THE WOMEN IN SCIENCE AND ENGINEERING SCHOLARS PROGRAM

Etta Z. Falconer and Lori A. Guy
Spelman College
Atlanta, Georgia

ABSTRACT

The Women in Science and Engineering Scholars Program provides scientifically talented women students, including those from groups underrepresented in the scientific and technical work force, with the opportunity to pursue undergraduate studies in science and engineering in the highly motivating and supportive environment of Spelman College. It also exposes students to research training at NASA Centers during the summer. The program provides an opportunity for students to increase their knowledge of career opportunities at NASA and to strengthen their motivation through exposure to NASA women scientists and engineers as role models. An extensive counseling and academic support component to maximize academic performance supplements the instructional and research components. The program is designed to increase the number of women scientists and engineers with graduate degrees, particularly those with an interest in a career with NASA.

THE WOMEN IN SCIENCE AND ENGINEERING SCHOLARS PROGRAM

The Women in Science and Engineering Scholars Program was initiated in 1987 as a cooperative effort between Spelman College and NASA. The program provides scientifically talented women from groups underrepresented in the scientific and technical work force with the opportunity to pursue undergraduate studies in science and engineering in the highly motivating and supportive environment of Spelman College.

The goal of the Women in Science and Engineering Scholars Program or the WISE Scholars Program is to increase the number of women, including minority women, entering scientific and technical careers. The specific objectives are:

1. To identify high ability women students from underrepresented groups and to provide the students with an opportunity to pursue undergraduate study in engineering and science.

2. To enable high ability women college students to maintain academic excellence in scientific and technical studies.

3. To motivate and encourage students to pursue scientific and engineering careers.

4. To provide research training for selected students both in the undergraduate setting and at NASA Centers.

5. To motivate and prepare students to earn graduate degrees in science and engineering.

Scholars are actively recruited and are selected by a competitive process. Preference is given to students residing close to NASA Centers. Selection criteria include high potential and achievement in science and mathematics as measured by college entrance examinations and the high school record, and an interest in pursuing a career in science or engineering. Scholars are selected by a committee of Spelman faculty and staff, the NASA Center Equal Opportunity Officers, and the NASA Agency wide Federal Women's Program Manager.

Currently, there are 13 sophomore and 15 freshman Scholars. Each Scholar has a sponsoring NASA Center. The Equal Opportunity Officers and the Federal Women's Program Managers at NASA installations have a primary role in the development of the students. The NASA Centers and the number of students sponsored are given below.

NASA CENTERS AND WISE SCHOLARS

Ames Research Center	3
Goddard Space Flight Center	4
Jet Propulsion Laboratory	2
Johnson Space Center	4
Kennedy Space Center	3
Langley Research Center	4
Lewis Research Center	4
Marshall Space Flight Center	2
Stennis Space Center	2
TOTAL	28

Scholars pursue majors in electrical or aerospace engineering through the Dual Degree Engineering Program, physics, mathematics, or another scientific or engineering major related to the mission of NASA and the work of the sponsoring NASA Center. In the Dual Degree Engineering Program a student spends three years at Spelman and two at Georgia Tech, Rochester Institute of Technology, Boston University, or Auburn University, earning degrees from both Spelman and the engineering institution.

A three-day Orientation Conference was held prior to the beginning of the Fall semester for the Freshman WISE Scholars, parents, NASA officers, Spelman administrators and faculty and program supporters. The objectives of the conference were to provide a detailed explanation of the program, including the role of NASA, and to make certain that student and parents understand their responsibilities and the various support mechanisms available to help students meet program requirements. The conference was valuable in providing an opportunity for the Scholars to become acquainted with NASA officers and the WISE program staff. It was particularly effective in creating a bonding of the Scholars which has been instrumental in their academic success.

The Academic Year

The students take a strong sequence of science and mathematics courses leading to a major in science or engineering. The following courses are required of every Scholar.

Honors Analysis I, II (Calculus of One Variable)
Analysis III (Calculus of Several Variables)
General Chemistry I, II
Mechanics and Heat
Electricity and Magnetism
FORTRAN or Pascal
Honors English I, II
Independent Study/Research

Freshman Scholars take a schedule of challenging courses, including Honors Mathematics, Honors English, and chemistry. Engineering majors also take Introduction to Engineering and Engineering Graphics. Honors Mathematics is offered on three levels and students are assigned mathematics courses based on placement examination scores. Honors Mathematics provides an introduction to research methods through the requirement of at least one paper or project reflecting independent work, library research, and oral and/or written presentation. Freshmen also enroll in a special Study Skills and Critical Thinking Seminar. Additional courses from the required general studies complete the schedule.

Sophomore Scholars take Mechanics and Heat, and Electricity and Magnetism, along with appropriate mathematics courses. General studies and major courses such as Computer Systems, Linear Algebra, or Organic Chemistry complete the schedule.

Academic Support and Counseling Component

The director serves as academic advisor during the first two crucial years and maintains close contact with instructors of Scholars in order to take necessary intervention action to assure student success. Early identification of potential problems in science and mathematics courses is made by requesting student progress reports during the semester from their instructors.

Tutorials are an important part of the Academic Support Program. Tutors are provided for students in mathematics, chemistry, physics, and computer science. Tutors are graduate students or upper-level undergraduates of exceptional ability and achievement. The graduate tutor in mathematics conducts a group session for freshmen who are taking Honors Quantitative Reasoning I, Honors Quantitative Reasoning II, or Honors Analysis I. The session is designed to develop the ability of the students to work in small, productive groups. The tutor moves from one group to another offering assistance as needed. The graduate student is also available at other hours to provide individual tutoring.

In chemistry, a graduate tutor conducts a required group tutorial session for two hours. Difficult but basic topics are emphasized by the tutor, and questions are taken from the group. The tutor is also available for individual tutoring. In physics, an undergraduate senior provides individual or small group tutoring. Students are encouraged to attend tutorial sessions as a means of enhancing learning. Individual tutoring is provided in computer science.

All freshman and most sophomore Scholars live in the same dormitory, the Living Learning Center. A special graduate residential assistant is available to provide counseling and to give assistance during the evenings, nights and weekends. Students also attend group meetings with the director during the year for the purpose of assessing progress, determining problem areas, and providing support. Each freshman Scholar has a sophomore Scholar who serves as her Big Sister. The students are matched by major and the Big Sister provides advice, support and friendship.

Freshmen attend a seminar in Study Skills and Critical Thinking. The non-credit course meets once a week for a semester and covers topics such as study and test-taking skills, time management, and techniques for studying the sciences. The seminar is taught by a college counselor and guest lecturers.

Each semester a woman scientist or engineer from NASA spends two days on campus as the NASA Lecturer. She gives several talks and conducts an informal session for the WISE Scholars. Through the visit a strong statement is made that women can achieve in science and engineering.

Research Experiences

Scholars engage in a 10-week research experience at the sponsoring NASA Center each summer. Each student is required to submit a paper upon return to Spelman and to give a presentation of her work. The following presentations were given this semester:

Inertial Reference Package
Detector Array
Computer Research at Stennis
Fuel-Rich Catalyst Combustion
Model for Research of LCG
Investigation of Space Adaptation Syndrome
Computer-Aided Design for Large Advanced Space Systems
The Attitude Heads by Display Prototype
Controlling Indoor Pollution
Zirconium Ignition Test
Thermal Cycling Effects on Crack Densities in the Space Station

The following report by WISE Scholar Lori Ann Guy is representative of the summer research component of the program.

Computer-Aided Design for Large Advanced Space Systems

The Large Advanced Space Systems Computer-Aided Design and Analysis Program (LASS) has the capability of modeling intricate structures that are too complex to be built by most existing computer-aided design software packages. Last summer under the direction of Melvin Ferebee, Jr. of NASA Langley Research Center, I developed expertise in the use of LASS and created a model of a space platform in order to validate the program.

LASS includes several antenna synthesizer programs and corresponding databases for each configuration. The configurations are: a box-ring, a box truss, a hoop and column, a radial rib, a tetrahedral truss, and a default database. Each database contains the information necessary to create an antenna or model. Once a configuration has been specified, the appropriate synthesizer must be activated. The synthesizer is the part of the program that creates the antenna that will be used for analysis. The size and design of the antenna must be specified after the synthesizer is activated.

Following the selection of the desired antenna for the model of the space station, the execution of the corresponding synthesizer resulted in an output of a model file, a database file, and a set of mass properties. Next, a translator program which writes a universal file of the structure was executed. It contained all of the structure, geometry, and data sets pertaining to the model. It was necessary to specify whether the antenna would be added to an existing model during the writing of an universal file.

The universal file creates a permanent group of the individual models which is useful in allowing the user to manipulate all of the nodes of the antenna as a whole structure. While writing the universal file, the user has the ability to translate and/or rotate the model.

Modifications of the physical structure and analysis of the physical and material properties were made to the various models of the space station by using other programs. An internal program translated the modifications into a NASTRAN output file, which in turn had to be translated into a format suitable for use in the LASS program. Then the General Truss Synthesizer (GTS) was used to make final changes in the model and to review its components. GTS has two input categories - a listing of the values for the structural model in addition to those of a tetrahedral truss, and a second category which may require additional changes in order to identify antennas other than a tetrahedral truss. GTS writes the elements and nodes of the model to a file which contains the structural and geometric data of the elements in the model. Finally GTS outputs information about synthesizers including the number of nodes and elements contained in the model, the types of elements (beams, cables, or rods), and data on physical and material properties.

Following the viewing of the GTS output for the models of the Space Station, the Thermal Analysis program was executed. This program specified the orbit and material properties of the model and then computed temperatures and heat rates. This data was also translated into an analysis data set in a universal file that could be read into another program.

Several antennas were designed and analyzed as trial cases in order to validate the program before the actual modeling of the space platform. LASS is an excellent tool for modeling large and intricate structures and with modifications, will become an essential tool in the design process of space craft.

Outcomes

An early evaluation based on the outcomes of the first year indicates that the program is successful. Thirteen of the original 15 Scholars are still in the program. The average GPA of the returning students was 3.3.

Fourteen Scholars made the honor roll at least one semester last year and 11 made the honor roll for both semesters. Two students were among the 15 Dual Degree Engineering students of all levels from the Atlanta University Center institutions who received outstanding student awards at the Annual Awards Banquet. Seven students received honor pins at the affair.

The WISE Scholars Program has given a high visibility to NASA on the campus. It has created a core of high potential minority women students who share common interests and goals in science and engineering. There is a sense of enthusiasm and confidence in the Scholars which has had a positive effect on other science and engineering students. The Scholars are already interested in pursuing graduate degrees and are determined to succeed.