

# Promoting Women's Participation in Physics

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# Overview

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- Current status of women in physics
- Recruiting women
- Retaining women

# Women's Education

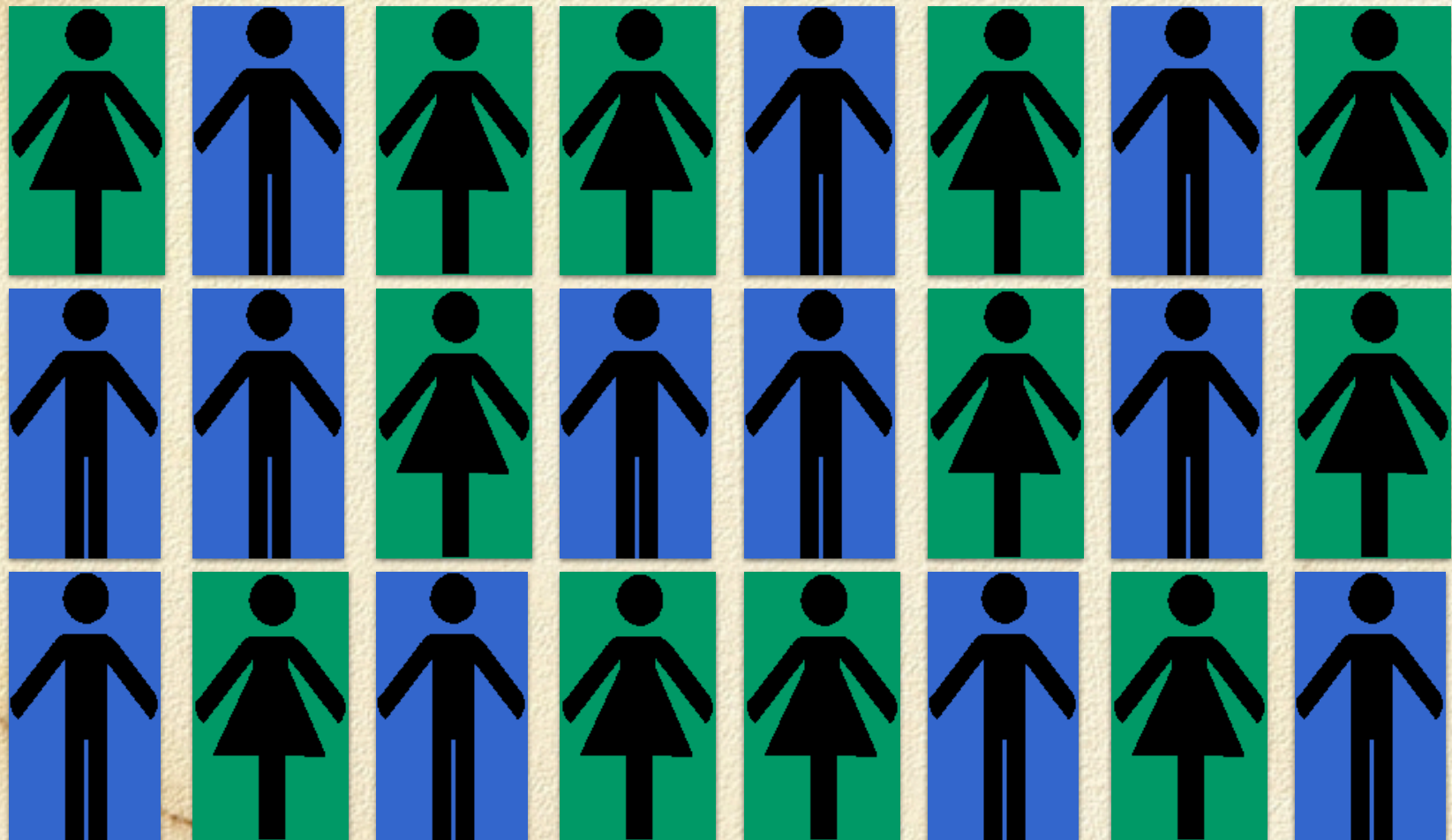
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- Women receive
  - about half of all high school diplomas,
  - over half of all bachelor's degrees (57%),
  - 59% of master's degrees, and
  - 45% of doctorates
- What about physics?

Data from <http://caspar.nsf.gov> (NSF and NCES sources)

# High School Physics

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# High School Physics

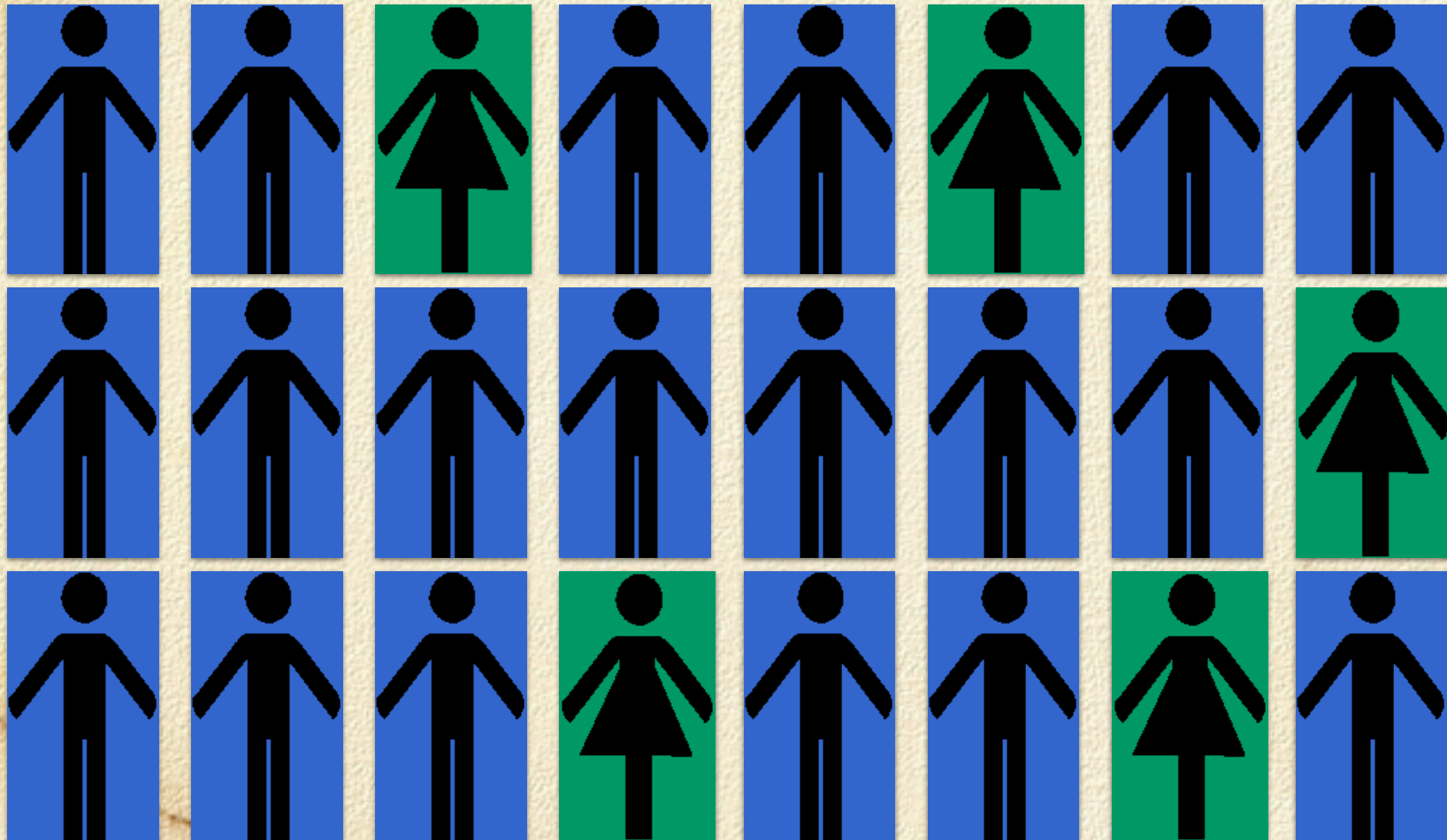
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- 46% of high school physics students are female!  
(31% of students take HS physics)
- But...
- Girls are still less likely to be in the AP courses  
which are better preparation for college coursework

\*Neuschatz, Michael, and Mark McFarling. 2003. *Broadening the Base: High School Physics at the Turn of New Century*. College Park, MD: American Institute of Physics.

# Undergraduate Physics

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# Undergraduate Physics

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- Women make up ~31% of two-year college physics students\*
- Among 25-year old college attendees who have had physics, 37% are female\*\*
- Women receive 22% of physics bachelors degrees\*\*\*

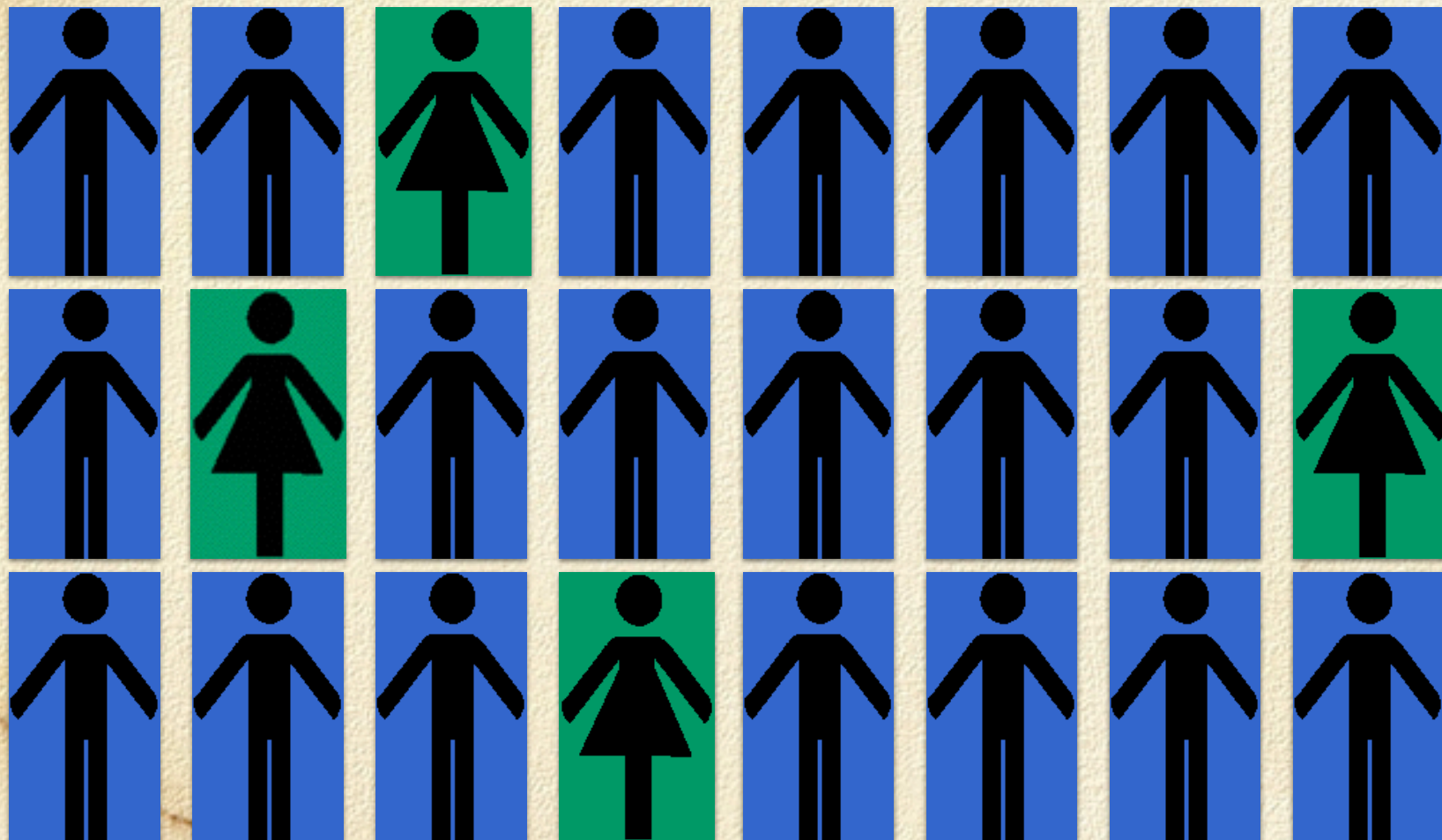
\*Ivie, Rachel, and Katie Stowe. 2000. *Women in Physics, 2000*. College Park, MD: American Institute of Physics.

\*\*Ivie, Rachel, and Kim Nies Ray. 2005. *Women in Physics, 2005*. College Park, MD: American Institute of Physics.

\*\*\*Data from <http://caspar.nsf.gov> (NSF and NCES sources)

# Graduate Physics

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# Graduate Physics

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- 21% of first-year graduate students are women\*
- Women receive 21% of master's degrees in physics\*\*
- 18% of physics doctorates go to women\*

\*Ivie, Rachel, and Kim Nies Ray. 2005. *Women in Physics, 2005*. College Park, MD: American Institute of Physics.

\*\*Data from <http://caspar.nsf.gov> (NSF and NCES sources)

# Teaching positions

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- 29% of high school physics teachers are women\*
- 16% of adjunct/instructors in physics are women\*\*
- 16% of assistant professors in physics are women\*\*
- 11% of associate professors in physics are women\*\*
- 5% of full professors in physics are women\*\*

\*Neuschatz, Michael, and Mark McFarling. 2003. *Broadening the Base: High School Physics at the Turn of New Century*. College Park, MD: American Institute of Physics.

\*\*Ivie, Rachel, and Kim Nies Ray. 2005. *Women in Physics, 2005*. College Park, MD: American Institute of Physics.

# The Problem: Under-representation

- Severe under-representation of women in physics
- Need scientifically literate public and technological/scientific workers
- Need to be working to keep women
- Need to be doing research on how to keep women

# Recruitment

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- First step: get women interested, get them into physics classes, get them into the major
- What helps interest women?

# Pedagogy to attract

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- What Works? project:  
More than one student cited an innovative teaching approach as a reason to major in physics
- Grinnell College: Changing pedagogy in intro courses draws more women

Whitten, B., S. Foster, M. Duncombe, P. Allen, P. Heron, H. Zorn, L. McCullough, K. Shaw, B. Taylor. (2003) What Works? Increasing the Participation of Women in Undergraduate Physics. *J. of Women and Minorities in Science and Engineering*, 9(3/4), 239-258.

Schneider, M. (2001). Encouragement of women physics majors at Grinnell College: A case study. *Phys. Teacher*, 39, 280-282.

# Retention

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- Once in physics, we need to keep the women
- What can we do in our classes to help retain women in a class and in a major?

# Pedagogy for retention?

- Can the way we teach affect women's participation?
- Can good teaching help us retain women?
- Does bad teaching hurt retention?

# Bad pedagogy

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- “Reports of poor teaching in S.M.E. classes were by far the most common complaint of all switchers and non-switchers.”  
Pedagogy was third-highest rated reason for leaving science
- Science teachers less likely to use active learning techniques; more likely to grade on curve

Seymour, E., & Hewitt, N. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Milem, J., & Astin, H. (1994). *Scientists as teachers: A look at their culture, their roles, and their pedagogy*. Paper presented at the NARST meeting, New Orleans, LA.



# Pedagogy to retain

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- Workshop Physics:  
Younger college women → positive experience  
More senior college women → more likely to feel negative about the interactive course structure
- SCALE-UP:  
Women were almost five times as likely to pass a SCALE-UP course than a traditional course

Laws, P., P. Rosborough, F. Poodry, (1999). Women's responses to an activity-based introductory physics program. *Am. J. of Phys.*, 67(7), S32-S37.

Beichner, R., J. Saul. (2003). *Introduction to the SCALE-UP Project*. Paper submitted to the Proceedings of the International School of Physics, Varenna, Italy.

# Pedagogy to retain

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- Rutgers University:  
“Extended General Physics” course with more interactive pedagogy helps women stay in the course; 1% drop compared with 11% drop in regular course
- “Individual differences between students far outweighed gender differences”

Etkina, E., K. Gibbons, B. L. Holton, G. K. Horton. (1999). Lessons learned: A case study of an integrated way of teaching introductory physics to at-risk students at Rutgers University. *Am. J. of Phys.*, 67(9), 810-818.

# Reform pedagogy to help women

- Long-range study at Harvard; traditional teaching, mixed-pedagogy, and interactive engagement
- Interactive engagement reduced significant gender gap on conceptual test to no gap
- “No observed loss of achievement among the male students.”

Lorenzo, M., C. Crouch, E. Mazur, (2006) Reducing the gender gap in the physics classroom. *Am. J. of Phys.*, 74(2), 118-122.

# What else works?

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- Faculty support structure: family-friendly policies, mentoring, research support
- Warm, inclusive departmental culture
- First year advising, good first year teaching
- Four-year mentoring

Whitten, B., S. Foster, M. Duncombe, P. Allen, P. Heron, H. Zorn, L. McCullough, K. Shaw, B. Taylor. (2003) What Works? Increasing the Participation of Women in Undergraduate Physics. *J. of Women and Minorities in Science and Engineering*, 9(3/4), 239-258.

# What else works?

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- Spend money on students (lounge, tutors, lab assistants, seminars, SPS, socials)
- Female-friendly department
- Invite alumni and alumnae back
- Students help create culture

Whitten, B., S. Foster, M. Duncombe, P. Allen, P. Heron, H. Zorn, L. McCullough, K. Shaw, B. Taylor. (2003) What Works? Increasing the Participation of Women in Undergraduate Physics. *J. of Women and Minorities in Science and Engineering*, 9(3/4), 239-258.

# What else works?

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- Need familiar, positive interactions between faculty and students
- Can't get too personal though!
- Don't serve as poor role models (students need to see work-life balance)

Whitten, B., S. Foster, M. Duncombe, P. Allen, P. Heron, H. Zorn, L. McCullough, K. Shaw, B. Taylor. (2003) What Works? Increasing the Participation of Women in Undergraduate Physics. *J. of Women and Minorities in Science and Engineering*, 9(3/4), 239-258.

# APS Site Visits

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- Committee on the Status of Women in Physics will visit RI graduate departments
- Interview students, faculty, staff
- Make recommendations on improving departmental climate

# Conclusions

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- Women still under-represented in physics
- Recruitment and retention are both important in getting women into physics
- Better pedagogy, welcoming culture keys to getting and keeping women in physics