

## Program Development Grant Final Report Cover Sheet

**DR#** 090

**Project Title:** Engineering a Space Experiment

**Date:** March 30, 2002

**Project Manager:** Suzanne L. B. Woll

**Section:** J03

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**Deliverables:** Indicate type (i.e. document, web page, brochure, etc.), title, and media (hard copy, email file, disk, etc.)

15 minute film, "Engineering a Space Experiment," 100 Videocassettes, 2 CDs and 1 DVD

**Select the one primary Strategic Priority this project addressed:**

- Leadership     
  Education     
  Diversity     
  Visibility     
  Vitality

**SWE Committees** to which this report and deliverables would be of interest:

- Career Guidance     
  Public Relations     
  MultiCultural Committee  
 Continuing Devel.     
  Publications     
  Other: \_\_\_\_\_  
 Membership

**Project Audience** (age, sex, diversity) Female: K-12 Male: \_\_\_\_\_

<i>Age Group</i>	<i>No. Actual/Proposed</i>	<i>Diversity</i>	<i>No. Actual/Proposed</i>
• Elementary	<u>50+ /</u>	• Caucasian	<u>/</u>
• Middle School	<u>10+ /</u>	• African American	<u>/</u>
• High School	<u>10+ /</u>	• Hispanic	<u>/</u>
• College	<u>5+ /</u>	• American Indian	<u>/</u>
• Professional	<u>50+ /</u>	• Pacific Islander	<u>/</u>
• Other _____	<u>20+ /</u>	• Asian	<u>/</u>
<b>Contact Hrs:</b> <u>2</u>	per attendee	• Other _____	<u>/</u>

**SWE Volunteers (No.)** 14

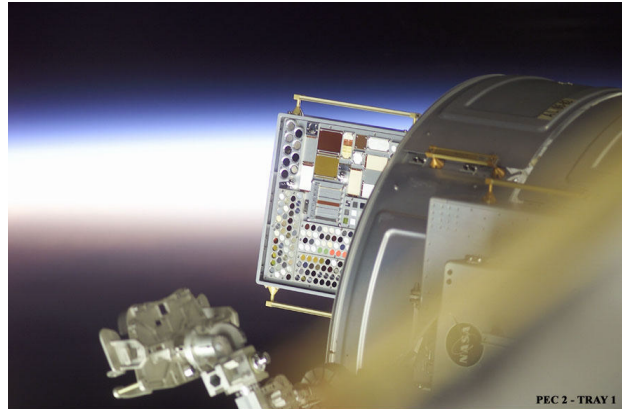
**Estimated Total Hours:** ~400 hrs

**Non-SWE Volunteers (No.)** 50

**Estimated Total Hours:** ~100 hrs

**Amount of Grant:** \$30K **Total Final Expenses:** ~\$50K **Amount SWE Owes You:** \$3K (Boeing)

## DR090 “Engineering a Space Experiment”



### Executive Summary

“Engineering a Space Experiment” was a two-year project that involved the development of a career guidance film for young girls. In this film, K-12 girls are shown a glimpse of the exciting world of engineering complete with female role models, stimulating them to ask how they too can pursue engineering. The backdrop for the film is the Materials on International Space Station Experiment (MISSE), the first externally mounted experiment on the International Space Station (ISS). Woven in between the scenes of the build process for the experiment, five key women engineers and scientists on MISSE tell their stories about what they do and why they became engineers.

The Pacific Northwest Section rolled out the film in January 2002 with a debut at the Museum of Flight in Tukwila, WA followed by a question-and-answer period. Over 70 girls were in attendance. The girls loved the film and asked lots of career-related questions. While the film works at many levels, the best response comes from elementary and middle school age girls. The questions and feedback were collected to generate a “How To Use This Film” worksheet. The film and the worksheet constitute the tool produced from this project that is intended for use by any and all SWE members to take into classrooms, Girl Scout meetings and other public educational events.

To reach the target audience, nearly 100 copies of the tool in VHS format were distributed to SWE leaders across the country, including all local section SWE presidents and Region directors. Members are already requesting additional copies of this new tool. A digital version of the film will be posted on the SWE website in the next few months. Watch for a showing on NASA-TV.

### Acknowledgements

The short film, “Engineering a Space Experiment,” was produced for SWE under Program Development Grant, DR090, with funding from the Ford Motor Company Fund and The Boeing Company. In addition, NASA (NASA Langley Research Center, NASA Glenn Research Center and NASA Marshall Space Flight Center) donated a considerable amount of

film footage and personnel resources. Many, many people across the country provided ideas, assistance and encouragement along the way. A list of credits is provided at the end of the film.

# 1. Project Description

## Introduction

The idea for “Engineering a Space Experiment” was born from a joint Air Force Research Laboratories and NASA project called the Materials International Space Station Experiment (MISSE). Dr. Suzanne Woll, a SWE J003 member, was named as one of the principal investigators for MISSE. As the team was forming, she noticed that almost all the leadership positions were being filled by women. Always on the lookout for ways to share science with girls, she thought, “Wouldn’t it be great to film the project over its life and provide girls with an inside look at engineering – complete with female role models?” What started out as a relatively simple idea turned into a 2-year project that produced a short, 15 minute career guidance film for elementary school girls.

The project produced over 100 VHS copies of the film as well as two electronic versions. SWE section J003 debuted the film in January 2002 to a group of Girl Scouts. The film was met with considerable enthusiasm by viewers. A “How to use this film” tip sheet was written based on the audiences’ questions and comments. The film and the tip sheet were packaged together as a tool for SWE members to take into classrooms across the country. In February 2002, the tool was distributed to all of the SWE professional sections through the local section presidents and the Region directors. The most frequently asked questions received are “How can we get a copy of this film,” and “Are you going to distribute it to schools?” The section (J003) has plans to make more VHS copies and the electronic versions will be posted on the web shortly.

## Background

The Materials on International Space Station Experiment (MISSE) is a joint materials flight experiment sponsored by the Air Force Research Laboratories/Materials Laboratory and the NASA Space Environmental Effects (SEE) Program. MISSE is a cooperative effort between the Air Force, NASA and industry that underwent initial integration at Boeing, NASA Marshall Space Flight Center and NASA Langley Research Center. The three principal investigators for the experiment are Dr. Suzanne Woll, Boeing-Seattle; Dr. Shiela Thibeault, NASA LaRC; and Ms. Rachel Kamenetzky, NASA MSFC. The program manager is Mrs. Junilla Applin. The objective of the film project was to highlight the engineering behind a space experiment and the efforts of the women engineers involved in the experiment in order to capture the interest of elementary school girls.

The goal of the MISSE experiment is to evaluate the effects of the space environment on a substantial number of spacecraft material specimens and capture the information in a widely available database. The data is not easily available because most satellites are launched and never retrieved. Other vehicles, like the Space Transportation System, are flown for only a few short days at a time. The material specimens were placed in four separate Passive Experiment Carriers (PECs) that were previously used to contain the MEEP (MIR environmental effects payload) experiment on MIR from March 1996 to September 1997. Two of the MISSE PECs were installed external to the International Space Station on August 16, 2001 and will fly for approximately 1 ½ years. The experiment time frame will correspond with solar maximum conditions, providing as severe a test environment in Low Earth Orbit (LEO) as possible. Materials being tested include thermal control coatings, optical materials and coatings, radiation shielding materials, thin film polymeric materials, inflatable structures materials, solar cell

technologies, structural materials, contaminated surfaces, mechanically stressed materials and a variety of specialty materials and devices.

### General Approach

The idea was to show engineering as exciting, flashy and something that women did. At the same time, it was desirable to show the women as friendly, honest and genuinely satisfied with their careers. As such, the initial approach was:

- Use professional video staff to produce a professional product. This goal was accomplished by hiring Boeing Video Services through a contract with SWE that was managed by a Boeing engineer.
- Obtain NASA support of the project. The NASA sites were very enthusiastic and were willing to conduct the interviews, etc. mentioned below and donate the footage to the project.
- Interview the women engineers and scientists about their job and how they got there. Ask them questions about “Who inspired them?” and “What have they worked on?”
- Film hardware sequences such as installation of the specimens into the base plates at Boeing and NASA MSFC, installation and vibration testing of the base plates at NASA-LaRC, clean room operations, installation of side wall carriers in Space Shuttle and the astronauts training at the Neutral Buoyancy Laboratory.
- Use NASA footage of deployment and/or retrieval by EVA on ISS
- Weave the interviews together around the hardware sequences to tell a story
- Add some animation to describe the environment to which the materials will be exposed. From the NASA footage, the environment will seem just black. It is important to show the erosive properties of atomic oxygen and describe the solar UV rays. The animation will describe the science behind the experiment.

### Benefits

The benefits of this project were directly aligned with the goals of the Society of Women Engineers. The film

- Promotes engineering as an achievable career choice and encourages young girls to pursue engineering and science (Education)
- Provides diverse (by sex, age and race) engineering role models for girls (Diversity)
- Markets SWE as a resource to young girls and K-12 educators through SWE member visits, Web access and NASA-TV (Visibility)
- Provided project management opportunities for SWE J003 members and continues to provide speaking opportunities for SWE members (Leadership)

### Project Progress

*July 11, 2000 – August 15, 2000*

The contract between the Society of Women Engineers and Boeing was officially signed on July 11, 2000. A kick-off meeting was held between the producer (Debra Buck), the principal investigator (Suzanne Woll) and the public relations representative (Beverly Weiss) (all Boeing personnel.) At the meeting, it was decided that the film would be woven around interviews of the

MISSE principal investigators and the MISSE program manager. Questions would be asked regarding why those women became engineers, what they like most about their jobs, etc. The interviewees were originally Dr. Suzanne Woll, The Boeing Company; Rachel Kamenetzky, NASA Marshall Space Flight Center; Dr. Shiela Thibeault, NASA Langley Research Center; and Junilla Applin, NASA Langley Research Center.

By coincidence, Suzanne Woll met Kim DeGroh, one of the MISSE experimenters, at a conference in France in June just prior to the contract award. After Kim heard about the project, she offered to participate too. Kim works at NASA Glenn Research Center (GRC) and routinely has high school interns from Hathaway Brown School in Shaker Heights, Ohio, work in the laboratory with her. NASA planned to film her group for NASA TV within a month anyway and so SWE became the recipient of a wonderful gift. The NASA GRC footage filmed in July 2000 showed the assembly of a sample holder as well as four high school girls from Hathaway Brown School suiting up in clean room garments for clean room activities, loading flight samples in flight hardware in a clean room and examining loaded flight samples with a black light. The video file also included interview footage with the four girls and Kim.

Since the assembly of the Materials International Space Station Experiment hardware was beginning at Boeing and was expected to end by August, it was decided to go ahead and film the tray assembly in the clean room on August 2, 2000. The camera crew shot video on the assembly of several sample holders, obtained close-ups on some of the more interesting trays and used interesting angles to look into the sample holding boxes. Dr. Woll gave a short summary speech targeted towards children on what items were being used and why. Gail Bohnhoff-Hlavacek and Dr. Gary Pippin were also filmed to show lots of activity in the clean room.

*August 16, 2000 – November 15, 2000*

Much of the activity during this period was aimed at developing video contacts at the NASA site and communicating the objectives of the film. The producer wanted the NASA crews to be fun and creative, using odd camera angles and interesting lighting. She also developed a series of questions for the crews to use during the interviews. Some of the questions that were asked in the interviews were:

Who or what inspired you as a young woman?

Why/when did you decide to become an engineer?

What do you like best about your job?

How important is this field today and in the future?

What advice would you give to young women interested in your field?

Using these questions, the goal was to bring out anecdotal stories that today's girls might be able to relate to as well as to convey excitement about our jobs. During this period, on-camera interviews were conducted for Dr. Suzanne Woll, Dr. Shiela Thibeault, and Junilla Applin.

*November 16, 2000 – February 15, 2001*

More hardware assembly was video taped at NASA LaRC in late November/early December. The assembly had been originally scheduled for the September/October time frame but fabrication delays at NASA LaRC pushed the experiment schedule, and thus the video schedule, out by two months. The scenes included installation of the sample trays on the base plate and into the passive experiment carriers and review and commentary by principal investigators in clean room garb.

During this period, the producer roughed out a script for the video. It was decided to use a young actress to narrate the film to provide continuity and logical segues.

*February 16, 2000 – May 10, 2001*

The astronauts were filmed by Boeing and NASA Johnson Space Center using the MISSE training hardware at the Neutral Buoyancy Laboratory on February 13, 2001. Surface footage was provided by Boeing through the Public Relations office and the underwater sequences that are routinely filmed during the training were provided from NASA JSC. It was difficult to make the contacts in Houston, Texas, but the footage definitely adds to the film.

*May 11, 2000 – August 10, 2001*

NASA Langley Research Center (LaRC) offered to film Dr. Sheila Thibeault working in the laboratory with her summer interns. This was another unexpected gift that was woven into the film.

The technical explanation of the science behind the experiment was written for the animation sequence and a draft of the ending credits that included logos (SWE, Ford Motor Company Fund and Boeing) was generated for the producer. When the video script draft was completed, it was sent out for approval in late July 2001. SWE, The Ford Motor Company Fund, NASA Glenn Research Center and NASA Johnson Space Center, Air Force Research Laboratories at Wright-Patterson Air Force Base, NASA LaRC and NASA Marshall Space Flight Center all had to approve the draft. Script approvals were received from all parties by mid-September.

*August 11, 2001 – November 9, 2001*

The shuttle launch that carried MISSE to orbit and the astronaut extravehicular activity (EVA) in which MISSE was installed on ISS and deployed was taped live. The STS-105 launch occurred August 10, 2001 and the 4 hour EVA took place on August 16, 2001. The installation and deployment of MISSE occurred almost flawlessly.

Interview footage for Rachel Kamenetzky, NASA MSFC, was finally received. The footage also showed two other women working with her in the laboratory.

It was hoped that NASA LaRC would loan Boeing the PEC hardware mock-up as a prop for the narrator. Unfortunately, the mock-up had been on loan to another agency and was damaged upon return. However, several Boeing women engineers allowed us to borrow space-related models for this purpose. These models included several satellites, a SeaLaunch rocket and a Shuttle.

In late September, the producer interviewed and selected a high school age actress to complete the narrator portions of the film. The narrator portions were filmed in one day using the props mentioned and several chemistry laboratories as background. The producer was very pleased with the actress' (Tasha Smith's) performance.

During this reporting period, Debra Buck, our video producer, moved from Seattle to Chicago. Originally, the move was to take two weeks. Because of various equipment delays and internal office moves in Chicago, this process ended up taking at least two months.

*November 9, 2001 - February 14, 2002*

The animation sequences were completed in early December and the rough cut of the film was completed by the end of December. All the animation was done via phone conversations and web files. (Animation is expensive and to be used sparingly.) The rough cut was sent out for review at the beginning of January. All the reviewers approved the film with minor comments within two weeks. The timely feedback was greatly appreciated. Comments were incorporated in time for the film to be released at the end of January. Six copies were delivered on January 25<sup>th</sup>, 2002 in time for the Pacific Northwest Section (J003) debut and the remaining 94 copies were delivered on January 30<sup>th</sup>, 2002 along with the MPEG digital versions.

The Pacific Northwest Section debuted the film at the Museum of Flight at a Career Night on January 27<sup>th</sup>, 2002. The section invited girls from the Girl Scout Totem Council, the Seattle Girls School and other local schools as well as SWE members and guests. The program agenda included a brief introduction, a showing of the film, a Question-and-Answer period and free time afterwards to browse the museum and SWE displays. Boeing provided funding (\$1200) to rent the Museum and its theatre for the evening.

A detailed description of the event and the outcome will be in the Measured Results section of this report. There were approximately 120 attendees, 70 of which were girls. The numbers were quite good, considering that it snowed that evening. Many of the girls in attendance were Brownies in 2<sup>nd</sup> grade. The exit survey results and the questions they asked were used to reach the following conclusions:

- The target audience (elementary school age girls) liked the film.
- The girls thought the film was at their level whereas some adults felt it was over the girls' heads. The goal was to capture their interest, not expect them to retain any level of detail on the MISSE experiment. The response from the girls indicates that we succeeded.
- The young girls liked seeing high school girls as role models.
- Many said they would now consider engineering after seeing the film.
- The girls asked mostly career questions, not space questions, meaning that we succeeded in getting our message about engineering across clearly without clouding it with the scientific platform.

Thus, the film project is considered an overwhelming success!

The film was distributed to the SWE professional sections by the end of February 2002. A cover letter and a "How To Use This Video" instruction sheet were written and copies were shipped with each VHS tape to SWE section presidents, Region directors and a handful of other SWE officers, thus concluding this project, DR090.

## 2. Results

The section has shown the film at several events. The first was the debut at the Career Night held at the Museum of Flight. At that event, surveys were handed out and the response is discussed quantitatively below. The film was also shown to an after-school care group of elementary students and to passersby at the mall during the Puget Sound Engineering Council fair. Within The Boeing Company, the film has been shown to a group of High Potential engineers (HIPOs) along with visiting high school students and to management. The response from these latter groups is discussed qualitatively.

### 2.1 Career Night

The Section hosted a Career Night to debut the “Engineering a Space Experiment” film as their January program. The results from the Career Night were used to gauge the success of the film and to develop the “How To Use This Film” worksheet. The film was rolled out on January 27<sup>th</sup>, 2002 at the Museum of Flight in Tukwila, Washington. Students and their parents were greeted by SWE members wearing “I’m a (chemical) engineer. Ask me a Question” identifiers. Approximately 120 people attended the event, a rather impressive turnout considering that it snowed that night. Of the 120 people, approximately 70 of the attendees were female students. Photographs of the event are presented in Appendix E.

Three display tables were set up in the lobby. One contained the SWE display that the section routinely takes to fairs, etc. One contained member scrapbook pages created just a few months earlier. Both of those tables were staffed with SWE members. The third table contained MISSE hardware and information and was staffed by MISSE experimenters.

The film was shown in the theater of the museum. Prior to the film, Hank Queen, VP of Engineering, Commercial Airplanes, gave an introductory address affirming The Boeing Company’s commitment to diversity.

Following the film, a question and answer period was held with Dr. Suzanne Woll, MISSE principal investigator and the executive producer of the film. Questions from the audience were recorded. Viewers were also encouraged to complete a short survey form prior to being released to peruse the museum and mingle with the SWE members. The survey form can be found in Appendix X.

### 2.2 Survey Results

From the approximately 120 attendees that night, 26 surveys were returned from students and 11 were returned by adults. Of the respondents, only two were male – one middle school student and one adult. The data was separated into the following five categories:

- 1) elementary school students (7 to 10 years old),
- 2) middle school students (11 to 13 years old),
- 3) high school students (14 to 18 years old),
- 4) college students (18 to 22 years old) and
- 5) adults.

The sample sizes were low (<15) but the purpose of separating the data was to determine the receptiveness of the age groups to the film and its ideas.

The original concept for the film was to target elementary school students. During the course of producing the film, it was thought that some of the footage received was too sedate for the attention span of elementary school students. When high school students were added into the film as experimenters and the narrator, there was concern that the target age of the film had crept upward.

Therefore, the first item to be determined from the survey was whether or not the different age groups thought the film was either too simple, just right, or over their heads. The Pareto chart in Figure 2.2-1 below shows that the majority of viewers thought that the film was just right. In fact, all of the elementary or middle school students thought that the film was at their level. It is interesting to note that it was primarily the adults who thought that the film missed the mark for their children.

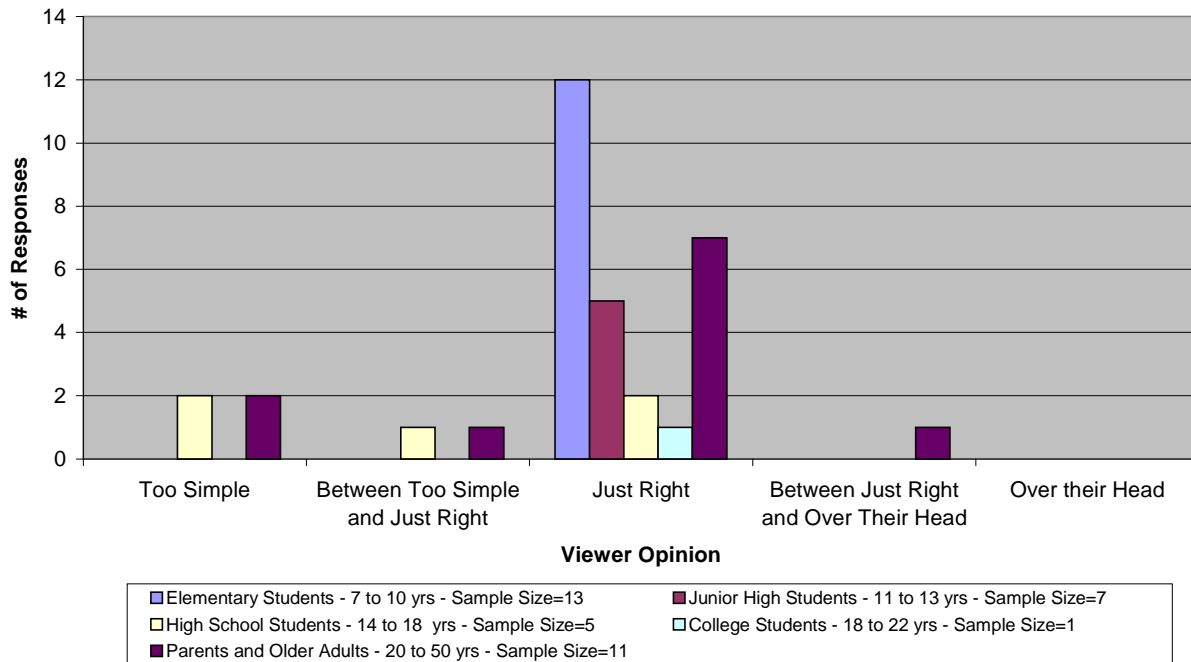


Figure 2.2-1 Perceived Level of Film

The next item to be determined was whether or not the viewers liked the film. Thirty two of the 37 people surveyed that evening (86%) liked the film. The data is provided in Figure 2.2-2. In addition, the SWE members (many of whom didn't fill out surveys) all had good words to say after the film and program, such as "Excellent film," and "Great Job." Based on comments from the surveys and a few other high school students whose parents borrowed the video and watched it with them, what some viewers did not like was the perkiness of the narrator or the odd, jittery camera angles. However, these features were put in to the film to make it attractive to elementary school students and that audience seems very receptive to the film.

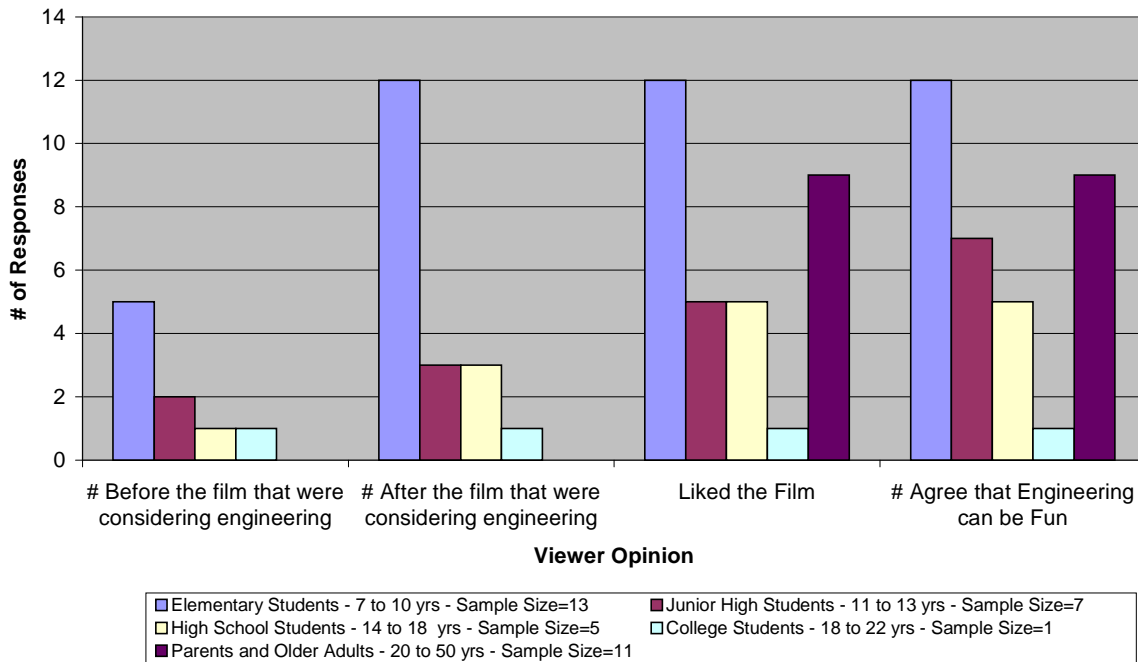


Figure 2.2-2 Effect of Film on Viewers

Actual comments received on the survey forms are

Elementary Students – 7 to 10 years of age

We liked seeing the lab and the girls in it.  
 I liked the experiments.  
 "The film" is encouraging.  
 I liked everything.  
 There were things I didn't understand

Junior High Students – 11 to 13 years of age

I liked how they showed what they were doing instead of just talking about it.  
 I liked it because it was short.  
 At least I didn't have to do any math.

### High School Students – 14 to 18 years of age

It was very understandable and good for younger children's learning.

The film wasn't hard to follow.

The girl who did the talking seemed fake.

### Parents and Older Adults (20 to 50 years of age)

I thought it was a positive influence for girls.

It is inspiring for anybody to consider engineering.

It is a good film about what engineers do.

I liked the age appropriate commentary person.

I thought that the terminology was over the younger students heads.

I felt that this film was not aimed at a younger group. I doubt that any of the girls understood what engineering really meant by the end of the presentation.

Lastly, it was desired to know if the primary messages of the film were well received. Respondents were asked if they agreed that engineering could be fun and what their feelings were about possibly pursuing engineering, both before and after the film. The data is presented in Figure 2-2. Thirty four of the 37 people surveyed (92%) agreed that engineering could be fun after viewing the film. This percentage was even higher than the number of people who said they liked the film.

The film had the greatest effect on the elementary school students. Before the film, 5 of the 13 girls were considering engineering but, after the film, 12 of the 13 girls stated that they may consider engineering as a career. More than half the girls opened their mind to engineering as a result of watching the film. The numbers were less dramatic with the older students. Of the 7 middle school students, the number of girls considering engineering went from 2 to 3 and, of the 5 high school students, the number of girls willing to consider engineer went from 1 to 5.

In the comments section, respondents were asked what questions they had. These questions were added to the list generated from the Question and Answer period and are included in Appendix B, How to Use "Engineering a Space Experiment."

In summary, the film was originally designed to interest elementary students in engineering. There was concern that the target age group had crept up but the survey responses seemed to indicate that the film was right on target. The responses seem to clearly show that the elementary students were captivated by the film. Despite what some adults may perceive, the elementary students can handle the technical terminology in small doses and they readily identified with girls a few years old than themselves. Junior High and High School students also enjoy the film but they are a tougher audience, especially the older they are.

## 2.3 Questions and Answer Session

At the Q&A session at the Career Night, the students began with some personal questions to get to know the speaker, Dr. Suzanne Woll. In particular, one student wanted to know if Suzanne had been a Brownie (she had been). Once they found her willing to talk about herself and could identify with her, the girls opened up and the questions became very career-oriented. Because the average age of the girls was about 10 or 11, the career questions were surprising. What we learned is that you should never underestimate what girls want to know. If they are asking questions, now is the time to answer them and get them interested in engineering. Very few

questions from the audience were about space or the MISSE experiment. It was clear that the students want to talk to the real, live engineer and hear about her experiences. The questions from this Q&A session can be found in Appendix B, How to Use “Engineering a Space Experiment.”

The film was designed as a tool for engineers to show to an audience and break the ice with students. Based on the number and type of questions voiced at the debut, the film is very successful as an ice-breaker with elementary students.

#### 2.4 Responses from Other Groups

The film was shown one evening to a group of students at Stevenson Elementary School in Bellevue, WA. The students attend after school care together and were putting on a Space-themed open house for their parents. The film was well-received by the students and parents. One young girl commented to the presenter that she was the first woman engineer she had ever met. That comment alone made the evening worth while.

The film was also shown at the Puget Sound Engineering Council (PSEC) fair at Crossroads Mall in Bellevue, WA on February 16<sup>th</sup> and 17<sup>th</sup> as part of Engineering Week. The Pacific Northwest SWE Section had a booth at the PSEC fair with a VCR and TV set up. The film was shown alternately with the Zoom movie. As people move from booth to booth, they really don't take the time to stop and watch. The Zoom film captured slightly more interest because the people recognized the program but neither film captured much attention in this manner. The conclusion from this experience was that this type of event (a career or science fair) is not a good place to use this tool. It may add a sparkle to your booth to attract people but don't expect to reach anyone with it.

One SWE president in Utah was very excited to receive her copy of the film. Apparently, their section is participating in a career guidance outreach event during Utah Space Week. Thanks to NASA LaRC, her section was able to receive three more copies of the film for this purpose.

The film was presented to a HIgh POTential group of engineers at The Boeing Company as an example of a stretch special assignment. Special assignments are an excellent way to practice leadership skills. The engineers were interested in the film and, as parents, wanted to know how to get a hold of the film and get it into the schools. This is a recurring theme with adults.

A number of individuals within Boeing have expressed excitement over the film. A copy of the film was sent to the University of Hawaii, Manoa on behalf of Boeing College Relations. While there is a student SWE section on Hawaii, it was surprising to learn that there is no professional SWE section. Also, Boeing engineers (~5 so far) have borrowed copies to show either their own daughters or small groups of girls. Boeing Phantom Works managers have been shown the film at offsite meetings as an example of community outreach and diversity recruiting development and it will be shown at a Phantom Works Road Show in Washington, DC at the end of March.

### **3. Lessons Learned**

The biggest lesson learned about this video project was that it was a BIG project. It was big in terms of time, money, effort and people involved.

This film project took almost 2 years to complete. Over the course of those 2 years, the project manager probably spent approximately 2 hours per week of volunteer time communicating with the various groups and directing the project. In addition, she spent time writing the SWE grant proposal, pitching the idea to Boeing management and NASA public relations, organizing the debut and writing the final report. Other SWE volunteers gave generously of their time also by reviewing the proposal and reports, packaging and shipping the film, contacting local media and assisting at the debut. However, it wasn't just SWE engineers who gave their time. Many engineers across the country personally stepped up to help, giving technical advice for developing the animation, reviewing the final product, setting up display booths, etc. As a rough estimate, approximately 500 volunteer hours were probably donated to this project. The lessons learned here are 1) make sure that there is at least one champion on the project who will complete the project no matter what happens and 2) involve as many people in as many delegatable tasks as possible.

One of the reasons that the film took almost 2 years to complete was that the success of the project was linked to the STS-105 shuttle launch. There was a two month launch delay that could have been longer if NASA had decided to swap missions to repair the Canadian robotics arm. Also, our producer was swept up in Boeing's move of its headquarters to Chicago. Getting her office and equipment back up and running took at least 3 months. The lesson learned here is that sometimes you have no control over events that affect your project. Roll with it.

As discussed in Section 6, the video production costs were \$30K and were contracted to Boeing Video Services through the project manager's division, Boeing Phantom Works. When using a support group in a large company, the project manager learned that the cost of a project needs to include contract overhead. This approach was different from the previous research and development contracts conducted within one division with which she was familiar and after which she had been modeling the SWE contract. This revelation was after she had already received approval for the project from SWE. Since SWE does not fund overhead, she was in a quandary. Thankfully, the project manager had a very helpful, very wise contracts person who estimated the cost of overhead that was not priced to SWE and helped her convince Boeing to fund that portion. It took letters signed by engineering and finance all the way up to the division president to obtain approval. A year later, when funds were tight, the financial commitment was still met because that commitment came from the top. The lessons learned here were 1) ask everyone involved when pricing a proposal and 2) get commitments in writing.

In this project, approximately \$3K was budgeted for the science animation. When the project manager was discussing the ideas with the animator, she was told "by the way" that the animator was doing much more than they usually would for what they were being paid because they wanted Boeing's business. If they had charged SWE directly, the animation cost would have been in excess of \$10K. The lessons learned here was animation is expensive. Use sparingly.

As it was, figuring in production and overhead costs, the film cost approximately \$50K and much of the raw film was donated by NASA. If more on-site filming had been required, the film

would have cost much more. NASA was very generous. The lessons learned here were 1) sell your ideas and 2) don't be afraid to ask for donations.

The choice to use an in-house production services company was, overall, a good one. Boeing Video Services produced a very professional product. The experience factor also kept the production costs within the original budget. The only drawback was that, by being within Boeing, the project manager had a limited number of Boeing SWE section members that could help her with on-site responsibilities. Luckily, that limited number included a few key SWE people (like Sandy Postel, Boeing SWE focal; Angie O'Gorman, PNW Section President; and Suzanne Hakam, past Region J director). The lesson learned here was that internal sourcing can mean that you are trading off the ability to share the workload.

The film was distributed to all the professional sections as promised with guidance on how to use it. Even so, the distribution plan was always sketchy. Perhaps a committee should have been put together to work the issue independently of the film production to reduce the workload for the project manager. Then, maybe the distribution could have been planned to coincide with Engineer's Week in February or made its entry completely separate from the Zoom video. The lesson learned here is to match people with their abilities. Some section members are good at generating a vision. Others are good at planning and executing to a plan. One of the most frequent questions we get are "How can I get a copy of this film?" If we had a better plan, maybe we could have a better answer than "We'll have some more available in a few months and it will be on the Web."

One of the more amusing lessons learned was from the 2<sup>nd</sup> grade Brownies. While some of their parents may have thought that the film was over their heads, the Brownies got it. Even though some of the scientists reviewed the film and thought we didn't fully tell them what they were supposed to learn, the Brownies got it. Girls are much smarter than what some people give them credit for. We already knew that, didn't we?

#### 4. Publicity

The publicity for this project so far has been local, focusing on the film debut at the SWE Pacific Northwest Section Career Night. Sometime this year, however, it is anticipated that the film will be broadcast on NASA-TV. As other professional sections plan events using the film, perhaps there will be more publicity at their local levels.

For the film debut, the Pacific Northwest Section reached out to the community in a variety of ways.

- 1) The PNW section invited Totem Council Girls Scouts and the Seattle Girls School. An email was sent to each key contact person along with a flyer. Given a positive response, a written invitation and color flyers were sent in the mail. Over 250 flyers were sent and over 20 troop leaders called to RSVP. (Suzanne Woll and Rae Sculerati)
- 2) The PNW section invited its members and guests via the PNW section newsletter in January. The section president's column mentioned the film debut, there was an article on MISSE from the Web published within and a color flyer was included. Later on in the month, section members received a second color copy of the flyer in the mail as a reminder. (Angie O'Gorman and Jeannette Taylor).
- 3) The Career Night was announced in Boeing News Now, an intranet news service, on Thursday, Jan 24<sup>th</sup>. (Angie O'Gorman)
- 4) A press release was sent to the following local news and TV agencies: E-mail: [scene@seattletimes.com](mailto:scene@seattletimes.com) Komo News Channel 4, KIRO TV News Channel 7, King 5 News Channel 5, UPN Channel 11, WB Channel 22 and Q13 Channel 13. (Meribeth Nordloef-Pederson) The text of the press release was

When: January 27th, 5-7 PM

Where: Museum of Flight

What: Career Nite and Premiere of short film "Engineering a Space Experiment"

BY: Society of Women Engineers/Boeing

The Society of Women Engineers, Pacific Northwest Section is hosting a Career Night for children and college students at the Museum of Flight on Jan 27th, 2002 from 5-7 pm. The highlight of this evening is the debut of a short film "Engineering a Space Experiment." In this film, five women engineers from across the country discuss their paths into engineering and the Materials International Space Station Experiment that drew them all together in leadership roles. The film was produced by Boeing and a SWE development grant from Ford Motor Company Fund.

Students and their families are encouraged to view the museum and mingle with other area women engineers after the show. For all ages. Free admission is made possible by Boeing sponsorship. For information call Angela O' Gorman at Phone: 206-662-0708 or Suzanne Woll 425-644-1779 evening.

At Career Night, the section distributed pencils to the attendees that were printed with  
SOCIETY OF WOMEN ENGINEERS  
“Engineering a Space Experiment”

[www.swe-pnw.org](http://www.swe-pnw.org)

in order to publicize the film and the Society of Women Engineers. (Meribeth Nordloef-Pederson)

5) The section pledged the event as part of Introduce a Girl to Engineering Day via eweek.org. The pledge was for 25 women engineers to reach 100 girls. The event was posted as

The Society of Women Engineers, Pacific Northwest Section is hosting a Career Night at the Museum of Flight on Jan 27th, 2002 from 5-7 pm. The highlight of this evening is the debut a short career guidance film. In "Engineering a Space Experiment," five women engineers from across the country discuss their paths into engineering and the Materials International Space Station Experiment that drew them all together in leadership roles. Students and their families are encouraged to view the museum and mingling with other area women engineers after the show. For all ages.

Unfortunately, it snowed in Puget Sound the night of January 27<sup>th</sup>, 2002. Residents in Puget Sound generally don't drive anywhere in the snow because there is no salt and no snow removal. In terms of our pledge, we fell slightly short with probably 17 women engineers reaching 70 girls that night. Despite the section's best efforts, nature had a way of surprising us all. It is estimated that approximately 50% of those planning to attend the event decided not to tackle the weather which was much worse on the north side of the region. Even still, there more than 120 people overall in attendance, which is more than 4 times the attendance for a popular PNW section meeting (~30). The section's public relations efforts must have had something to do with that.

On a more national perspective, the PNW section loaned the master copy of the film to NASA Langley Research Center to make a Beta copy. The Beta copy will be given to NASA TV. At this time, the PNW section does not know when the film will be scheduled for its first showing on this station.

## 5. Deliverables

In accordance with the contract with the Boeing Company, 100 VHS copies were delivered to the PNW section. These 100 copies were then distributed across the Society. The Table 5-1 provides an accounting of these copies:

Table 5-1 Distribution of SWE Copies

SWE Local Section Presidents (including J003)	81
SWE Region Directors	10
SWE President, Shelley Wolfe	1
SWE CEO, Gina Ryan	1
SWE Career Guidance Committee Chair, Kim Tholen	1
Submitted in Final Report (for Project Development Grant Program and for Ford Motor Company Fund)	2
Reserved for SWE Award Submittal in June (Exxon Media Award)	4
Total	100

In addition, a Beta SP submaster tape, two CDs and a DVD were delivered to the PNW section. The submaster BETA SP tape can be used by SWE J003 to make additional VHS copies without the need to contract with Boeing. The CDs and DVD contain electronic MPEG versions of the film that will be posted on the SWE website.

Another 24 copies were delivered to the PNW section from the Boeing Company. These 24 complimentary copies were distributed to various NASA and Boeing personnel. Where appropriate, individualized "Thank-you" certificates were made and sent along with the copies of the film. An accounting of the additional 24 copies is provided below in Table 5-2:

Table 5-2 Distribution of Boeing Copies

NASA Marshall Space Center	2
NASA Kennedy Space Center	2
NASA Langley Research Center	5
NASA Glenn Research Center (includes Hathaway Brown School)	7
Boeing, Management and Public Relations	4
University of Hawaii, Manoa, HI, SWE Faculty Advisor per Boeing request	1
Boeing SWE engineers	3
Total	24

## 6. Funding and Expenditures

The total cost for DR090 “Engineering a Space Experiment” was approximately \$50,000. Funding for was provided by The Society of Women Engineers, the Ford Company Fund, The Boeing Company and NASA. A full accounting of the expenditures is shown in Table 6-1.

Table 6-1 DR090 Expenditures

Item	Expense
Production Services <sup>1</sup>	\$30,223
Contract Administration <sup>2</sup>	\$18,729
Total Contract Expenditures	\$48,952
Contract Funded to	\$30,000
Paid to date	\$27,000
Balance due to Boeing	\$3,000

Item	Expense
Shipping Materials	\$79.10
Postage	\$138.53
Thank you Certificates	\$7.81
Promotional Pencils <sup>2</sup>	\$120.00
Copying	\$4.57
Museum Rental <sup>3</sup>	\$1,200.00
Total Program Costs <sup>4</sup>	\$1,550.01

Item	Expense
Total Contract Expenditures	\$48,952
Total Program Costs	\$1,550
Total Project Cost <sup>5</sup>	\$50,502

<sup>1</sup>It was understood that the contact work would not be itemized.

<sup>2</sup>This amount was provided by Boeing

<sup>3</sup>This item was a SWE member donation

<sup>4</sup>The Pacific Northwest Section intends to have more copies of the film made for the 2002 SWE Conference

<sup>5</sup>Total does not include film footage donated by NASA

The Society of Women Engineers entered into a fixed price contract with The Boeing Company for \$30K to cover production costs. Of that \$30K, \$27K was applied for and received through a SWE national Project Development Grant funded by the Ford Motor Company Fund. The SWE local section sponsor of the project, the Pacific Northwest Section, provided \$3K.

The total production costs for the film came to \$30,223, which was very close to the original estimate of \$30K shown in Table 6-2. The original estimate included approximately \$28 K for film development by Boeing Video Services, \$1.2K to conduct a trial run and make any

necessary revision, \$0.42K to produce 100 copies of the videotape, \$0.36K to convert the video into a Web-viewable format. As the terms of the contract with Boeing precluded itemization of costs and because the original estimate was so close, the original detailed estimate for the video alone is provided in Table 6-3 as supporting information.

Table 6-2 Original Production Cost Estimate

Item	Amount
Video	\$28 K
Trial Run and Revision	\$1.2K
Copies	
VHS	\$0.42K
Web-version	\$0.36K
<b>Total Production Cost Estimate</b>	<b>\$30 K</b>

Table 6-3. SWE Sponsored “Engineering a Flight Experiment” Video Production Costs

TV-xxxxx					
TOTAL ESTIMATED COST:	\$28,692.40				
Total Boeing Manhours:	260				
POSITION / ITEM	ESTIMATED	CHARGED	REMAINING	ESTIMATED MANHOURS	
WRITER:	\$4,823.00		\$4,823.00	53	
PROD/DIRECTOR:	\$12,831.00		\$12,831.00	140	
DIR/PHOTOGRAPHY:	\$2,184.00		\$2,184.00	24	
CAMERA ASSISTANT:	\$1,456.00		\$1,456.00	16	
PRODUCTION ASSISTANT:					
PRODUCTION ASSISTANT:					
PRODUCTION ASSISTANT:					
Digitize for web	\$364.00		\$364.00	4	
DUPLICATION (Video Copies):	\$415.98		\$415.98	4	
SOUND (transfer/editing/mixing):	\$1,638.00		\$1,638.00	18	
ART/ANIMATION:	\$3,000.00		\$3,000.00	1	
Web stream	\$72.75		\$72.75		
MISC. (wardrobe, props, needle drop, etc.)					
VENDED SERVICES +Finance- hardware					
VENDED SERVICES +Finance- talent/cre	\$577.50		\$577.50		
VENDED SERVICES +Finance- post product					
TRAVEL:					
FILM PROCESS & TRANSFER COST+Finance					
TAPE COST+Finance:					
ISS FINANCE CHARGE (display only):	\$27.50		\$27.50		
VIDEO SERVICES OVERHEAD CHARGE	\$1,330.17		\$1,330.17		
<b>TOTAL PRODUCTION COSTS:</b>	<b>\$28,692.40</b>		<b>\$28,692.40</b>	<b>260</b>	

Notes:

- 1) The cost of copies is based on 2 hr of labor at \$68.67/hr plus \$1.50/VHS, \$0.50/case and \$0.85 for actual VHS tape. For this amount, 100 copies will be made and labeled.
- 2) The additional cost for digitizing the film into a Web-viewable form will require approximately half a day (4 man-hours) to accomplish. The estimate at 4 hours at \$91/hour is \$364.
- 3) The vended service refers to any outside narration or talent that may be utilized.
- 4) The finance charge is a Boeing overhead cost associated with the subcontract administration to the animator.

A large sum of money (\$18,729) was spent on Contract Administration as shown in Figure 6-1. This amount represents the cost of monitoring a contract in a large company. It includes the cost of overhead, progress report generation (9 hours of engineering time for 7 reports) and interdivisional work authorization. The entire amount was donated by The Boeing Company.

Considerable film footage was donated by NASA Langley Research Center, NASA Marshall Space Center, NASA Glenn Research Center and NASA Johnson Space Center. The various NASA sites were very generous and supportive of the project. The public relations people conducted on-camera interviews, had film crews in the laboratories, provided Beta tape to the Boeing Producer, reviewed the script, rough cut and final version and helped out whenever asked. NASA's support, although not itemized in Table 6-1, gave this project its exciting, national appeal and SWE is extremely grateful.

For various reasons, the Air Force Research Laboratory/Materials Laboratory (AFRL/ML) did not have definable involvement in this film. However, the AFRL/ML was very supportive of the project and allowed their hardware to be filmed for public use. For these reasons, SWE is also extremely grateful to the AFRL/ML.

The Pacific Northwest Section was responsible for distributing the film. Distribution costs to date (\$230) have been less than budgeted (\$1K). The Section was fortunate to have The Boeing Company donate the cost of renting the Museum of Flight (\$1200) for the program debut. The Section will be spending additional funds in the near future to have additional copies available for the 2002 SWE Convention in Detroit.

APPENDIX A  
Cover letter to SWE Officers

February 8, 2002

Dear SWE Local Section President (*or Region Director*),

The Pacific Northwest Section of the Society of Women Engineers is pleased to provide your Section with this videotape of the short film, "Engineering a Space Experiment." The film provides girls, young and old alike, a glimpse of the exciting world of engineering complete with female role models, stimulating girls to ask how they can pursue engineering too. The 15-minute film was produced for SWE under Project Development Grant DR090 with funding from the Ford Motor Company Fund and The Boeing Company.

The backdrop for the film is the Materials on International Space Station Experiment (MISSE), the first externally mounted experiment on ISS. Woven in between the scenes of the build process, five key women engineers and scientists on MISSE tell their stories about what they do and why they became engineers. Of course, they also provide advice to budding engineers to take lots of math and science classes and develop good communication skills. There are even high school interns in the film.

One of the best ways to reach girls and spread the SWE message is to visit and talk with them. The film is designed as an icebreaker for SWE engineers to use with elementary students. The concept is that SWE engineers will take this film into classrooms, Girl Scout meetings and other events, show the film and then step back and answer the girls' questions about being an engineer.

Our experience with this new tool is amazing! We held a film debut with a question-and-answer period one snowy evening in January. Despite the snow, we had over 70 girls in attendance, most of them second-graders. The girls loved the film and asked lots of questions. The good news for SWE is that most of the questions were career-related. Very few of the questions were related specifically to space. This data point tells us that the film will work well as an icebreaker for any SWE member willing to give it a try. A list of the questions from our experience is provided on the attached "How-To" sheet that we hope you will share with your SWE volunteers to prepare them to use this tool.

Enjoy the film! If you'd like to provide feedback on this film or if you'd like to request additional copies, go to our website at [www.swe-pnw.org](http://www.swe-pnw.org) for our contact information.

Sincerely,

Suzanne L. B. Woll, Ph.D.  
V.P. Career Guidance  
SWE PNW Section, J003

## APPENDIX B

### How to Use “Engineering a Space Experiment”

1) Gather your audience and introduce the film. Try something like, “Choosing a career is much like shopping for clothes. Your career not only has to be the right size but it has to fit your style and personality. Here is a film about five women for whom Engineering fits.”

2) Show the Film

3) Open up the floor for audience questions and watch the kids come alive! Here is a sampling of questions you might receive when you show the film to school-age audiences:

#### Personal questions

(Yes, these are the ones you have to be prepared for because kids don’t really know what they’re not supposed to ask and they are naturally curious.)

How old are you? Where are you from? Where did you go to school?

Are you married? Do you have children?

#### Career Questions

How long do you have to go to school to be an engineer? How long did you go to school?

What did you study in school? What kind of engineers are there?

Did you ever design anything that didn’t work?

Have you worked on something people didn’t like?

What was your favorite project? What are you working on now?

How long have you worked for (your company)? Did you work anywhere before?

What was the hardest thing you ever did? Do you ever get bored at work?

How do you balance work and family? Did you have any trouble being a woman in engineering?

#### Materials on International Space Station (MISSE) Questions

The web is a great place to look for MISSE information. Search on the key word MISSE. The main experiment page can be found at <http://www.misse1.larc.nasa.gov>

#### Other

Adults may ask “How can we get a copy of this film?” The film is being distributed to all local Society of Women Engineer sections and will eventually be available on the Web. Go to the main website at [www.swe.org](http://www.swe.org) for local SWE contact information or visit [www.swe-pnw.org](http://www.swe-pnw.org) to access the Pacific Northwest Section that produced the film.

APPENDIX C

SURVEY FORM

"Engineering a Space Experiment"

Age \_\_\_\_\_ Circle one: Female Male

The level of this film was (circle one)

too simple                  just right                  over my head

Before this film, I was considering engineering.                  True False

I liked this film.                  True False

After seeing this film, I agree that engineering can be fun                  True False

After seeing this film, I may consider engineering                  True False

What I liked (or disliked) about this film/event was

---

---

---

I have a question about

---

---

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## The Society of Women Engineers

presents

### Career Night at the Museum of Flight

**Sunday, Jan 27th at 5:00 PM**

Admission is  
**FREE!**

9404 E Marginal Way South  
Seattle, WA 98108

Sponsored by

] Watch the NEW Video **“Engineering a Space Experiment”**

See and Hear the life and work stories of several women engineers involved in the Materials on ISS Experiment - now orbiting on board the International Space Station.

[15 min Film Produced through a SWE Program Development Grant]

- ] See College Students honored by SWE
- ] Talk to Local Working Engineers and
- ] Tour the Museum of Flight Exhibits!



For More Information About this Event - Call Suzanne Woll at (253) 657-4133

For more information about the Society of Women Engineers - logon to <http://www.swe-pnw.org/>

APPENDIX E  
Career Night at the Museum of Flight  
January 27<sup>th</sup>, 2002



Before the show, attendees browse the SWE PNW Section Scrapbook Pages



Students ask Dr. Suzanne Woll the tough questions



After the show, Girl Scouts browse the MISSE display



Teens browse the SWE display



Angie O'Gorman shows the girls how to get the Museum gyroscopes moving



Meribeth Nordloef-Pederson sharing her experiences as a woman engineer



SWE PNW Section members showing their support  
(l to r: Joni Unehara, Meina Wong, Terri Morse, Isabelle French and Peggy Confer)