

Send a Kid to Camp, the Engineering Way

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ABSTRACT

The percentage of young men and women declaring engineering and sciences as their major continues to decline. Exposure to some of the outstanding careers available in the Engineering and Science fields is critical. The Virginia Military Institute has successfully run a one-week science and engineering camp on the campus during the summers. The camp is designed for rising 9th and 10th graders. Projects are accomplished in the civil, electrical, and mechanical engineering, physics, chemistry, and mathematics fields. The activities are run by VMI professors using the various labs and facilities. In addition to projects, field trips to local industries are taken to see and meet engineers in the work place. Science and engineering students are camp counselors and play a vital role through discussions about their high school and college experiences. This paper will discuss the various facets of the camp and how it actively tries to recruit high school students to become interested in the sciences and engineering.

INTRODUCTION

Undergraduate engineering enrollment across the country continues to decline with noteworthy shortages of women and minorities. This is also true for the physical sciences. Numerous programs are being generated to spark an interest in engineering for high school students. Examples of these programs include high school and middle school science projects, Junior Engineering Technical Society (JETS) competitions, and student research for the Junior Academy of Science. In the early 1970's, two Virginia Military Institute (VMI) physics professors began a program known as Phun with Physics to show students that physics can be fun. They were extremely successful and were funded for summer workshops for high school science teachers through the National Science Foundation. Since then, they have given over one thousand of demonstrations to numerous groups including middle and high school students, visitors, and teachers.

In the mid 1990's, John McNemar, a professional engineer and director of the VMI Conference Office, submitted an idea to conduct a summer camp for high school students aimed at generating an interest in engineering and the physical sciences. The engineering and science Departments at VMI developed a one-week science and engineering camp, known as E-Camp, and the inaugural camp was held at VMI in June 1998. The camp has completed three successful sessions and made changes to the program as it has evolved.

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CAMP PARTICIPANTS

Decisions about the age group for camp participants were made and the camp has been offered to rising 9th and 10th graders. This decision was made for a number of reasons. Most students have an idea what courses they enjoy and excel in by the time they finish middle school. During their first two years in high school, many are formulating what field of study they desire to enter and it is important to expose them to the sciences and engineering at that point. Many of these students, if questioned about what an engineer does, are not sure, but are interested in it because their high school guidance counselor or teacher told them to look into engineering since they are good in math and science. Many times that is not a real convincing reason for a teenager to set his sights on the engineering profession.



Figure 1. Group Picture of E-Camp 2000.

By the time students reach their junior year in high school, many have a vague idea of the field of study they want to pursue and are into the process of deciding on which colleges to submit an application. Hence, it is important to introduce the many exciting engineering fields to the students as soon as possible in their high school careers.

A second reason to offer the camp to students at the beginning of high school is to assist them in the types of courses they should take during their four years. It is important for the potential engineer to take a rigorous regiment of chemistry, physics, and four years of math. Discussions were held about opening the camp to all high school students, however it was decided to target the younger students.

Recruiting Potential Campers

Initially, the first task to be completed is recruiting campers. It is an erroneous expectation to think that if brochures are sent to each middle school principal in the state, they each will end up on a table at the school entrance labeled as fun things to do this summer. Even if it does end up in the child's backpack, the chances of it ever being seen again are extremely small. Hence, some learning about methods to attract campers was needed, and continues with each year. It also must be realized that the competition from sports camps is keen for this age group, especially during the first 4 weeks after the schools end on summer recess.

Pamphlets and a letter were sent out to each middle school principal in the state in 1998 announcing the first camp. It was a huge effort and did not generate tremendous response. Since then, the

letters have been sent to the guidance counselors. It was found that announcements in the "Summer Camps" section of the newspapers have generated a great deal of interest. After three years of holding the camp, the best information tool has become word of mouth. In addition, the camp has picked up about 10 percent of students who desire to return the following year. This year pamphlets were also passed out to all the attendees at a state meeting for science teachers. In addition, announcements are made at some of the other functions dealing with high school students such as the Phun with Physics Demonstrations.

HOW DO YOU SPELL LOGISTICS?

College campuses are ideal locations to hold such a camp. There are the facilities to include lecture halls and classrooms, computer centers, laboratories, dorm rooms, dining halls, and athletic facilities. In addition, there are personnel resources such as camp staff, professors, security or campus police, athletic trainers, and counselors (college students) available during the summer months. The other benefit is that many colleges already have a wide variety of camps already in place, usually sports camps. Camp startup is made a lot simpler when other camps have already paved the way for many of the functions (such as eating).

The Engineering Camp at VMI is held during a one-week period between sessions of summer school. Many of the post services are available; however, the college students are not present for most of the week. In addition, there are usually three or four other sports camps occurring simultaneously. All the campers are housed in the VMI barracks, which can lead to some interesting times with approximately 500 young adults (kids). Several of the facilities and activities, such as the pool, are shared which helps to cut costs.

Funding

VMI's Engineering Camp is a project of the VMI Research Laboratories (VMIRL), which is separate from VMI. Funds for the camp are obtained from registration fees, industry, societies, and private funds. The registration fee is currently set at \$345 per camper. This is extremely competitive when compared to the sports camps. In a large part, the fees are used for the various activities, meals, and modest facility costs. Stipends are paid to professors, counselors, and camp staff.

A scholarship program has been set up using money donated from various sources for campers who have a demonstrated need. Demonstrated need is simply a letter from that student's guidance counselor stating that there is a need. It is the goal of the camp to ensure no student is turned away due to lack of funds, and that has been met. The camp has been able to provide financial aid to approximately 30 students over the past 3 years. Some of the industry donations have been used to sponsor a camper or an activity (for example, the canoe trip or the T-shirts).

ACTIVITIES

A busy camper is a happy camper and a tired camper means a happy counselor. A major ingredient for the camp activities is hands-on experiences. Activities could be broken into five groups; breakout sessions in different science and engineering areas; field trips; design projects; cultural and athletic time; accountability meetings; and sleep time. Sleep time is mentioned because if the weather is hot, it takes a lot of work to get them to go to sleep (hence the statement, a tired camper means a happy

counselor). Campers are assigned groups in order to keep the number conducting each activity to a minimum. Each breakout session and field trip is scheduled at least two times during the week. A matrix is developed to assign groups to different activities. This allows the activities to be more manageable. An example of a daily matrix is given in Figure 2. The activity groups are defined below.

Breakout Sessions in Science and Engineering

Breakout Sessions are the main thrust of the camp activities. The sessions expose the campers to many different areas, give them hands-on time in small groups, and in many cases, they have a finished product of what they have built. Each activity is run by members of the VMI faculty and will last three to four hours. During the first two years, each camper was run through each session, however, the past year, seven breakout sessions are offered and the camper may choose four that he or she would like to participate in. This was done to give campers a wider choice and also it allows a returning camper to experience some new areas. A listing of the breakout sessions offered is:

1. Rocket designs are studied and each camper then builds and launches a rocket. Ideally, they would build them from scratch. However due to time constraints, kits are purchased and the camper uses those materials. After construction each camper is allowed to launch his or her rocket twice. Surveying instruments are set up to determine the height of the rocket flight using trigonometry.
2. An egg drop contest is conducted. Campers are broken into groups of two and allowed to build egg drop vehicles using plastic straws, the paper sleeves the straws come in, and electrical tape. Dropping each vehicle with an egg inside tests the success of the project.
3. A computer Internet class is held dealing with searching the web, vice surfing the web.
4. Physics experiments are conducted to determine various constants such as a spring constant, gravity and gravity.
5. Chemistry experiments are conducted to determine the chemical composition of an unknown substance.
6. A digital tic-tac-toe game is built using a circuit board and electrical components. The first year this was accomplished using breadboards, however, it was frustrating for the students when the wires came loose later on. The components are now soldered which adds hands on activity using the soldering iron.
7. A fun with Math skills workshop is conducted. Various exercises are done using math and card tricks.

In addition to these breakout activities, each group builds a large hot air balloon out of tissue paper, a wire, and glue. Each balloon is then filled with hot air and launched. The balloons are approximately eight feet tall and often will rise several hundred feet into the air when launched (Figure 3). It is a great team building exercise.

ENGINEERING CAMP DAILY MATRIX

TUESDAY

| <u>TIME</u> | <u>ACTIVITY</u> | <u>NOTES</u> |
|--------------------|---|----------------------------------|
| 0630-0700 | OWLS/EAGLES CLUB ACTIVITY | MEMBERS SPECIALLY SELECTED |
| 0715-0745 | BREAKFAST (CROZET HALL) | ALL GROUPS |
| 0745 | GENERAL MEETING (JACKSON STATUE) | ALL GROUPS |
| 0755 | FIELD TRIPS LOWER HALF OF ALPHABET FRAMATONE TECHNOLOGIES, LYNCHBURG UPPER HALF OF ALPHABET HANSON PRECAST CEMENT,SALEM | BUSES LEAVE PROMPTLY |
| 1200-1300 | LUNCH (PIZZA HUT - SALEM) (PLANET PIZZA – LYNCHBURG) | |
| 1330-1630 | BREAKOUT SESSIONS PHYSICS – DR. THOMAS EGG DROP – DR. PAGE INTERNET – MAJ. WINTER | |
| 1730-1830 | SUPPER (CROZET HALL) | ALL GROUPS |
| 1845 | GENERAL MEETING (NEH 507) | ALL GROUPS |
| 1900 – 2200 | LIME KILN OUTDOOR THEATER COMEDY/DRAMA “MOUNTAIN MEMORIES | ALL GROUPS VMI VANS |
| 2300 | LIGHTS OUT | |

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Figure 2. Example of a Daily Matrix for Tuesday.

Design Projects

After the first two years, it was decided to add a full day design project in each of the different areas of engineering. This was conducted successfully in the summer of 2000. Each camper is allowed to choose which project he or she desires to participate in and they are done on the last full day of camp. The three design projects are:

1. Design, build, program, and test a robot to using a computer. The Lego robot kits are used for these activities. The kit allows any type of design and has a battery pack, a motor, and an electronic control module. The Mechanical Engineering Department uses them in their introduction to engineering course. The students design and build a vehicle. It is then hooked up to a computer and programmed to accomplish tasks. The task given is to set the robot in the center of a 4x8 piece of plywood with sides. It then must drive to a side, and ring the bell, followed by traveling to a different side to knock a ball off a stand. Successful robots are demonstrated for everyone in the camp.
2. Design, build and test a bridge made out of matchsticks (with the match tips cut off). This could be done in two ways. Each group could be given a certain amount of building supplies or they must purchase matchsticks and cost can be evaluated. This past year, they were given 100 matchsticks. The requirements were to construct a four-inch wide bridge to span twenty inches. The matchsticks used were ten inches long (usually can be found in outdoor grill supplies) and they were allowed to cut them to any length. Glue guns were used to attach the sticks together. An example of the bridge testing is shown in Figure 4. The winning bridge held 12.5 Kilograms.
3. Use a computer to design a circuit board and then build and test it. Again, soldering is used to attach the electrical components to the board.

In the past, some students noted that they desired more time to spend on a certain area. This allowed them that option. In some cases, some of the students finished their project, got bored and left. However, this allowed those who became extremely interested time to pursue these interests. This portion of the camp is considered very valuable.



Figure 3 Balloon Launch



Figure 4 Bridge Testing

Field Trips

One big goal of the camp is to allow the campers to see real engineering and science in action. This is done through field trips. The first year, two days (Tuesday and Thursday) were set aside for all day field trips to two sites each day. The presentations at the sites were outstanding, however, rule one applied (a busy camper is a happy camper), and the field trips were reduced to half day trips. At each site, engineers broke the campers into small groups and gave them a tour of the site. Discussions were also held concerning what they do in the engineering profession. A listing of field trips, which have been taken, is as follows:

1. Bath County Pumped Storage Facility (Virginia Power)
2. Big Island Paper Mill (Georgia Pacific)
3. Framatone Nuclear Technologies
4. DuPont
5. Des Champs Laboratories
6. Hanson Precast Concrete Pipe Facility

Cultural Activities and Demonstrations

Many other events have been conducted with all the campers together. Some of these activities have been in the evenings. Examples of these include:

1. The Phun with Physics demonstration kicks the week off on Monday morning. It is a great show with a lot of audience participation.
2. Trip to Natural Bridge Caverns and Bridge.

3. Launch three-gallon water balloons with a trebuchet built by VMI.
4. Canoe Trip on the Maury River to observe the locks and dams dating back to 1860. This is done in the middle of the week and is always the favorite.
5. Attend a theatrical production at Lime Kiln Theater.
6. A discussion led by a retired Marine Corps Sergeant Major dealing with responsibilities for young men and women.

In addition to organized activities, campers are also given free time. This allows them to get on the computers, swim, pick-up sports games, watch a movie, or just relax. It should be noted that the local pizza delivery service does well during these periods.



Figure 5. Canoeing on the Maury River.



Figure 6. Counselors by the Trebuchet

Accountability

A major concern is camper safety and accountability. College students are hired for the week as counselors and each is given 8 to 10 campers for accountability. They also serve as role models for the campers. Meetings are held in the morning after breakfast, in the afternoon after lunch, and in the evening after supper. These meetings are good to ensure everyone is accounted for and it helps kick off the next planned session. The last big check is in the evening at lights out. Along with safety, the health of the campers is extremely important. With the other camps in progress, sports trainers are available for minor items. A major item would be referred to the hospital. The biggest challenge dealing with health is to ensure campers have taken their medicine when required.

Snoring Noises

It is important for all concerned that the campers get sleep. If they stay up all night playing cards, they will be miserable the next day and make others around them the same. It can be noted on the Matrix in Figure 2, there is an Eagles and Owls Club Activity scheduled in the morning. This would be for any campers who stay up all night. A two-mile walk at 0600 welcomes them into the next day. This was instituted after the first year and surprisingly, never has had to form up.

FACULTY AND STAFF

Tremendous support has been given to the camp from the VMI Faculty and Staff. Last year there were nine engineering professors, four science and math professors, and four staff members who assisted in the operations of the camp. They put in many hours to provide a successful activity. They are not fully compensated for their time in order to keep the costs down, however, a stipend is provided and they enjoy working with the campers. In addition, nine college students worked as counselors.

RESULTS

Looking at the statistics for the past three years give some of the results. The one result that statistics are not available for yet is whether the camp influenced young men and women to pursue careers in engineering and science. Since the first year targeted 9th graders, they are currently in their junior year of high school. A survey will be sent to the original first year campers to make that determination next year. Statistics for the camp itself are given below. Ideally, the camp would have approximately 60 campers. The upper limit would be 72 campers. The percentage of underrepresented groups can also be shown. The camp has been very successful attracting women, however, is still trying to increase the percentage of minorities.

| Year | Number of Campers | % of Minorities | % of Women |
|-------------|--------------------------|------------------------|-------------------|
| 1998 | 48 | 13 | 25 |
| 1999 | 39 | 10 | 28 |
| 2000 | 51 | 8 | 34 |

Many campers have told the staff that it was the best camp they have attended. The camp has been dynamic and changed various activities using the suggestions of campers.