

# FIRST-YEAR WOMEN IN SCIENCE AND ENGINEERING RESEARCH: ATTUNING PROGRAMS TO BENEFIT AVERAGE STUDENTS

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**Abstract** *This paper examines undergraduate research in the sciences and engineering, probing the question of whether research programs can be designed to benefit first-year women students of average ability. The paper also examines what motivates research faculty to work with first-year women students, and also considers how programs such as these can be disseminated to other universities and sites. Significant factors accounting for the successful dissemination of programs to other institutions will also be discussed.*

**Index** *average, dissemination, first-year women students, retention, undergraduate research*

## INTRODUCTION

Women in Science and Engineering Research (WISER) Program places first-year women students in science and engineering research laboratories at Penn State University. WISER is a retention program designed to intervene during the period of highest attrition for women in the sciences and engineering: the first year. Between 1994 and 2001, a total of 306 Penn State students have participated in WISER. Of these, approximately 20% are students of color.

WISER is a Penn State adaptation of Dartmouth College's Women in Science Project (WISP). Their organization is explained here for the benefit of those who may not be familiar with these two universities. Dartmouth is small, private, and teaching-oriented, whereas Penn State is state-affiliated, large, multi-site and research-oriented. Penn State has also disseminated WISER to two other sites, Penn State Abington and Penn State Altoona.

## GOALS

The primary purpose for initiating WISER was to encourage, motivate, and retain more women undergraduate students in science and engineering majors. A pilot project was provided under the auspices of two senior women faculty and two program assistants in the life sciences. Specifically, this pilot research placement phase aimed to nurture students during the first year in which attrition is highest. The program also countered isolation in courses where women are fewer than men. First year women students were also introduced to faculty and graduate students, who served as colleagues, role models and mentors. From them, the students received

hands-on skills training in a scientific and technical context. This experience prepared students for more in-depth research in other university laboratories and industry.

## WISER STUDENTS

WISER students are recruited and placed in matching research labs during their first semester on campus when grade point averages (GPA) are not yet available. Self-reported SAT scores, an essay about their career aspirations, and interviews are tools that faculty use in selecting students. The "mother" program at Dartmouth does not use SAT scores because the university policy there is that SAT scores are unreliable in predicting women's performance at the university level. This is a liability we acknowledge. But we rationalize this by noting that because women are competing against each other and not men the disadvantage is equalized.

The range of WISER SAT scores reflects the standard Bell curve: 90% have cumulative scores of 1400 or less, and 74% have 1300 or less. This refutes two conventional ideas. First, that it is only academically gifted students that apply for research experiences, and second that undergraduate research experiences are suitable only for the academically gifted students. This dovetails with faculty assessments and evaluation of WISER students. WISER faculty (35 in total) report that WISER students are prepared to conduct research, and two professors have mentioned that, caliber-wise, their WISER students are as capable as graduate students.

## WISER PLACEMENT PROCESS

Incoming students receive several announcements including an information brochure on WISER and various presentations are conducted on campus. Students interested in conducting research under the WISER program are then asked to fill out application forms. These are distributed to faculty who receive between one and thirty applications for review. Professors then select one to three students and relay their choices to the WISER administrator. The WISER administrator in turn matches the student and faculty making every effort to pair first choice selections. Each year, approximately 30% of the applicants cannot be placed. These are usually in the life sciences, a specialty which has traditionally had fewer opportunities and less funding. Therefore these students are assigned to physical science and

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engineering research laboratories. Applicants have a choice of three labs.

### RESEARCH PROFESSORS PERSPECTIVES ON FIRST-YEAR STUDENTS CONDUCTING RESEARCH

Not all faculty members were receptive to the idea of first-year students conducting research. Professors who were skeptical about the success of such a program tended to come from highly rated departments with a tradition of recruiting students nationally and internationally. Departments requiring a BS thesis were also not anxious to recruit WISERs because their professors were already too busy. Areas where the primary research used high-tech computing were reluctant to take on first-year students. Lastly, research units that were indifferent to the under-representation of women did not see the value of working with first-year women.

Nevertheless, most professors were eager to work with young students. WISER faculty members have not only continued working with young students, they have recommended WISER to their colleagues. We have followed up on these recommendations with great success. All WISER professors, male and female, have a cadre of female graduate students, post-doctoral fellows, and research associates. But 75% of the WISERs tell us that because of the personalized selection process, gender does not make much of a difference to them once they settle down in the labs.

Professors who are keen to work with first-year students tend to display the following characteristics. Many of them began research very early on in their careers, some even as early as high school. Faculty members who are setting up new labs are appreciative of the work conducted by the WISERs and the supplies that they bring. Younger faculty who are eager to fulfill their service component like the WISER program because it allows them to become mentors as well. They also tend to describe first-year students as ideal because they are highly motivated. Moreover, these faculty also value the prospect of working with students who will be on campus for four years. Professors in departments with declining enrollments, and also those that do not have an undergraduate program enjoy working with first-year women. Finally, Departments wishing to add gender and cultural diversity are also keen participants of the WISER program.

We asked professors to comment on the attributes of WISERs in their labs. These (based on an 81% response rate) are reported here with percent of mention. Multiple answers were permitted. Therefore totals are greater than 100%.

1. "She is unusually talented or has skills the lab needs" – 51%
2. "She fits well into the lab"-51%
3. "I hope to recruit her to the major"-36%
4. "The supplies and student funding are useful"-33%

5. "She adds diversity to the lab"-33%
6. "She is in the major"-27%
7. "She lacks confidence and skills which the lab may give her"-21%
8. "Best choice of not too many applicants"-12%
9. "Reminds me of myself at that age"-9%
10. "My graduate student selected her"-3%
11. "I was asked by a colleague or WISER Director to take her"-21%

### DISSEMINATION OF WISER

WISER has been successfully disseminated from Dartmouth to Penn State (University Park) and from University Park to both Penn State Abington and Penn State Altoona. The reason for this success is that both Dartmouth and Penn State share some structural attributes. Both locations are rural with a high residential student population as opposed to a commuter one. Both universities have full-time professionally trained staff to administer recruitment and retention programs for under-represented students in the sciences and engineering. Both universities acknowledged that they needed to reduce attrition rates, and as a gesture of sincerity, committed seed funds to initiate the project.

Penn State administrators, on hearing about the Dartmouth model, were determined to conduct their own undergraduate research program for first-year students. Not only was the information about Dartmouth opportune, but the Dartmouth administrators were generous in handing over details of their model project to Penn State. Because of the precedent set by Dartmouth, the dissemination from Penn State University Park (40,000 students) to Penn State Abington (enrollment of 3,200 less emphasis on research) and Penn State Altoona (4,000 students) was straightforward.

The dissemination to Penn State Abington provided some unexpected results. First, the WISER program stimulated new research among faculty. Second, it led to the additional recognition of faculty already doing research. And third, the program served to integrate adjunct faculty through the student contact and administration recognition. Dovetailing the original Dartmouth program, the Abington WISER program also added activities such as research placements off-campus, presentation of research results, brown-bag lunches and resume-writing workshops.

### FUNDING

Dartmouth's WISP program was funded primarily by the Alfred P. Sloan Foundation and the National Science Foundation (NSF). The WISER program at Penn State is funded by the NASA Pennsylvania Space Grant Consortium. But we hope to institutionalize WISER by integrating it into the university's budget. WISER students receive independent research credits, and they work for at least five hours per week. Students may also opt for wage-pay roll at \$6/hour for up to \$750. For each WISER student, faculty members receive \$500/semester for supplies.

An NSF funded evaluation of WISER revealed a 50% reduction in drop-out and switch rates among WISERs as compared to their cohorts during the first three semesters when students are most at risk.

### CONCLUSION

High attrition rates among undergraduate women students intending to major in the sciences and engineering continues to deplete a pool of interested and talented students. This exacerbates the problem of under-representation in this field. The period of highest attrition at Penn State, and elsewhere, is the first year. We have created an undergraduate research program to benefit average students in science and engineering at a critical juncture in their career. Our experience tells that for research placements to be effective retention tools, they must intervene early, preferably during the first year of university.

### REFERENCES

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Dr. Lisa L. Brown is the Associate Director of the Pennsylvania Space Grant Consortium, a NASA-funded research, education and outreach program at the Pennsylvania State University with affiliates across Pennsylvania. She also teaches a first-year seminar in the College of Earth and Mineral Sciences. Lisa obtained a BS in Aerospace Engineering from the University of Colorado at Boulder and a PhD in Geosciences from Penn State University. Her dissertation research involved the use of computer models to study the chemistry and climate of the primitive atmospheres of Earth and Mars.