Girl Scout Engineering Day

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Abstract

Efforts to promote the participation of women in engineering are receiving increased attention from a number of engineering societies and institutions. Intervention programs must take place long before the senior year in high school to maximize effectiveness. One program created at The University of Alabama is Girl Scout Engineering Day. This day-long program of activities is aimed at introducing 4th to 9th graders to engineering. Logistical issues and specific activities are discussed in the paper along with several anecdotal outcomes. Since the program is run by undergraduate students, it serves as a retention activity for our current engineering students as well as a recruiting activity for future engineering students.

Introduction

The first question that is always asked is "Why have a Girl Scout Engineering Day?" Girls need to be exposed to engineering and encouraged to pursue it as a career. This needs to be done at a young age before they choose not to take classes that will help them prepare for a technical undergraduate experience and before they convince themselves that technology is boring. It is also important for boys to be exposed to engineering and for them to be encouraged as well, but there is one significant difference. Every woman practicing engineering that we know of, from Deans to co-op students, has had someone question the appropriateness of her career choice based solely on her gender. Of all the male engineers that we know, no one has ever commented that he was discouraged from practicing engineering because he was a man. For every girl that you encourage to practice engineering, you can assume that someone at some point in time is likely to have told her that this is not a suitable career for her. Events such as Girl Scout Engineering Day reduce the impact of the discouraging words that they may have heard.

In 2001 the engineering profession has recognized the need for diversity by making "Introduce a Girl to Engineering Day" as one of its main events. Over the past 50 years, a number of professions that were traditionally male-dominated, such as medicine, law, and the ministry, have seen rapid increases in enrollments in the necessary degree programs [Jonas et al., 1993] with a corresponding increase in the number of women practicing in these professions. In the period from 1970 to 1980, enrollment in undergraduate engineering programs increased from 2% to 15% [Engineering Manpower Commission, 1996]. At that time, it was assumed that this increase would continue at a nearly constant rate until women approached about half of the enrollment. However, the next 20 years saw only a marginal increase in the number of women enrolled in undergraduate engineering programs. By 1998 (the most recent information available) it was just under 20%. This unexpected plateau has led to many questions and discussions on what can be done to increase the participation of women in engineering. One strong belief is that girls need

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to be introduced to engineering long before the senior year in high school. Thus, programs like "Introduce a Girl to Engineering Day" or "Girl Scout Engineering Day" have developed.

Method

Girl Scout Engineering Day is a Saturday selected during Spring semester where a group of Girl Scouts from 4th – 9th grades come to The University of Alabama to participate in a variety of engineering activities. The group has ranged in size from 25 girls to 85 girls. Activities have been chosen that are hands on, fun, and simple enough that a pre-teen can relate to them. After Girl Scout Engineering Day is over, participants receive a badge and have some information about what engineers do.

We have learned many lessons in the six-year period that Girl Scout Engineering Days have been held. They are as follows:

- Contact the Girl Scout Office VERY early
- Girl Scouts are ACTIVE, not passive, learners
- It is politically expedient to hold activities that encompass a wide range of engineering disciplines
- Girl Scouts need supervision
- Girl Scouts value something with a financial cost, however small
- Troop leaders need a separate activity

Management

Girl Scout Engineering Day is an activity of The University of Alabama Society of Women Engineers (SWE) Student Section. It is student conceived, student organized, and student led. There is minimal requirement for faculty involvement except possibly for a few hours during the day of the event. Even if there were more involvement on the part of faculty and staff, it is extremely important for the Girl Scouts to see engineering as an activity of the young, particularly young women. If they perceive engineering as an activity of old people (anyone over 25 for 10-year-olds), it will be more difficult for them to envision themselves becoming engineers one day.

It turns out that many if not most of our female engineering students have some experience babysitting, teaching Sunday School, or participating in some other activity supervising pre-teen children. Some of them have much more experience than engineering faculty, so it is important to pay attention to their input when discussing a program of this type. More importantly, they enjoy working with kids, so it is usually easy to find interested and enthusiastic volunteers for this project.

We have been very fortunate over the years in having well-organized, reliable, and responsible students chair our Girl Scout Committee. In the various activities that we do, we have found from time to time that some individuals are apprehensive of 20-year-old women in positions of authority. Fortunately, and possibly due to the fact that they are trying to develop girls into leaders, the Girl Scout Office has never questioned the ability of our students to carry out this program. Individual Girl Scout troop leaders on the other hand have been a different matter. From time to time, they have attempted to take over an activity from our students or behaved in other condescending ways. Methods for dealing with this problem will be discussed below.

Interaction with Girl Scout Office

The Girl Scout Office is an extremely important component of this activity and it has been extremely cooperative with us. Our experience indicates the necessity to start planning very early. Typically there are weekends when it is not possible for students to carry out an activity like this, whether it's Spring Break or

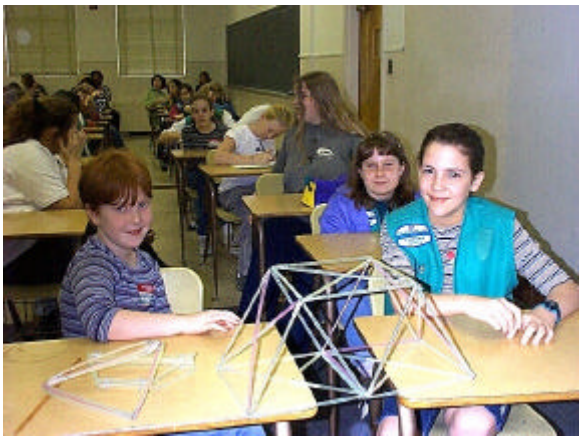
a weekend of a student organization conference. Also, there will be times when University facilities are not available, such as the day of Science Olympiad or an Open House for admitted high school seniors. Girl Scouts often plan their major activities early in the academic year. It is very difficult to mesh these two complicated schedules. The Girl Scout Office needs to know that this event is available to fit it into their activities. We have found it useful to contact the Girl Scout office in the Spring before we hold the event. Although it does not take a full year to plan an activity such as this, it is necessary to begin coordinating the event date to maximize participation.

Activities

As mentioned previously, Girl Scouts enjoy being active. They do not want to sit and listen all day to someone talk about engineering, although one or two minutes of explanation at the beginning of an activity can be very effective. They do not want to watch someone do engineering—although a short wind tunnel demonstration, or similar activity, can be exciting. They want to participate in hands-on, active learning. It is also a good idea to have one or more activities where they can get some exercise and possibly even go outside.

Pictures of some of our previous Girl Scout Engineering Day activities can be found at our web-site: http://www.me.ua.edu/swe/GSED_photos.htm. One thing to keep in mind if an event such as Girl Scout Engineering Day is held in sequential years is that some of the same girls will participate in a second or even a third time. While it may not be necessary to have all new activities, it will be very important to have a variety of new things to do each year. Some of our previous activities are discussed and shown below. Other web-sites for possible activities include http://www.swe.org/SWE/StudentServices/studentstuff.html. Of the activities listed, ones that we found to be effective include Chocolate Asphalt Cookies and Chemistry --Chromatography. Simple freshman design projects can also work well. Some of the activities that we have completed are discussed below.

Bridge Building. One favorite activity is to build bridges out of straws or craft sticks. This activity can be done in teams of three or four girls. First the concept of compression and tension members can be discussed as well as talking about the importance of bridges in our transportation system. The first year that we used this activity, we used straight pins as our connectors. After many complaints about stuck fingers, we now typically use tape. Everyone can be gathered at the end of the day to determine whose bridge can carry the greatest load. It is important to have an adequate facility for testing that will accommodate all participants. Also it is important to have an adequate weight source—clean playground sand poured into a bucket is commonly used.



Component Dissection. As our culture becomes more computerized, engineering faculty find more and more students who have never used a hand tool, such as a screw driver, wrench, or pliers. While this may have been a unique issue associated with women in the past, in recent years it seems to now include men in increasing numbers. Having an activity where Girl Scouts can take something apart, see how it works, and try to put it back together is fun and very educational. Faculty, staff, and students can be solicited for small, broken appliances, such as can openers, mixers, alarm clocks, or radios. As an alternative, a

collection of small appliances can be purchased for dissection with a fairly modest budget. For example, disposable cameras have been purchases for $5 each.

Internet Scavenger Hunt. Another popular activity that is easy to change from year to year is the Internet Scavenger Hunt. As more and more children have access to the Internet at school and at home, this activity may become too commonplace in the coming years; however, Girl Scouts have enjoyed it in the past and it is a great way to give children an initial exposure to computers. After the students receive a brief tutorial on internet search engines, they can be given a list of questions to answer or information to find. One option is to use questions related to Girl Scouts. Another option is to give them some simple questions about engineering to answer. Whether it's searching the Internet or a fun introduction to Word or Excel, it is very important for these Girl Scouts to have a computer experience.

Paper Airplane Design. One way to introduce the topic of design is to have the Girl Scouts make paper airplanes. This session can begin with a simple presentation on lift, thrust, and drag. Also, different types of potential designs can be discussed. After giving the girls adequate time to design and build their own airplanes, all of them can be tested to determine whose plane goes the furthest.

Acids and Bases. Another fairly simple, yet fun, project is to determine if common household products are acids or bases. This session would begin with a brief discussion on pH and litmus paper. Then the girls were sent to different stations set up in a room to take measurements of various products, such as grape juice, hair spray, glass cleaner, furniture polish, laundry detergent, shampoo, etc. These are products to which they can relate on a daily basis while developing an appreciation that chemistry is in fact an integral part our world.

Egg Drop. Another activity that has been used in the past includes the Egg Drop. Teams of students are given a back of components such as cotton balls, rubber bands, string, tape, paper, etc. and told to design a device that can be used to carry a raw egg as far as possible so that it can be dropped to the ground without breaking. Again, the devices can be tested as part of the closing ceremony at the end of the day.

Logistics

Once the Girl Scout Office is contacted and a date is set, we rely on them to contact individual Scout troops in our area and make the information available to them. Registration numbers are given to us approximately three to four weeks in advance. At that time, we can better determine the amount of supplies that will be needed as well as the space that will be used throughout the day. A typical schedule is shown below in Table 1.

There are a few things to note about the schedule. If possible, there needs to be a common convening room for everyone to gather after registration. It's a good idea to have some kind of activity planned for the Girl Scouts once they get to that room. Some girls will arrive 15 – 30 minutes before registration begins. Others will be late. It's good to keep them busy until everyone gets there. When they arrive, it is also a good idea to tell them where the water fountains and restrooms are located.

Table 1. Typical Girl Scout Engineering Day Schedule

Time	Ha 207/ Measuring	Room 2/ Bridge	Room 3/ Airplanes	Room 4/ pH	Room 5/ Computer Lab
8:30-9:00	Registration	Registration	Registration	Registration	Registration
9:00-9:10	Switch	Switch	Switch	Switch	Switch
9:10-9:50	Blue	Red	Green	Yellow	Purple
9:50-10:00	Switch	Switch	Switch	Switch	Switch
10:00-10:45	Red	Green	Yellow	Purple	Blue
10:45-10:55	Switch	Switch	Switch	Switch	Switch
10:55-11:40	Green	Yellow	Purple	Blue	Red
11:40-11:50	Switch	Switch	Switch	Switch	Switch
11:50-12:30	Lunch	Lunch	Lunch	Lunch	Lunch
12:30-12:40	Switch	Switch	Switch	Switch	Switch
12:40-1:25	Yellow	Purple	Blue	Red	Green
1:25-1:35	Switch	Switch	Switch	Switch	Switch
1:35-2:15	Purple	Blue	Red	Green	Yellow
2:15-3:30	Closing	Closing	Closing	Closing	Closing

The girls need to have nametags. Remember that they are young, so it works very well to have a yellow group, a red group, a blue group, etc. Nametags can be appropriately marked. It is also a good idea to have the college students who will be leading these students to wear a shirt of the appropriate color. Twelve to

fifteen girls in a group seems to work fairly well, depending on the activity. Depending on the distance from room to room, be sure to have adequate time to switch activities. Remember that water and restroom breaks may be needed.

Girl Scouts really enjoy design/build activities such as bridge building and the egg drop. However, there is only so much time available for testing at the end of the day before they become bored or their parents pick them up. It is suggested that only one activity that has a common testing time be done each year. Another way that we have handled this in the past with a smaller group is to have all of the design/build activities in the morning and do the testing over lunch.

For lunch, our Girl Scout Council recommends that we have the Girl Scouts bring bag lunches and that we provide drinks. When we began holding Girl Scout Engineering Day, we thought of this as a service to the community and didn't want to charge anyone to participate. The Girl Scout Council on the other hand recommends that a small fee, such as $5, be charged so that the girls will learn to take their commitment seriously. There are fewer last minute cancellations if the fee is charged. A portion of the $5 is used to pay for drinks at lunch, as well as to provide the girls with a patch to commemorate the day.

Some of these activities lend themselves to having a competition and prizes. Since we have been hosting Girl Scout Engineering Day for a number of years, we have found that our alumni who have been previously involved enjoy offering small prizes from their company, such as pens with engineering logos, posters of the space station, mousepads, and other company insignia items. Major prizes such as caps can be used for major competitions. We like to make sure that everyone leaves with at least one pen. This is also an opportunity to give away items with University or College of Engineering imprinted on them.

Volunteer Duties

There needs to be one or two students who guide the groups of scouts from room to room. These students stay with the same group of Girl Scouts all day long. There also needs to be one or two students in each room who are in charge of an activity. The Girl Scout Committee Chair and one or two other students need to be available to move from room to room to check on things and solve any problems or questions that arise. In the past we have had participants numbering from 25 to over 80. Typically it takes approximately 25-30 student volunteers to work on the event. It has never been that difficult for us to find an adequate number of volunteers. This event is not exclusively for women, and every year several male students choose to participate.

Finances

One source of income to cover event expenses is the $5 fee charged to each participant. In addition, this is the type of event that our Student Government Association likes to sponsor to show community support. Typically we can receive about $50 from the SGA for supplies for the event. If that does not cover everything, we have some additional funds in our treasury that we can use for Girl Scout Engineering Day. Departments are usually agreeable to aid in funding supplies for the event as well. We have never had any difficulty meeting our expenses.

Troop leaders

The first year that we hosted Girl Scout Engineering Day, we had a separate event for the troop leaders to tell them more about engineering. Studies have been done that show that parents and teachers have much more influence on the choices that girls make about careers than anyone that they meet during a one-day program. Making leaders and parents aware of the options for careers in engineering allows them to feel more secure in suggesting engineering as a potential career. This event was put on by the faculty, and it

was well-received. We had a similar program during the second year that we had Girl Scout Engineering Day, and many of the troop leaders were there for the second time. They felt that the program for leaders was repetitive, and we have dropped it in future years. Now, however, we have a number of new troop leaders involved in Girl Scout Engineering Day. We have also found in the last two years that some of the troop leaders have interfered with the activities during the day—either by doing them for the scouts or undermining the authority of the student who is in charge of the activity. Therefore, we have decided to offer a program for troop leaders again this year.

Results

Our primary goal is to make girls aware of technology and the possibility of careers in engineering and other technical fields. We hope that enrollment will increase, but we realize that a single program is not, by itself, going to double the enrollment in engineering.

Since Girl Scout Engineering Day has been a student-run project, we have not followed up on the progress of all of the Girl Scouts who have participated in the program. We do not have statistics that we can provide to assess the effectiveness of the event. However, there are a few individual anecdotal stories to tell. Since this is the sixth consecutive year for Girl Scout Engineering Day, we are starting to see some former participants enroll in the College of Engineering.

One of our first and greatest success stories is Tina DiBlasi. Tina was in 9th grade the first year that we held this event. Her mother was a troop leader, so Tina was dragged along to participate in the events of the day. At that time Tina had no interest in engineering, she was planning to major in Elementary Education when she went to college. Tina liked the activities of Girl Scout Engineering Day, and as one of the older participants, she struck up some friendships with the university students who were leading the program. Tina came back again the following year and continued to participate in Girl Scouts in more of a leadership role as she completed high school. Tina is now a sophomore majoring in Electrical Engineering with a nearly perfect 4.0 GPA. Last year for Girl Scout Engineering Day, Tina was in charge of the Internet Scavenger Hunt. We have also had comments and contact with mothers of other participants saying how a year or two after the event, their daughter will comment about some piece of information or activity from Girl Scout Engineering Day.

Of course another result of hosting Girl Scout Engineering Day is the soft skills that our students develop and practice [Todd and Cole, 1998]. The student who is in charge of this event learns a great deal about project management. She has to coordinate the event with the local Girl Scout Office, the College of Engineering media relations, and the SWE officers and advisors, as well as her committee members. She has to delegate tasks to her committee members and recruit volunteers to work at the event. She has to work within a budget and complete the necessary financial reports for reimbursement. Committee members and other volunteers practice their team skills as they work together for a common goal.

Participating in an event like Girl Scout Engineering Day can help students to feel more confident in developing their presentation and communication skills as well as working with others. For a student who is not sure about whether or not she wants to continue in engineering, this can be a confidence booster.

Conclusion

Girl Scout Engineering Day is a program to inform young girls about activities associated with a variety of engineering disciplines. It is designed so that these children see the excitement of the engineering profession and consider it as a career option when it is time to choose a college major. By participating in this program, current engineering students receive an opportunity to develop a variety of soft skills, including project management, communication, and teaming skills.

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Beth A. Todd

Dr. Beth Todd graduated from Penn State University with a BS degree in engineering science in 1981. Before attending graduate school, she worked in nuclear reactor core performance at Bettis Atomic Power Laboratory. She earned an MS degree in applied mechanics in 1986 and a Ph.D. in mechanical and aerospace engineering in 1992 from the University of Virginia. She is interested in applying mechanical analysis to problems of the human body. She has completed biomechanics research projects for NASA and the US Air Force. Prior to her current position as an Assistant Professor and Undergraduate Program Coordinator in Mechanical Engineering at The University of Alabama, Dr. Todd was an instructor at GMI Engineering & Management Institute (currently Kettering University) in Flint, Michigan. She has served as an advisor for SWE Student Sections at both GMI and The University of Alabama.

Kristin L. Wilson

Kris Wilson is a senior majoring in Electrical and Computer Engineering at The University of Alabama. She has participated in the cooperative education program with Adtran and interned with Georgia Power. Kris has participated in Girl Scout Engineering Day since her freshman year, and she is a member of the SWE National Girl Scout Committee. In addition to her positions with SWE, Kris is Vice President of IEEE at The University of Alabama. She is currently participating in a research experiment for NASA to be flown onboard the KC-135 aircraft.

Stormy L. Speer

Stormy Speer is a junior majoring in Mechanical Engineering at The University of Alabama. She has completed two summer internships with Georgia Power. Stormy has helped out with Girl Scout Engineering Day since her freshman year. She is currently serving SWE at The University of Alabama as Outreach Vice President, responsible for all K-16 educational outreach programs. Stormy is currently working on a research project to further the understanding of bone remodeling related to long duration space flight funded through a NASA EPSCOR grant.