barriers:

- Peer culture
- Peer harassment
- Bad counseling and advice
- Sexism from administrators and teachers
- Classroom culture of sexism
- Lack of female teachers/role models (25%)
- Parental influence




 “In 1962 I switched to a new high school. I wanted to sign up for physics, but the principal would not allow it. His comment was that a girl had no need for physics.”

Failing at Fairness, 1994, pg. 120

 During the roll call on the first day of class, Mr. Y called out the name of a girl who was head varsity cheerleader, then stopped and said “What are you doing in chemistry? Shouldn’t you be out jumping up and down or something?”

Leach, Sch. Sci. & Math, 1995



Jennifer noticed that Mr. X focused his attention on the seven male students who sat in front of her and to her left. She raised her hand to answer questions; he ignored her. She raised her hand to ask questions; he ignored her. At one point, [the other female students] began tallying her attempts to respond in class. During a five day class period, she raised her hand to answer or ask a question 32 times. She was never once acknowledged.

Leach, Sch. Sci. & Math, 1995

- On the first day of class, students were told to sit where they wanted the next day. When Kim entered class the next day, and took a seat toward the middle of the room, Mr. Z approached her and asked her to please move to the front, because he “liked to look at her.”
- When Kim was working on an assignment in class one day, Mr. Z leaned over her desk and said, “I guess you won’t kiss me because you think I look like the elephant man.” Dumbfounded, she remained silent but replied by pointing to his wedding ring.

Leach, Sch. Sci. & Math, 1995

# High school science lab

- Lab and hands-on experiences are some of the most effective teaching techniques in science; but only if students participate
- In mixed-sex classes and groups, male students tend to dominate equipment and materials; female students are often relegated to role of note-taker and recorder

# The Problem:

## Undergraduate science

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### Barriers:

- Peer harassment
- Outright sexism in the classroom
- Poor advising
- Lack of mentors and role models
- Poor pedagogy

● “Freshman chem is taught at Harvard by a famous chemist, a man in his sixties who would put an equation on the board and in a room of five hundred people turn and say ‘Get that, girls?’

● The first time I heard him say that I laughed. The second time I became angry. The third time I was scared. I started thinking ‘Do you get it? Can you get it?’”

Gornick, *Women in Science*, p. 74

# The Problem: Industry and Academe

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## Barriers:

- Parallel tracking: “lab technician”
- Harassment
- Sexism
- Lack of role models
- Cultural expectations
- Family/work conflicts
- Two-body problem

- “They said to me, ‘If you become pregnant you’ll get fired.’ Can you imagine what it means to hear something like that? I mean, that says something deep to you.
- So I got pregnant, and they never knew it. I just wore a lab coat one size larger. Who every really looked at me? I came back two days after the baby was born, and I never told a soul there that I had had a child.”

Gornick, *Women in Science*, pg. 102



# There is a Problem

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- Discouraging women at every stage
- Many societal and cultural barriers
- Are there particular barriers in science education?

# The Problem: Science Education

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- Physics exhibits one of the most severe under-representations in the sciences
- Personal interest in women & physics
- Personal interest in research in physics education and general education research

# Biological/Psychological Differences

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- Meta-analyses suggest no large or significant differences in cognitive ability between males and female; though there is an increasing amount of research on cognitive processes.
- Memory tasks

# Learning Styles

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- Learning styles probably differ by gender, but research results vary widely
  - men are more abstract learners, women have more anxiety about study success; men are more intuitive, women are more analytical; women more organized, men more undirected, etc.
- Different tests produce small but consistent gender differences

# Attitudes towards Science

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- 1983 meta-analysis suggests no gender difference, a 1995 meta-analysis found more positive attitudes among boys; research still inconclusive
- Possible age-gender interaction/ rates of development
- 1995 analysis found positive correlation between attitude and achievement; higher correlation for girls

# “Self” Variables

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- Women tend to attribute success to luck or effort, men attribute success to ability
- Feelings about science due to sex-role stereotyping
- Decrease in confidence and academic risk-taking as girls get older

# Gender and Problem-Solving

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- Higher problem-solving achievement among males than among females
- How you ask the question may affect student responses

# Gender and Learning

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- All of these are factors which could affect learning. But...research in these areas is often inconclusive
- Overall picture suggests that men and women may learn differently
- The context of being male or female interacts with the classroom and society to affect learning



# Summary

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- There is a problem with the lack of women in science, particularly physics
- Many different factors contribute to the under-representation of women
- Social, educational, psychological and biological differences
- We need to be accounting for these differences and working towards getting more women into science

# What can we do?

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- Many intervention programs at the K-12 level
- Site visits for physics graduate departments (APS Committee on the Status of Women in Physics)
- Recent project doing site visits at undergraduate physics departments
- Awareness/education of men and women through professional organizations, research articles, websites, and informal communications

# Good resources

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- AIP Education/Statistics Page
- NSF Report on Women, Minorities and Persons with Disabilities
- UW-System Women and Science Program
- APS CSWP website and newsletter
- Association of Women in Science
- Achieving Gender Equity handbook from Brown University Faculty and Students

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