

WISE-UP: A FOUNDATION COALITION EFFORT TO RECRUIT WOMEN INTO ENGINEERING

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INTRODUCTION

Women constituted only 17% of those awarded bachelor degrees in engineering in 1995¹. In 1990, senior males in public high schools were more than three times as likely to choose a career in science, math or engineering than women². Interest in engineering careers among college freshmen in 1995 reached a 20-year low, with only 2% of the women planning to enter engineering majors³, a percentage that remained constant in 1996⁴. Minority women are the least represented in engineering, making up only 4.8% of the 1995-96 freshman class⁵ and receiving only 2.2% of the Bachelor's degrees in engineering in 1994⁶.

In order to recruit more women into engineering, and into the Foundation Coalition program, the Women in Applied Science and Engineering (WISE) Office at Arizona State University (ASU) was charged to develop a program for high school girls to encourage them to consider engineering as a career. The result of this charge is the WISE-Up (to the choices for women in engineering) Program.

THE NSF FOUNDATION COALITION

The National Science Foundation funded Foundation Coalition links seven higher education institutions: ASU, the Maricopa Community College District, Rose-Hulman Institute of Technology, Texas A & M University, Texas A & M - Kingsville, Texas Woman's University and The University of Alabama in an effort to improve engineering education. The Coalition's mission is to construct improved curricula and learning environments, to attract and retain a more demographically diverse student body, and to graduate a new generation of engineers who can more effectively solve societal problems that demand: life-long learning, teamwork, communication skills, appropriate application of math and science, integration of knowledge, and flexibility and competence in using modern technology. An outreach program for high school girls sponsored by the Coalition would therefore necessarily encompass these objectives.

THE DEVELOPMENT OF WISE-UP

Year 1

When an outreach program was first discussed, WISE was a new program itself. Founded in August, 1993, WISE was an effort by the College of Engineering and Applied Sciences at ASU to recruit and to retain women in engineering and applied

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science majors. During that initial year, the staff of WISE (a half-time director and graduate student) were busy assessing current student needs and gearing up for some initial programs. The task of developing a full-blown camp was daunting. However, the idea of putting together three days of hands-on activities seemed within reach.

Recruiting Participants

A simple tri-fold brochure was developed and mailed out to local high school math and science teachers and counselors on a pre-existing database maintained by the College's Recruitment Office. Teachers and counselors were asked to distribute the brochures to female students who were not necessarily excelling in math or science, but who showed potential in these areas. Brochures contained a registration form which asked for a recommending teacher's signature, GPA, and the highest level math class taken.

Once accepted, participants were required to submit parental permission forms and a photo release form. This form is required for underaged individuals to have their picture published. This was definitely needed as WISE-Up enjoyed media coverage on three news stations (including the local Spanish-speaking channel), three major newspapers, and a hand full of community and university newspapers in the first year alone.

Teachers were also invited to attend WISE-Up (tuition-free) to learn more about engineering and generate ideas for activities that could be incorporated into their classrooms. In year one, out of a maximum of 40 participants, 36 girls and 2 teachers participated in WISE-Up. Roughly 30% of the participants were minorities.

Developing Labs

Fortunately, this step was made simple by a cooperative faculty and funds to supply faculty with a week's summer salary. First year labs were developed by faculty from Bioengineering, Environmental Engineering, Electric & Computer Technology, and a Ph.D. student in Aerospace Engineering. Faculty were charged with developing their own labs, which were to encompass team-based, hands-on activities using high technology equipment. Faculty were encouraged to recruit female graduate students to assist in the development and running of the labs, to provide a female perspective and role models for program participants. Due to space restrictions, the labs will not be discussed here, but lab manuals are available from the WISE Program. Each lab block was 3 hours, with an exception for the aerospace lab which required additional time later in the program for the girls to launch rockets they had constructed. The labs were reviewed by a non-engineering student to ensure an appropriate level of challenge.

A training was held for all WISE-Up personnel the week before the event. The training consisted of using gender-inclusive and age-appropriate language and materials. The one problem encountered in this area the first year actually came from two of the female graduate students who developed the manual for one of the labs. The manual contained cartoons of women who were posing as if in a fashion show. A request to remove the pictures was ignored, and the graduate students asked program participants if they thought the pictures were inappropriate during their lab. This unfortunate situation was rectified the following year by requiring all lab materials to be turned into WISE at least 2 weeks prior to the program. WISE staff review the material for appropriateness and then bind all of the materials together in a program notebook.

A generic evaluation was designed to be completed by program participants at the end of each lab. The evaluation contained questions about the level of challenge and interest for each lab. This evaluation provided lab facilitators with immediate feedback.

Designing the Program

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The program was scheduled from 8:30 a.m. to 4:30 p.m., with optional programming from 7:30-8:30 a.m. and 4:30-5:30 p.m. to assist with parent's transportation schedules. Optional programming in the mornings were intended to include videos, word problems, and other activities that would not depend on everyone arriving at the same time. As it happened, virtually no one arrived early the first morning and subsequent mornings the girls were more interested in socializing than working on planned activities, so these activities were basically unutilized. The afternoon activities were somewhat more structured and included industrial engineering "mini labs", such as organizing the most efficient party, and doing quality control experiments with microwave popcorn. Many participants stayed for this optional programming so as not to miss out on these labs.

	DAY 1	DAY 2	DAY 3
7:30 am	Optional Programming	Optional Programming	Optional Programming
8:30 am	Welcome/Orientation	Ice Breaker	Rocket Launch
9:30 am		Lab II	Lab IV
12:30 pm	Lunch	Lunch	Lunch
1:00 pm	Lab I	Lab III	Picture/Ice Cream Lab
4:00 pm	Wrap-up	Wrap-up (T-shirts)	Evaluation/Conclusion
4:30 pm	Optional Programming	Optional Programming	Optional Programming

The morning of Day 1 included a Welcome/Orientation with a continental breakfast. An ice breaker called "People Bingo", where participants find enough people who meet the criteria in each square of the Bingo card to make a "Bingo" was used to help the girls meet one another. The squares have engineering-related criteria, such as "Someone who can tell you who the first female astronaut was". Information on choosing a college and major was also presented during the first morning. Finally, a civil engineering "mini-lab", where the girls broke into teams to construct a structure that would stand one meter high for 15 seconds using only marshmallows, straws and toothpicks, helped the participants become more comfortable working together in teams.

Subsequent mornings consisted of a continental breakfast with an ice-breaker on Day 2 and Rocket Launch on Day 3. Next, the girls and teachers broke into four, predetermined groups to rotate through the first lab block. The groups were designed to keep participants from the same schools together, hopefully building a supportive community for the students that they would bring back to their home campuses. The two teachers were assigned to the same group so that they could discuss the activities with each other. Each of the four groups began with a different lab, and then rotated through so that each lab was run a total of four times.

After lunch, the groups spent the afternoons in another lab block. During lunch on Day 2, the girls had an opportunity to talk to officers from the Society of Women Engineers (SWE) about college life and engineering. Participating SWE officers attended a training to learn active listening skills and how to focus on overcoming challenges in engineering in a positive light, so as not to discourage the girls. The officers were also trained not to talk about "breezing through" engineering (if this was true for any of them), so that the girls would expect to be challenged.

During the last afternoon, the girls had a group picture taken in their WISE-Up T-shirts, which had been distributed the day before. The program concluded with the "Ice Cream Lab". In teams, the girls wrote out instructions for making an ice cream sundae. The instructions were followed by WISE-Up staff, who followed the instructions literally, making for great laughs and a big mess. While participants enjoyed ice cream sundaes, they completed a summary evaluation of the program and said good-bye.

Year 2

Many important lessons were learned during the first year. It was anticipated that there would be an increased demand for the program in Year 2 so it was decided that WISE-Up would retain its original three-day commuter format and would be offered twice to accommodate more participants. Both programs were offered in the same week with an overlap on Wednesday. In Year 2, 78 participants, three of them teachers, completed WISE-Up. Roughly 35% of the participants were minorities.

Feedback indicated that the morning orientation was too long the first year. Therefore, a Computer Modeling Lab, with an introduction to cooperative learning, was integrated into the first morning session. This was an important addition because it provided the participants with insight as to how the Introduction to Engineering class is taught at ASU. This module gave participants more of a team-work orientation.

To accommodate repeat participants, it was decided that some new labs would be offered and continuing labs would be modified to keep them interesting. Labs in Year 2 were offered in Bioengineering, Environmental Engineering, Aerospace Engineering, Robotics, and Industrial Engineering.

The program again concluded with the Ice Cream Lab, but this lab was shortened to two hours. Prior to this final lab, a Problem Solving Lab in which participants searched the internet to answer questions, was offered.

Year 3

During Year 3, the WISE Program underwent significant transition with the departure of its director. An interim, part-time director was appointed and a part-time program coordinator was hired. As a result, WISE-Up underwent only modest revision for Year 3.

One important lesson learned in Year 2 was that holding both WISE-Up sessions in one week was far too stressful on staff. WISE-Up in Year 3 was therefore offered in two successive weeks. The flexibility this schedule offered appeared to help increase participation as well. In Year 3, 93 students and 2 teachers participated in WISE-Up. Thirty-five percent of the participants were minorities.

Year 3 Labs were offered in Bioengineering, Aerospace Engineering, Industrial Engineering, Materials Engineering, Construction, and Scanning Probe Microscopy. A greater connection between the lab activities with career information was emphasized. The schedule underwent revision to accommodate additional time needed for the Rocket Launch on Day 3. The Welcome and Introductions was abbreviated so that the first lab block could be accomplished during the first morning session, leaving Day 3 free to hold activities for the whole group.

The morning of Day 3 was split into two, with two groups launching their rockets while the other two groups participated in a Computer Science Internet Lab; then the groups switched. The Internet Lab was held in the Foundation Coalition classroom to demonstrate the environment offered by the program. A Coalition faculty member presented on the program in an effort to recruit future participants. After lunch on Day 3, the group as a whole participated in the Industrial Engineering lab. It was necessary to have the entire group participate in this lab to have the demonstrations of probability experiments yield the best results. The program again concluded with the Ice Cream Lab.

Also during Year 3, an exciting off-shoot of WISE-Up was developed. TEAMS, Teaming Engineering Advocates with Middle School Students, was a collaborative program between WISE and the Office of Minority Engineering Programs at Arizona

State University. TEAMS was funded by a grant from the City of Tempe's Seized Asset Community Action Grant program, and was targeted at City of Tempe female minority middle school students. Thirty-five students, 30% of whom were minorities, participated in TEAMS. TEAMS is based on the WISE-Up format, with hands-on, team-based engineering activities. The program will be offered again in 1997 through funding provided by Intel Corporation.

Year 4

The summer of 1997 will be WISE-Up's fourth year. WISE-Up will be expanded to a five-day, residential engineering camp. The added time the girls will be on campus allows for many new facets of the program to be developed. The team building component will be expanded, as will interactions with female engineering students (especially SWE members) and information about college admissions and financial aid. Industry tours and presentations by industry representatives will be added. Added ice breakers, team building exercises, and free time should allow the students to build a stronger supportive bond. Also, break-away sessions for teachers will provide them time to consider how to bring the activities and information back to their classrooms. Finally, one additional lab block will be added, bringing the total to five. This will allow for five participant groups, a benefit since the groups will be smaller (8-10 in each). WISE-Up will be held twice again this summer, and will accommodate up to 50 participants in each session.

The expanded time frame makes for many new benefits, but also presents many challenges. Staying in the dorm allows participants to become more comfortable with the campus environment. However, increased supervision will be required, along with clear policies about what will and will not be acceptable behavior -- and the resulting consequences. WISE is grateful to Susan Metz and Kathleen Bott's chapter on Developing Pre-College Programs in Increasing Access for Women in Engineering⁷, which has assisted in the planning for the upcoming year.

BUDGET

WISE-Up had an initial budget of roughly \$10,000, approximately \$6,000 of which came from the Foundation Coalition. In Year 2, WISE-Up's total budget was \$22,290, with \$15,000 from the Coalition. This increased slightly to \$25,000 for Year 3, with \$18,000 from the Coalition. Additional funds from the College were used to match the Coalition contribution. Student participants were charged a nominal tuition of \$35 (teachers attend tuition-free). Faculty received a week's salary for their efforts, constituting the biggest expense. Because Coalition funds can not be used for food or T-shirts, a large portion of College and participant tuition funds were used for these expenses.

WISE-Up has a budget of \$41,000 for Year 4. The Foundation Coalition will fund \$22,227. Participants will be charged \$125 tuition, with scholarships available for low-income students, as they were in previous years. Additional funding is currently being sought from external sources. Funding will be a major consideration in future years as this will be the last year WISE-Up will be funded by the Foundation Coalition.

OUTCOMES ASSESSMENT

Outcomes of WISE-Up have been assessed in three ways: Participant evaluation, pre and post measures, and tracking participants to determine who enrolls in engineering at ASU. WISE-Up evaluations have been overwhelmingly positive. These evaluations are quite detailed, asked for feedback on each component of the program. This information has been crucial to improving WISE-Up from year to year.

Pre and post program evaluations include measures of participants' confidence in their abilities to major in engineering (Betz and Hackett's College Major Self-Efficacy Scale⁸; Lent, Brown and Larkin's Academic Milestones Scale⁹; Hackett, Betz, Casas and Rocha-Singh's Coping Self-Efficacy Scale¹⁰); occupational interests (Betz and Hackett's Occupational Interest Scale¹¹); and what they expect a degree in engineering will do for them (Lent, Lopez and Bieschke's Outcome Expectation's Scale¹²). T-test comparisons of pre- and post-group means indicate a significant increase in participants' confidence for completing an engineering major. Participants planning to major in engineering increased by nearly 64%. Comparisons between pre-group means and six month follow-up means indicate a significant increase on all measures.

Of the Year 1 participants who are of college age, 40% are currently enrolled in engineering at ASU. Of the Year 2 participant who are college age, 60% are enrolled at ASU. Because WISE-Up targets students entering the 10th-12th grades, participants from Year 3 (1996) are not yet of college age. WISE has now expanded it's tracking to include students who enroll in engineering at other universities.

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