

What works for women in undergraduate physics?

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Why worry about undergraduates?

- That's where graduate students come from.
- This is the biggest leak in the academic 'pipeline,' according to Rachel Ivie, AIP.
 - 50% of high school physics students are female.
 - Less than 25% of physics bachelor's degrees go to women.
- It's our last chance to recruit new students into physics.
- Look for advice to those who specialize in undergraduate students, especially women's colleges and Historically Black colleges.

General ideas

- Work on recruiting majors
- Pay special attention to first year students (also important for graduate students)
- Attractive and research-rich curriculum
- Interactive and cooperative pedagogy
- Friendly and inclusive department culture

Female-friendly curriculum

Can we recruit into the physics major?

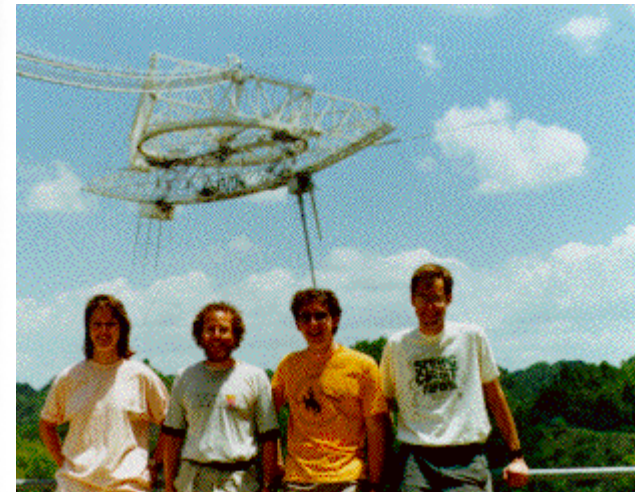
- Pay particular attention to the introductory course.
 - Choose a charismatic and effective teacher.
 - Create an attractive curriculum with interesting contemporary topics.
 - Emphasize interactive classes and labs.
 - Encourage a cooperative learning environment.
 - Consider a “Day in the Lab” for introductory students to introduce department research opportunities.
- Be sure first year students are well advised.
- Be sure first year students are included in department culture.

Use Astronomy to Recruit into the Physics Major

- Historically, and at present, the participation of women in astronomy is higher than in physics.
- Topics and applications are attractive to women (and men).
- There are many undergraduate research opportunities.
- Astronomy lends itself to outreach and other activities that help build department culture.



Fig. 10. Cecilia Payne-Gaposchkin 1948



Female-friendly pedagogy

What does it mean to teach physics to women?

- It *doesn't* mean “watering down” courses (Uri Treisman)
- High expectations and goals
- Confidence-building atmosphere
- Female leadership, especially in lab
- Spirit of cooperation
 - Working in groups deepens student understanding of physics
 - Participatory classes
 - Group work encouraged in and out of class

Female-friendly department culture

Many small factors—no “silver bullets”
Some important elements

- Student Lounge
 - Spin Up found this to be an important marker of a healthy department culture.
 - Space where students can hang out, study, and be part of the department.
 - Attractive room (not a scary basement corner), comfortably furnished with study tables, computers, comfy chairs, fridge and microwave.



Female-friendly department culture

Hire majors as tutors and lab assistants for introductory physics

- Benefits for majors
 - Physics related job.
 - Practice explaining physics concepts.
- Benefits for intro students
 - Less intimidating place to go for help.
- Benefits for department culture
 - Creates relationships between older and younger students
 - Allows opportunities for informal mentoring and recruiting.



Female-friendly department culture

SPS chapter or Physics Club

- Provide a mix of social and professional activities.
- Informal departmental activities (picnics, softball games, holiday parties) give students a chance to get to know faculty and other students under casual circumstances.



Female-friendly department culture

Outreach activities

- Outreach activities for younger students “put a human face on physics.”
- Allow students to see *themselves* as role models and members of the physics community.



Female-friendly department culture

Relationships with Alumni



- Most students would like more advice about career opportunities and paths. (Graduate students also say this.)
- Alumni are a useful resource for career advising and recruiting

Female-friendly department culture

Some Elements

- Departmental seminars (at least some) should be at undergraduate level.
- Monitor department culture to be sure it's inclusive.
- It's not necessary for faculty to do all these things.
 - Faculty provide continuity and modest resources.
 - Students create their own culture.

Women Students Want and Need Adult Female Role Models



- Many women students speak affectionately and respectfully of male mentors.
- Male faculty can and do effectively mentor women students.
- But women faculty (and other women in leadership positions) are important role models for women students.
- Recruitment and retention of women faculty are important to the recruitment and retention of women students.
- The single most important career barrier for women scientists is family/career conflict.

Conclusions

- Female-friendly departments also benefit male students.
- Pay attention to the first year. (This is important for graduate students, too.)
- Consider the introductory course as a recruiting tool.
 - Attractive curriculum
 - Interactive pedagogy
 - Atmosphere of cooperation
- Department culture is many small factors, not just one thing. Try lots of things and don't be discouraged if just one doesn't immediately change the culture. Persist and be patient.
- Men can and do mentor women students, but adult female role models are important.
- Career-family conflicts are an important barrier for women in science.

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Consider the range of introductory students

- Many students come to college with two years of high school physics, including a calculus based introductory course. What becomes of these students?
 - Do they repeat their high school experience and become bored?
 - Do they intimidate other students?
 - Do they flounder in advanced courses for which they are not prepared?
- What about underprepared students? Do they have a chance to major in physics?
 - HBCUs treat poor high school physics preparation as a barrier to be overcome rather than evidence that students should not major in physics.
 - This strategy might also work to recruit students who came to college not intending to major in science, and to increase the diversity of physics majors.