

ACTIVITIES TO ENCOURAGE PRE-COLLEGE STUDENTS TO STUDY ENGINEERING

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Stevens Institute of Technology has helped young women gain access to careers in engineering and science through the Office of Women's Programs (OWP) since 1977. To date, more than 13,000 students, parents, teachers and counselors have participated in pre-college programs conducted by OWP.

The programs developed for high school students provide an introduction to the fundamentals of engineering and science. The programs for middle school students encourage participants to continue studying mathematics and science in high school to broaden their career options. Program evaluations indicate that we are successful in meeting our objectives. The cornerstone of the pre-college programming is ECOES - Exploring Career Options in Engineering and Science, a residential summer program for high school students. Follow-up evaluations identifying post-high school plans of 1608 ECOES students indicate that 78% have majored in engineering, while 9% have majored in science.

To support the on-campus pre-college programs, and to reach out to secondary schools in the state, OWP coordinates a Women in Engineering and Science Network. This Network includes more than 100 women scientists and engineers. Approximately 50% are Stevens alumni. The others are predominantly colleagues of Stevens alumni. These professionals volunteer to participate in the pre-college programs as speakers, coordinators or tour guides for industry site visits, and mentors. Members of the Women in Engineering and Science Network are invited to give presentations about careers in engineering and science to more than 500 students at 25 secondary schools annually. Although the program formats vary, there are several key components that exist in all OWP pre-college programs:

- * Role Models
- * Hands-on Laboratories
- * Supportive environment which promotes students' interest in engineering and science and increases confidence in their ability to succeed.

Pre-college programs that involve a one-day format present a special challenge in terms of encouraging students who may not know each other, to actively participate. The following two activities have been very effective in helping the group relax in a new environment, promoting interaction, and setting the stage for the balance of the program. Both activities are effective with pre-college students in the 7th-12th grade.

"STARTLING STATEMENTS"

We typically begin a one-day program with this activity. The questions identified below are handed out to the students. They are asked to write down an answer to all questions without consulting their friends. After ten minutes, the session leader goes through every question, asking the students to volunteer their responses. After students guess, the correct answer is given.

1. Women are 52% of the U. S. population. How many are...
 Supreme Court Justices....1/9
 Senators....2/100
 Representatives....26/435
 Governors....3/50
2. What percentage of secretarial jobs are held by women?....97%
3. What percentage of salesclerk jobs are held by women?....75%
4. What percentage of lawyers are women?....20%
5. What percentage of doctors are women?....18%
6. What percentage of engineers are women?....7%
7. Women are 98% of employed dental assistants, what percentage of dentists are women?....8%
8. What percentage of American women aged 25-34 are in the labor force?....80%
9. How many years will the average woman college graduate, class of 2000 (that's most of you) work in her lifetime?....30 years
10. What percentage of American women with pre-school children are in the workforce today?....53%
11. What is the average salary of women working fulltime in the United States?....\$18,096
12. What is the starting salary of engineers in the United States?....\$35,064

Source: U. S. Department of Labor

Once all of the questions are answered a discussion begins. Typical discussion topics include:

- * A historical perspective on "a women's place in society"
- * Why women are so underrepresented in politics
- * Why women are underrepresented in jobs that are technical, lucrative and require a solid background in math and science.

"MYTHS AND REALITIES"

Another warm-up activity that also begins to address the barriers that deter young women from pursuing careers in engineering is "Myths and Realities: Is Engineering For Me?" This activity begins with a blank overhead with the word "NERD" on top. Students are then asked to do a word association with the term "ENGINEER". *"When you think of an engineer, what personality characteristics come to mind?"* After the students come up with their descriptions, the session leader may want to add a few more to the list. The list below identifies stereotypes that we have found are often used to describe engineers:

- * NERD
- * Must Be Brilliant in Math and Science
- * Enjoys Dirty Work
- * Work in Labs with Test Tubes and Machines
- * Rarely Works with People

- * Very Competitive
- * Unfeminine
- * Must Like to Take Apart Cars
- * Does Not Speak or Write Well - Can't Communicate!!
- * Destroys the Environment

The exercise that follows is to present or develop a list of characteristics of people who do well in engineering. Examples of important elements to include are listed below:

- * Enjoys Solving Problems
- * Asks Why...About the World Around Us
- * Curious How Things Work
- * Creative
- * Likes to Work With People
- * Wants to Improve the Environment
- * Interested in Helping People
- * Enjoys and Does Well in Math and Science
- * Seeks Challenging and Rewarding Work
- * Wants to Earn a Good Living

Students in 7th, 8th and even 9th grade not only require information about careers in engineering, but information about how to prepare for a career in engineering. It has also been our experience that most students do not have a working concept of the value of money since their parents provide for their needs.

The focus of the next two activities is to help students understand the connection between taking mathematics courses in high school and increasing their career options, which also have the potential of increased earning potential. The message is that students in 7th-9th grade do not need to decide what they want to study in college or do for a living right now. Rather, they need to be prepared for whatever it is that may interest them in the future. We have also found it useful to discuss the connection between career selection and salary level, with specific emphasis on careers that require knowledge of mathematics compared to careers that do not.

"MONOPOLY MONEY GAME"

This activity teaches students a lesson about income and expenses. One student is chosen to assist the session leader. She is given a job with a salary of \$18,000, the average salary of women working full time in the United States (U.S. Department of Labor, 1991). The student receives \$1500 in Monopoly Money, representing her income for one month. The exercise proceeds with her handing over money to the instructor, with every expense that she will incur as an adult working woman. All students, occasionally assisted by the instructor, participate in identifying realistic expenses such as taxes, rent, transportation, clothing, food, etc. The result is living very modestly with no discretionary income or savings.

"MATH THE KEY THAT WILL OPEN DOORS"

After the Monopoly Money Game, this exercise is used to establish the connection between math and science course taking, and careers which provide access to higher salaries, both initially and five years later. The following information is displayed on large, stand alone posters.

MATH REQUIRED TO GRADUATE HIGH SCHOOL

Nurse's Aide
Receptionist
Teacher's Aide
Salesclerk
Factory Worker
Secretary / Typist
Waitress
Bank Teller

Starts at \$327/wk
5 Years Later \$400/wk

ALGEBRA I, GEOMETRY

Laboratory Technician

Dental Hygienist

Bookkeeper

Draftsperson

Computer Technician

Starts at \$400/wk
5 Years Later \$500/wk

ALGEBRA I, II, & GEOMETRY

ALGEBRA I, II GEOMETRY, TRIGONOMETRY

Nurse
Dietician
Teacher
Business Administrator
Computer Programmer
Physical Therapist
Banker

Starts at \$500/wk
5 Years Later \$800/wk

Physician
Dentist
University Professor
Accountant
Engineer
Computer Scientist
Pharmacist
Architect

Starts at \$620/wk
5 Years Later \$1270/wk

Posters begin face down and each one is shown and discussed beginning with the least amount of mathematics and fewest career options. The posters, along with the job possibilities are dramatically knocked down, one-by-one, until the basic math and limited career choices are left standing.

It is important to let the students know that the careers being discussed are a random sample of careers and average salaries. In addition, be sure to stress that money should not be the predominant reason for choosing a career - just one factor.

"WHAT IS ENGINEERING? WHAT IS THE DIFFERENCE BETWEEN ENGINEERING AND SCIENCE?"

Lack of knowledge about engineering continues to be a barrier which deters young women from pursuing a career in the field. This session provides information about engineering in a concise format. The diversity of engineering is emphasized since most students who are unfamiliar with the field tend to narrow the definition. A secondary focus is the differences and similarities between engineering and science, since this is often confusing and requires clarity. Identified below are the statements used in this presentation.

ENGINEERS AND SCIENTISTS USE THEIR KNOWLEDGE OF MATHEMATICS AND SCIENCE TO SOLVE PROBLEMS

SCIENCE AND ENGINEERING

Scientists Analyze

To understand and explain the world around us

Engineers Synthesize

To design products based on scientific research to benefit society

PRIMARY ENGINEERING DISCIPLINES

Aeronautical	Civil	Marine/Ocean
Agricultural	Computer	Materials/Metallurgy
Automotive	Electrical	Mechanical
Biotechnology	Environmental	Mining
Chemical	Industrial	Nuclear

PRIMARY SCIENCE DISCIPLINES

Astronomy	Computer Science	Meteorology
Biology	Geology	Physics
Chemistry	Mathematics	

WHAT DO ENGINEERS AND SCIENTISTS DO?

Production (Primarily Engineers)	Sales
Design	Consulting
Development	Teaching
Research (Primarily Scientists)	

CAREER CHALLENGES FOR THE 21ST CENTURY

Energy	Information Systems
Environment	Materials
Healthcare	Transportation

The vocabulary and explanations are altered slightly for younger students. Once the students are given an overview of engineering, they have enough information to appreciate listening to a professional engineer talk about her work,

and participate in a lab in a specific engineering discipline. Both these components are very successful and typically incorporated into our one-day program. Participants maintain that attending OWP's one-day career seminar sparks their interest in engineering and encourages them to learn more about career opportunities in the field.