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Design of a Workshop for Camp REACH

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Abstract

This report for an Interactive Qualifying Project (IQP) portrays the foundation, the steps taken, and the final decisions made for designing a workshop that is to be implemented in Camp REACH. The primary goal is to stimulate girls' interest in the engineering and technology field. Included in this report is research on why girls are generally not interested in engineering, how to fix that problem, project ideas, an insinuated project, a methodology that describes the approach that was taken to implement the workshop and to attract the girls' interest to the field of engineering, mathematics, and technology, and detailed description on steps that lead to the final decision for the workshop, including testing data and evaluations.

Introduction

During the summer of 2001, Worcester Polytechnic Institute (WPI) will be hosting a program that is designed especially for middle school girls mainly in the 7th grade. The purpose of this program is to try and attract girls into the field of engineering. The reason to attract more girls into the engineering field is because there is an excessively low number of women who go into the science and/or technology fields and actually maintain a career in it. Although there are many attempts being made to attract women into the engineering and technology field, programs like the one that is being held by WPI try to attract girls at a younger age.

Although WPI will be hosting this program, the actual sponsor of the event is Camp REACH. Camp REACH, established in 1989, introduces many aspects of science and engineering to young students through active participation in hands-on experiments, challenging design projects, visits to state-of-the-art engineering labs and exciting demonstrations [1]. Mauro Franco, a second year Computer Engineering student at Concordia and President of Concordia's Engineering & Computer Science Student Association (ECA), stated that "The camp attempts to teach young students the basic principles of science and engineering in a fun and entertaining format. Engineering can be intimidating to young kids but if we can apply the basic principles to simple projects that are related to real-life application we can help spark their interest in this field at an early age."[1] While gaining their interest, the camp would also aid in increasing self-esteem, self-confidence, and encourage peer learning.

The implementation of Camp REACH requires a workshop so that its participants can have hands-on activities in order to maintain their interest. By doing so, the goals of the camp

are still achieved. The workshop that is described in this report is intended to follow as many, if not all, as the original Camp REACH goals as possible. To help maintain and increase interest intensity in technology and engineering, group activity will be encouraged so that the girls can work amongst themselves as though they were hanging around with each other.

The main goals for this Interactive Qualifying Project are:

1. Attract girls into the field of engineering
2. Show the importance of engineering
3. Increase self esteem
4. Introduce new topics
5. Show the participants of Camp REACH the importance of cooperation within a group
6. Have fun

In order to begin and complete this project, an understanding of the stages of education girls go through in life was necessary. This research is accumulated in the literature review. After researching and understanding fully what and how girls learn, a description of what was done is found in the methodology.

In order to determine which workshop was to be chosen for further implementation for Camp REACH, a pilot testing for the workshop was employed. Past participants of Camp REACH were invited to this experimentation. Included in this report are results that were recorded on the day of the testing, as well as the responses from the participants from the evaluation form that was given them. Other things included are surveys that were given out to the alumni of Camp REACH prior to selecting the projects, detailed project selection methods, detailed description of the final project that was selected, and details on the improvements that were made to the original workshop.

Literature Review

Overview

Girls and boys begin their lives with equal ability and interest in math and science, but during the course of a female's life they will tend to diverge away from these fields, resulting in separation from the prestigious and rewarding careers of engineering and science. The purpose of Camp REACH is to reverse these negative effects that have occurred in a girl's life by encouraging them to take interest in science and technology. To create a well-balanced and effective program it is essential that we understand what factors can hinder a girl's advancement and what can make it flourish in an educational environment. From the information gathered, we are provided with good incentive to implement the camp and key aspects to follow and consider during the process of development.

Why it is important to attract girls to mathematics & science?

As we step into the new millennium, technology becomes more essential to almost every aspect of society. The great advancements in technology effect even the most distinct fields such as sports and art. With the inevitable expansion of technology, the "traditional" feminine forms of employment become more scarce. [3] It is important that we prepare and encourage young girls to pursue in the direction of the upcoming.

Regardless of the inequalities in pay between men and women, women who pursue careers in science and engineering generally will earn a higher income than those of the

traditional fields. [5] As society is faced with innovating technologies, opportunities for people to join the technological employments will exponentially increase. The new range of careers will provide women with challenging work and numerous accomplishments. Present day science related jobs provide the option of telecommunicating, enabling women to coalesce family and career.

It is important that women be competent in science and technology not only because of employment possibilities, but also for the scientific knowledge. The qualities usually associated with science are objective, rational, and impersonal. These qualities are generally associated with men, for women to also attain these qualities would give them complete equality and control in their lives. [3] There is a great call for women to participate in the development of science. Women can make an immense contribution in creating a truly balance science for the community. [3]

Employers are changing their attitude towards female employees. A reason contributing to this attraction are the efforts to improve customer service. Attitude surveys conducted by gas companies, for example, have revealed that many female customers prefer to be visited in their homes by other female service engineers. [8] Many engineering companies are trying to develop a more balanced variety of employees. A diverse workforce, these companies argue, composed of men and women from a variety of different backgrounds and cultural experiences, is a more creative workforce capable of challenging old attitudes and practices and bringing fresh thinking and greater innovation to product development. [8,9]

Statistics

Women are now entering other male-dominated professions such as law and accountancy in numbers comparable to men. However, relatively few are choosing a career in

fields of science and engineering. Although in the recent years the proportion of women in the science and engineering have rose from 8.5% to 29.5%, women still only account for a small percent of 5-6% of the total number of employees in engineering jobs [8]. Attracting women into technological organizations is likely to become a challenge over the coming years for employers in science and engineering.

Women's income has traditionally been the lowest of workers. Two out of three minimum-wage earners are found to be women. They only pursue careers in approximately 5 percent of the possible job categories, and only 6 percent of women will engage in careers that are "traditional". Occupations that involve no technological skills or training have been predicted to drop dramatically. Girls need to participate in significant educational opportunities to increases their chances of attaining professions, which will hopefully elevate them from their current financial statistics.

Numerous studies and surveys have been conducted dealing with women in the work force and all have indisputably illustrated that women are under-represented in the fields of science. As technological change is transforming the job market it is of great concern that at senior levels, girls are much less likely than boys to study subjects such as mathematics, science, and technological subjects limiting there employment opportunities. Only 25 percent of all women work in fields related to science, whereas 86 percent of men do. Although, women comprise almost half of the overall American workforce no more than 16 percent of scientist are female. More dramatic figures are found in the fields of mathematicians and computer scientist where the number of women is lowered to10 percent, and engineering is dropped to only 6 percent.

Development

When students make career choices, they tend to select fields that are traditional for their own gender. Girls will lean towards social sciences, health services and education, while boys opt for engineering and business. Girls choose not to participate in potential technical experiences. They express a much lower priority to the importance of technical occupations than boys. The choices that girls make start from early influences.

Early School Years

The alienation of girls from engineering and technology takes place at an early age. [6] As early as the age of five, girls and boys have already developed views about what is "men's work" and "women's work", for example, usually mechanical work such as repairing cars are exclusively work for men and housework such as cooking and cleaning are for women. [8] In a research project conducted to find the gender stereotypes of different professions in children, "being a scientist" emerged as the most stereotyped of all the occupations included. The children who participated in the research project thought that science was a more male oriented field than firefighting or mountain climbing. [8]

When girls start middle school, the previous influence and stereotypes that they possessed become more complex and complicated. [8, 10] A research group by the name of Girls into Science and Technology (GIST) found that when 10 and 11 year old were asked about their concerns about careers in science, boys had a more positive view of women in science than the girls did. The girls thought that science was a very demanding and difficult job and were concerned about time with their families. Also, the appearance of a female

scientist was often described by unflattering terms. [8] During the adolescent ages girls will generally prefer painting, drawing, and writing, boys will often prefer building, modeling, and physical activities. [2] According to researchers there exist a psychological barrier between girls and science related subjects. [8]

High School Years

When children are older and given the choice of selecting their own courses a large gender difference in selections are observed. Overall girls are doing just as well as boys in school if not outperforming them, but not in the subjects dealing with math and science. In many studies it shows that girls perform just as well as boys in science and math until the ages of 14-16. [4] Various efforts have been attempted to reverse the lack of interest, which develops in young women, but have failed due to the fear of math and science that has set into their minds. Efforts such as creating "balanced" science courses, in which there is equal coverage of biology, chemistry, and physics have also shown little improvement. [8]

Another contributing component to this imbalance is the negative attitude that parents frequently hold against girls entering these occupations. Parental attitudes exert a major influence on children's career choices. [1] Females also commonly do not receive as much parental guidance and pressure in regards of career preparation than males. Parents may still retain their outdated descriptions of technological employment, but the ones to suffer will be their daughters. Parents need to be better informed about current states of employment to widen the range of profession choices for their children. A study conducted by Somerset careers education and guidance service at the end of 1995 suggested that not only should careers education and guidance begin much earlier in secondary schools but it should be

targeted at parents as well as pupils if girls are to feel free to choose non-traditional career paths. [8]

College Years

Due to the early discouragement in many girls, it becomes of no surprise that relatively few girls pursue science and engineering courses at the college level. Although the number of women who follow technological sciences has increase dramatically in the past few years there is still a very disproportional balance between the genders in these fields. [2] Most of the women who are involved in the sciences are generally taking roles in biological sciences. The design and the execution of the science courses at the college level play a critical role of whether or not a women will continue with the sciences. Women will be more attracted to courses that provide a large range of elective options, but it is important that the scientific and academic value remain the same. [1]

Women who are successful at conquering the barriers between themselves and science will graduate with a science degree, but often do not follow by taking careers related to the subject. [1] Many times women do not choose occupations where they will likely feel "cultural discomfort". Young women, in engineering sciences, are likely to find themselves judged based on the values and criteria created by men for men. Men's value systems may not necessarily interest women, because women are more likely to be interested in problems with social relevance and benefit, where men organize things into an hierarchy and work in a competitive environment. [8]

There are many barriers, which hinder the advancement of girls in technological science. The stereotypes that children, teachers, parents, and even the media hold about

careers, although slowly diminishing, are very discouraging to girls when selecting a future profession. Many employers and schools are working to break down the barriers that prevent girls from math and science. [2, 8]

Gender Equity in Education

One of the largest contributing sources to the lack of women in technological fields is the schooling, which they receive during their adolescence. The age when girls are in middle school are the most critical years for deciding their career path, but this is also the age at which girls are faced with the most ambiguities. Girls are most psychologically at risk during their adolescent years. [2] They organization and the teacher of the girls classes play a major role in her future.

There are many teachers, who are often well meaning; who deliver subtle messages declaring boy's dominance. [2] Research indicates that boys receive more attention from the teacher than girls do, which results in building the self-esteem of the boys and lowering the confidence of the girls. [6] Boys are often encouraged to speak in class while girls are encouraged to be polite and quiet. Also, teachers can make boys seem more important by calling on them more frequently. When girls are selected in the classroom to answer questions, the questions posed by the teacher are usually more simple than those asked of the boys. These actions can make girls feel invisible and unimportant. [5] Gender selection by teachers can begin as early as the pre-school level.

Many classroom activities chosen by teachers are more appealing to boys than to girls. Teaching methods will generally include competition, boys genetically excel with competition,

but girls are more interested in cooperative learning. [2] During projects requiring hands-on demonstrations, teachers will primarily pay attention to the boy's usage of the lab equipment. Although girls state that they are also interested in using the technological equipment, they tend to remain passive during experiments. [13]

The interactions between the teacher and the students differ with gender. Teachers often treat girls better than boys are but not educationally. Teachers are more concerned about the well being of girls and treat them as delicate creatures, while boys are given more freedom and independence. [5] Girls are often praised by teachers for their neatness, but boys are applauded for content. Some studies reveal that teachers more often provide boys with detail instructions for executing experiments, but will show or take over the girls' experiments for them. [14]

Solutions

To persuade more girls into science and engineering careers there are two main objectives that need to be achieved. First the stereotypes about the abilities of girls and boys need to be challenged in schools and society, it is important that parents, teachers, and employers play a role in this. Second, it is crucial that the image of women who pursue science and engineering careers be changed. [8]

Mentors, which are variously described as advisers, friends and counselors, are thought to be a useful way of attracting more girls into science related careers. [8] Many successful women scientist can point to individuals who have encouraged them into scientific professions. Mentoring programs have proven to have a positive impact on young girls. Mentors and role

models can direct girls to work and achieve their goals by setting examples. Girls often associate unpleasant adjectives with the appearance of women scientists, so it is important that girls have role models to reverse this stereotype. [2] A good role model and mentor can use their own life styles to exemplify how to balance career with family, friends or other activities beyond work.[5]

Teachers can be one of the most influential types of people in a girl's life. [1] It is important that teachers be educated about how to deal and achieve classroom gender equity. Teachers should set high standards for their students and show signs of self-interest in the sciences. Also, the contents of a class should be organized so that both boys and girls get equal benefit. Girls are more interested when dealing with hands on projects that deal with real life problem solving. [1,2] Also, girls will gain more and enjoy working in groups more than in competitive situations. Through studies it was proven that girls profit more from "student-centered" classrooms rather than "teacher-centered". "Student-centered" classrooms encourage active learning through cooperative learning groups, hands on experience, role-playing, or thematic projects. [2] If a course could be comprised of all these elements a girls enthusiasm in math and science will greatly increase.

Methodology

Overview

The summer engineering camp will be a workshop for girls in the 6^{th}, 7^{th} grade (between the ages of 12 to 14). The steps in which we took in order to develop a summer engineering camp for girls were, firstly, by doing extensive research. The research was concentrated on how the mind of a teenage girl in our age group usually operates. We found out how girls of our intended age group normally act and think, what they like, and also what they learn in school so that we know exactly how difficult the project(s) which they will be performing should be. In order to determine how the project(s) should be presented, we researched different methods of teaching that are used by teachers/instructors. After we finished all the research that was necessary, we devised different projects for which the camp can use for a workshop, and two of the projects were chosen as the best fit activity for the camp. When everything was ready, we contacted and invited the past participants from Camp REACH to help test out our workshop.

How the girls were be divided

In many cases for group activities for school there is usually one team of students where one student does most or all of the work that is assigned, or one student that merely just sits, stares, and does nothing, giving no opinions, nor listens. For the camp, we felt that the girls should be divided equally and fairly. We separated the groups in a way so that the above

situation does not happen, where everybody will want to participate. At the pilot testing, we decided to divide the girls according to the year in which they had attended Camp REACH. We felt that since the girls had gone to the Camp together, they would know each other and work better together in a group, rather than putting them in random groups and risk having them be shy and not talk with one another.

Possible Workshop Ideas

The following is a list of the projects that we have thought of in an effort to meet the goals that were mentioned in the Methodology. Each project is followed by a description, which includes what the girls will learn and benefit from. At the end of each depiction, two projects were chosen to be the best projects for further implementation during the pilot testing.

Sound Sensitive Robot

Description

To build something is not usually an easy task. Whether it is constructing a computer, automobile, or a skyscraper, there is always some "level of difficulty" to the assignment. Despite how strenuous the assignments may be, they are still performed, and completed. Building something that a person knows he or she has put time and effort into makes them feel accomplished, or makes them feel as though they have aided someone else who was in need. The purpose of this workshop is to have the girls construct a robot from the very beginning.

This project will give the girls the opportunity to build and test something that can be called their own creation. This will hopefully increase their self-confidence so that problems that they encounter in the future will not be as stressful, and they will, therefore, be able to confront the problem at hand without hesitation.

Because this particular workshop would involve soldering and putting components together, the girls will not be working individually. Another reason they will not be working individually is so that they can get to know some of the other girls and meet more people. Ten groups of thirty will be formed, and each group will be given a kit to work with. The instructors will give a brief explanation and demonstration on what they will be trying to do. While in the introductory stage, the instructor will reassure the girls that they will be there if there are questions, and encourage the girls to interrelate with each other more.

The Sound Sensitive Robot is a robot with a built-in sensor which reacts to vibration from sound or physical contact. It moves forward, but when it comes across a high-pitched noise (such as a hand clap) or vibration from a physical contact with obstacle or object (such as bumping into a wall), it backs away, rotates left for a preset time and continues to move forward.

The robot requires assembling and soldering. The soldering may sound like a difficult task, but we feel that the girls will be able to accomplish this job. Also there will be many instructors there to guide them through the soldering phase, and if we feel that the soldering is indeed too difficult, than the instructors will pre-solder the more difficult areas for the girls. This way, the girls can still gain some experience in soldering.

Just building the robot will not be all that the girls will be doing. After assembling and soldering the robot, the girls will have a period of time to get more acquainted with their "piece

of work", getting used to how the robot operates and seeing if they can direct it to a desired destination. Once the girls have calculated the time period which the robot rotates left for and have gotten a good handling of it, they will put the robots through a maze. The girls will try to guide the robot through the maze with claps and other sounds. The sounds that they will be making, however, will not be the only factor. The robot, as mentioned previously, reacts to physical contact. This is where the calculations that the girls made will come to help them. Once the robot encounters something in its path, the girls will know where it will be facing, so they will know exactly how many times to clap to get their robots back into the correct path. They will be competing to see who can get their robots out of the maze first, or to see who can get the robots out the fastest.

What the girls will gain

The most attractive portion of this workshop might be the fact that the girls will have an opportunity to build a robot. In the workshop, the girls will not only be able to use their hands and minds, they will be learning to do the work of mechanical engineers. This will give them a little preview of how the engineering field is, and, if they decide to be engineers later in life, give them a brief design of what an engineer does.

Initially, the girls may seem excited over the idea that they will be building robot. They may also be enthusiastic and encouraged to finish the robot so that they can test and "play" with it. After a period of time, however, it is expected that the girls may get impatient and frustrated. This is why there will be instructors to assist the girls periodically, walking around the groups and asking how their progress is going and helping them if they say "We don't get

this part here". This will prevent the girls from losing confidence in themselves, so that their spirits and initial attitudes on building the robot will be the same throughout the activity.

Triathlon

Description

This workshop was enlightened from the 2000 Summer Olympics. This activity will require the construction of a solar powered car, a crane, and a steam powered boat. What the three machines will be doing is transporting a light object, such as an egg, to a destination point. The object will be transported by, first, the car, which will have a solar powered engine for a certain distance. The crane will than pick up the object and transport it from the car to the steam-powered boat. The boat will in turn transfer the object to the finish line. Just transporting the object from one point to another using different forms of transportation will not be the only goal that the girls will attempt to accomplish. They will also be trying to see who can relay the object to the finish line the fastest. This means that the girls will not only have to build the car, crane, and boat to transport the object, they will also have to build it in such a way so that the three combined can carry the object to the finish line the fastest. This workshop should be the most time-consuming, and would probably need to be divided into two workshop sessions to complete. If given enough time, another possibility that the girls could do is to see whose cars, cranes, and boats will look the best, so that there can be multiple prizes for everybody.

For this particular workshop, the girls will be divided up into groups of five. Each group will work on one component of transportation. Three groups will be put together to form one big group. This will than come two form two groups of fifteen girls. For example, a

group of five girls will construct the solar-powered motor car, another group of five will be responsible for making the crane, and another group will make the steam-powered boat. These three groups will combine to form one big relay team, thus making a group of fifteen girls. The other group of fifteen girls will do the same and the two relay teams will than race to see which car, crane, and boat can cooperate most efficiently and effectively to get to the finish line first.

What the girls will gain

This workshop is again more dedicated to the mechanical engineering field. In this particular workshop, however, the girls will get to build three things, as opposed to one. The placing of the crane will allow the girls to calculate the distance it should be from the car and boat. In the Sound Sensitive Robot workshop, the girls would have to observe how long the robot rotates left for when it comes across impact or sound. In this workshop, they would have to calculate an appropriate the crane should be distanced from where the car stops, and from the boat, so that the object can be transported with ease. Also, they would have to calculate how many things would and would not be needed to build the car and boat with so that it can go fast enough. Other factors that will be needed to take into consideration of the motion of the car and boat is what can cause lagging of the vehicles (such as friction, gravity, wind, etc.). Therefore, the girls would not only be given the chance to all work together to make one big thing, they will also be challenging themselves by making calculations to aid in their relay and asking themselves questions on where, how, and why their respective creations would operate best so that they could win the triathlon.

Learning How to Build Various Kinds of Alarms

Description

The Alarm workshop is designed to interest girls in the electrical engineering field. In this workshop, there will be five different types of alarms that the girls will be able to implement. The five different alarms are listed below with a description of how each one operates and what each alarm consists of:

1. Burglar Alarm: Universal type burglar alarm kit that features a board mounted horn and red LED "on" indicator. This alarm operates on a 6VCD battery, and capacitors.
2. Insanity Alarm: This alarm stays off when the lights are on. When the lights go off, however, it gives a high-pitched irritating sound. This alarm operates on a 9V battery, capacitors, resistors, diodes, and transistors.
3. Secret Alarm: This alarm operates exactly opposite to the Insanity Alarm; it stays off when the lights are off, but goes off in the presence of light. The alarm contains the same components that are required for the Insanity Alarm.
4. Manual Siren Kit: This kit produces a wavering wail of a police siren as a push button is pressed and released. The kit is small in size but produces a loud tone from a small speaker. It operates on transistors and IC circuitry. The kit requires a 9V battery.
5. FM Wireless Microphone Kit: Although this is not an alarm, we felt that this would be a very good workshop to demonstrate to the girls the electrical engineering world. This kit builds a simple RF transmitter. A miniature electret microphone

picks up sounds which are amplified by transistors. The amplified signal is then transmitted and can be picked up on an FM radio. This kit, like the other fore-mentioned above, operates on a 9V batter as well.

A good advantage about this workshop is that each girl will be able to each get her own alarm and build it individually. The girls will work in groups of three, helping each other out, but will implement their own devices. This way, each of the girls can each bring home an alarm to show their parents and friends that they built an alarm.

What the girls will gain

In this particular workshop, the girls, like the previous workshops described, are still building something. Rather than building something that can commute, however, the girls will be building something that involves circuitry. This may seem very dull and boring, but it can also be very exciting and beneficial. After the girls are done building the circuits for the alarm or for the wireless microphone, they can play around with it by turning lights on and off, screaming to see if they can get their voices into the radio. This can be educational for them since after building these circuits, they will have a brief idea of how their alarm clocks at home work, or at least know what the inside of something that involves electricity and circuitry would look like. By having the girls build a circuit board, it could stimulate their interests in the nature of circuits, and in doing so gain their interest in the electrical engineering field.

EE or ME?

Description

Since the first three projects that were mentioned above were either primarily directed towards the mechanical engineering or electrical engineering fields without giving the girls a choice, this project gives the girls an option to see which field they'd like to explore. In this project, we will separate the girls into groups of three. We will give them brief descriptions of what mechanical and electrical engineers do so that they can have a choice. Those that choose to explore the world of mechanical engineers will be given the chance to a solar powered car. The other group that chooses to discern what electrical engineers do will get to make the alarms described in the previous section. At the end of the workshop, the girls will have a "Project Presentation", where they will show other groups what they chose to make. During this "show-and-tell" presentation, the girls will have a chance to explain their particular project. After giving each other an explanation, they are given the chance to demonstrate what their devices can do and tell each other how it works (i.e. the circuitry, solar panels). At the end of each girl's presentation, they will have a discussion session where they can tell the other girls how they felt about the projects and give comments to each other.

What the girls will gain

Since the girls are separated into different projects in this workshop, they should be able to learn the most with this method (choosing mechanical or electrical engineering). The reason they would learn the most from each other if this method were used is because they will be implementing different topics and sharing them with each other. Although each girl will not be able to actually implement every project, their fellow participants of Camp REACH will

have the opportunity to, and they will be learning from each other during the presentations. By using this method, the girls will be able to learn and actually see the works of mechanical and electrical engineers.

Which Workshop will be chosen?

We were given the opportunity to choose which workshop to implement. We came up with four different projects, described in the next section, for the workshop. To decide which was the best project out of the four candidates, we created tables of a "Pros-and-Cons" (see Appendix J) list for each project to see which was ultimately the best choice. Generating a list of positives and negatives was still not enough though. We also put ourselves back into the mind of a sixth-seventh grader and asked ourselves the following questions:

1. Will this project or workshop be too hard? Will the workshop seem too childish?
2. How long is this activity going to take?
3. Will it be interesting, or "fun", enough so that the girls will be interested throughout the workshop, or so that they will not want the workshop to end?
4. Will the girls be able to work well with each other? How much tension will there be?
5. How detailed should the instructions for the project be?
6. How many components are there for each model?
7. Will the girls be able to learn and experience a lot from this workshop?

8. There can be no particular group that will be the "loser": How will we implement the workshop so that every girl in all of the groups can and will feel proud of themselves?

The last question that we asked ourselves was the most important question of all. It is important because the one of the main purposes of Camp REACH is to gain the interests of the girls in the engineering and math fields. In doing so, the girls would first have to feel confident in themselves that they can do a good job with the project.

In between asking ourselves questions and making lists of the positive and negative sides of each individual project, we also took into consideration the budget. Because of the REACH budget constraints, we had to keep our spending budget to a limited amount--$240 total.

After we generated more detailed explanations of the projects, reviewed the "Pros-Cons" list of each individual project, considered the costs for parts, and answered the above questions for each project, there was still one more step that we needed to take to finally decide on which is the best project. The final step was to email the past participants of Camp REACH, inform them of who we are, give the girls brief descriptions of each of the workshops, and ask them to give their opinions on which project seems most appealing (see Appendix B). We then used their feedback to help us decide.

When we had finished reviewing the "Pros-Cons" list and reviewed the past participants' responses to the email that was sent to them, it could be seen that the most appealing projects were the robots and the alarm kits. After viewing the "Pros-Cons" list, it was apparent that the alarm kits was a good choice. The robot kits, however, showed the same

amount of bad points than good points, but we had decided it would not be time consuming, like the remaining two projects ("Triathlon" and "ME or EE?"). Because of this, we had chose the robot kits and the alarm kits for further implementation.

Implementation of the Workshop

After making a final decision for which workshop to implement, we will now go into greater detail. This implementation consisted of the following: introduction and background information on the workshop, a timeline for how long it should take the girls to complete each stage of the workshop (i.e. assembling, testing, put into action), separate instructions for the instructor and the girls, handouts, and models.

The introduction and background information part is for both the instructors and participants of this workshop. It consists of information such as what they will be learning, the purpose and importance for them to participate in the workshop, and what the project that they will be assembling together actually is. A timeline may not seem essential at all when compared to everything else that needs to be done, but it actually can help the instructors a lot. The timeline will tell the instructor approximately how much time is required for each stage in the workshop. If the instructor sees that any group of girls might be lagging behind according to the timeline, he or she will know that the group might have difficulty and help them. Finally, we made handouts with descriptions and instructions of the project and a finished model of what the girls will have to build so they know exactly what to expect when they are done.

How things were presented

In classroom lectures, lessons, or business meetings, there are various styles by which instructors use in order to express themselves. After researching for the more efficient ways, we found the best method to teach the girls how to generate the experiments that they will be conducting, with supervision whenever necessary. By researching, we examined books and handbooks on methods of teaching, determining to what difficulty level would be most appropriate for 7^{th} grade girls.

Some of the things that we used during the workshop were handouts and models. Handouts are beneficial if it provides a source for comparison/contrast for analysis, or provide an extra component for synthesis; the importance of a handout must be stressed and the students must know why it was handed out [7]. This may sound boring for the participants, but the handouts were structured in a way so that they would be similar to reading a comic. We used as many models as possible because they help all different types of learners; to be truly effective, all students need the opportunity to manipulate the models. Lessons were carefully planned so that everyone would stay involved while turns are taken with the models [1].

In addition to handouts and models of what the project will be, the instructors that were there during the workshop also assisted the girls with any questions they had, or help them with assembling parts, such as soldering, screwing, etc.

Testing of the Workshop

All products that are created, developed, or invented are usually put through a series of experiments before it can actually be put on a market. For example, automobiles must be put through a test with crash dummies to see if all components in the vehicle are operating correctly before they can be sold, otherwise there will be many accidents. Prior to having our workshop implemented, we invited a group of former campers to do a test-run on the workshop that will be our final decision.

In order to see how well the testing phase of the workshop went, both members of our group made observations on how long and efficient the girls worked, and how well the girls worked together as a group. We provided assistance to the girls only whenever it was necessary because they were given a copy of the handout with the instructions, and the best way to see what kind of changes that will be needed to improve the handouts was to let the girls follow the instructions themselves. Other observations that we made during the testing was the girls' level of interest in the workshop. If their interest showed a positive result, than we would know we were successful in this aspect. However, if the girls showed signs of boredom or lack of interest, we would have had to devise new ways to present the workshop.

Outcomes Assessment

The role or purpose of outcome assessment is to facilitate improvement. According to Roger Debreceny, a member of the faculty of Business and Computing at Southern Cross University, the theoretical structure for any outcome assessment program is broken up into five steps:

1. State the mission or purpose of the institution
2. Formulate goals and objectives. These goals and objectives should be operational and specific, not theoretical and general.
3. Develop and implement a set of procedures that can be used to evaluate the extent to which the goals and objectives are being achieved. This involves identification of specific outcome measures that can be used to test the goals and objectives. Some measures may be in-house and custom designed; others may be purchased externally and standardized. The approaches need not be elaborate, but they need be thorough and persistent.
4. Use the results of the assessment to improve the institution.
5. Develop procedures to examine, on an ongoing basis, the extent to which the outcome measures selected are effectively testing the goals and objectives specified. [15]

The role of an effective outcome assessment program must be an improvement oriented (formative) one rather than a comparison-oriented (summative) one. Formative assessment is the collection of data and the feedback of the results on an ongoing basis. It is designed to provide information for the intention of improving the project being evaluated. Summative assessment is designed to produce information that can be used to make decisions about the overall success of the project.

For this project, outcomes assessment was practiced. A goal or purpose was set and experimented. Procedures on how to implement the workshop were than made. Next, the pilot testing of the workshop was implemented. After the experimentation the participants were asked to evaluate the project and themselves. The responses that were received from the evaluation were than used to improve the workshop.

Pilot Testing

Past participants of Camp REACH, whom were invited through an invitation letter (see Appendix C), attended the pilot testing. The first fourteen girls that responded via email or phone were selected. Only the first fourteen were selected because it was necessary to see if the girls would work better in groups of four or groups or three (two groups of three and two groups of four).

Pilot Testing Schedule

Past participants of Camp REACH, whom were invited through an invitation letter (see Appendix C), attended the pilot testing. The first fourteen girls that responded via email or phone were selected. Only the first fourteen were selected because it was necessary to see if the girls would work better in groups of four or groups or three (two groups of three and two groups of four).

December 2, 2000 was the date of the pilot testing. On this day a schedule was followed to ensure that every aspect of the testing would be covered. This section will provide the schedule and descriptions of all the various parts of the schedule followed. The testing officially began at 1:00pm and ended at 4:00; all times that are used in this schedule are in reference with these times.

Schedule Outline

- Introduction (5 min)
- Ice Breaker (5 min)

- Project Explanation (5 min)
    - Sound Sensitive Robot
    - Alarm Kits
- Electrical Engineering Lesson (10 min)
- Form Groups and Choose Project (5 min)
- Soldering Lesson (5 min)
- Start Project (60 min)
- Break (15 min)
- Finish Projects (60 min)
- Fill in Survey (10 min)

Pilot Testing Schedule Description

Introduction (5 min)

The testing began with a brief introduction of our goals and ourselves. We explained to them why they were here and what we hope that they would be able to help us accomplish. We asked them to be truthful when filling out the survey, and also gave them a brief report of the schedule that was to be followed.

Ice Breaker (5 min)

After introducing ourselves, it was necessary for the girls also to know each other. We used the time for the icebreaker for the girls to introduce themselves to the other girls. Each

girl was given time to say their name, the year of REACH they participated in, and also one or two facts about themselves.

Project Explanation (5 min)

There were two projects selected for further testing: the Robotics Kit, and the Alarm Kits. The girls were divided so that they were working on one of the kits only in order to see which was the better workshop for Camp REACH.

Although each girl will only be building one of the two projects selected, it would be better for them to know what everyone else would be building as well. Both projects were described briefly to the girls. The aspects that were described to the girls were how the projects were to be built and what the project should be able to do if made correctly.

Electrical Engineering Lesson (10 min)

The robot and alarm kits contain many electrical engineering related components. The kits can be assembled with no prior background in this area but it would be more beneficial if the girls could relate knowledge to what they were doing. A short lesson was organized to give a little background about electrical engineering to the girls. Topics that were covered include capacitors, transistors, and calculate the resistor value of a resistor.

Form Groups and Choose Project

Four groups were formed from the fourteen girls that participated. Two groups of three and two groups of four were formed. One group of four and one group of three worked on each project. A representative from each group had to play a simple game with the

representative from the other group of the same size. The winner got to choose which of the two projects they would like to work on.

Soldering Lesson

After the groups were formed, each group was given a demonstration of how to put a component onto the circuit board. They were shown the correct way to insert a component, solder it, and then cutting off the excess wire. After the demonstration was given, each girl was given the opportunity to try putting a component into the circuit board.

Start Project

After the soldering lesson, the groups were given their respective kits to begin building.

Break

To prevent the girls from getting overly tired or bored with the experiment, they were given a short break. During this break the girls were taken to another room where they had snacks and drinks.

Finish Project

After the break the girls were asked to continue building their projects. They were given sixty minutes to finish what they needed to do.

Fill in Survey

The last ten minutes of the pilot testing were reserved for a survey. Each girl was given an individual survey that they were asked to fill in.

Pilot Testing Preparations

Before the day of the testing for the workshop, a series of steps had to be taken to ensure that the experimentation would be well organized. First, a group of volunteers had to be found to help implement the testing. This was accomplished by asking the alumni of Camp REACH. A group of approximately one hundred girls were sent an invitation letter to the testing. However, out of the hundred, only the first fourteen girls that replied via email or telephone were accepted, due to a limited budget and instructors. After finding out how exactly how many girls were able to come, the robot kits and alarm kits were ordered from www.pitsco.com. Three robot kits and ten alarm kits were ordered from the website.

After the participants were found and the kits were ordered, it was necessary to obtain the required materials and a room to experiment in. The necessary materials were borrowed from the ECE workshop in Atwater Kent Laboratories of Worcester Polytechnic Institute. These tools included soldering irons, soldering wire, goggles, wire cutters, model knives, and screwdrivers. Making sure that a room was able to be reserved for the testing date was the next thing to do. After speaking to Jim O'Rourke of the ECE workshop, room 317A of Atwater Kent was reserved. The only condition was that a faculty member of the ECE department had to be present. Because the advisor, Professor Denise Nicoletti, said that there was a possibility she would not be able to attend the pilot testing of the workshop, searching for a substitute for her was advised. When asked if he could help with the implementation, Professor Sergej N Makarov was more than willing to.

Only reserving the room was not enough, however. Professor Nicoletti was asked to write a memo to the WPI Campus Police (see Appendix E), informing them of the testing so

that there would not be any complications at all on the day of the workshop implementation and so that there would be a room and building ensured for the testing.

Before testing the workshop with the girls, it was important that each kit was put through a trial run in order to determine the real time that would be required to implement the workshop. A robot kit and an alarm kit was built to determine approximately how long it would take. The alarm kit that was built only required about forty-five to sixty minutes. Building the robot, however, required over three and a half hours, thirty minutes more than the given three hours. After realizing this, it was decided that there would be some changes that needed to be made so that the girls could finish the workshop on time. For example, one thing that we did to help the girls was pre-solder some of the components (resistors, capacitors, transistors) for the robot kit. There were approximately forty-five components for the robot. About twenty of these components were pre-soldered for the girls, since they needed to assemble the body of the robot as well.

Description of Evaluation Form

In order to determine what the girls thought about the workshop, they were asked to take an evaluation form so that they could appraise the workshop, as well as themselves. The evaluation was divided into two parts, the perspective part and the free-writing portion. The perspective part of the evaluation consisted of eighteen statements, which pertained to the girls' perception of the workshop. The free writing portion consisted of five questions for written comments. They were asked to rank the statements from a scale of one through four; a one corresponding to how much they disagreed with the statement, and a four corresponding to how much they agreed with the statement. The structure of the eighteen statements in the evaluation form was divided into four categories: organization, interest, educational value, and team value. A chart showing this distribution is shown in Figure D1:

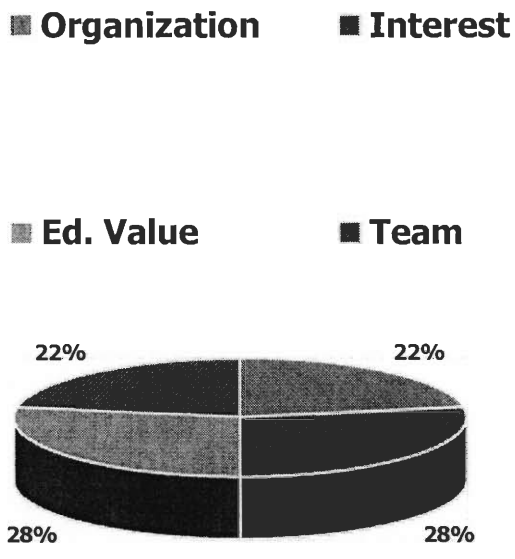

Figure D-1 Distribution of questions

Like the statements, the five questions were also divided into different categories: likes/dislikes, improvements, pros and cons for working in groups, and free comments.

How well the girls thought the testing of the workshop was organized was an important factor. Organization is an important factor because it could effect how much the girls learn and experience. If an event was not well organized, the participants' enthusiasm and momentum could disappear easily. Another reason why organization is important is because it plays a very big role in determining how the final workshop for the camp should be implemented. If the girls had thought that the workshop was poorly organized, than how the testing of the workshop was executed would have to be reorganized from beginning to end so that the girls could enjoy themselves and so that they could benefit more. On the other hand, if the girls thought that the implementation of the workshop was well organized, than it would signify that they did not feel confused, and only minor adjustments would need to be added to make the workshop better. Also, if the girls thought that the workshop was well organized, than the instructors of Camp REACH could use the same steps that were taken on the testing day.

In the evaluation form that the girls took, there were four statements that fell into the organization category. The statement, "*The instructions were clear and informative*" tells how the girls felt about the clarity of the instructions to the kits. This was an important issue because the instructions would need to be edited if the girls felt that the instructions were not organized well and not clear enough. Other statements included:

- "*The experimentation process was well organized*"
- "*The experiment was within my abilities*"
- "*I felt confused during the experimentation*"

The second and last statements show how hard the girls felt the workshop was. If the experiment were not within their abilities or if the girls had felt confused, adjustments to the difficulty (pre-soldering more components, for example) of the kits would need to be made.

One of the goals for this workshop was for the girls to have fun while learning. "Interest" is one of the more important categories, as it signifies how much fun the girls had and how interesting they found the topic that was being presented to them. Another goal was to stimulate the girls' interest in engineering. If they had not found the workshop to be interesting, but to be rather boring, than there is a possibility that they did not learn anything and another possibility that they were not motivated into the engineering field. This would lead to a partial failure in achieving the goals for the workshop and Camp REACH.

Like the organization category, there were also four statements in the evaluation form that was dedicated to the interest category. The statement, "*I would like to participate in this experimentation again*", shows to more of an extent how interested the girls really were; if they gave a high score, it would signify that they were really interested and would participate again. Other statements that pertained to the interest category include:

- "*The experiment was interesting*"
- "*The experiment was fun*"
- "*The experiment was pointless and boring*"

In the outside world, as well as in school, teamwork is a very important feature. It is always a good thing to work with one another and learn from peers. For this reason, it was pertinent to ensure that the girls work well together in their respective groups. This way, they could learn from each other and increase their communication skills.

Like the other categories, there were also four statements in the evaluation form that dealt with teamwork. In the first statement, *"The experiment was a good project"*, if the girls had felt that their respective project was not a good group activity, steps to turn the project into a good group project would have to be taken. For example, consideration of breaking the groups down would need to be done if the girls felt there were too many people in the group, and vice versa. Another step would be to make the kits more difficult so that additional help from the girls' peers would be needed. The statement, *"My group members had equal participation"*, was used to see how well the girls were able to distribute the work evenly amongst themselves. This, once again, shows how well they participated with each other. Other statements that fitted into the teamwork category were:

- *"I worked well in my group"*
- *"I enjoyed working in my group"*

In addition to having fun, one of the goals of Camp REACH is to make sure that the participants learn. The education value category in the questionnaire helps to see if the girls had gained anything academically from the workshop. If the results for this category showed that the girls did not learn anything, some new steps or approaches would have to be taken and put into the workshop so that they can learn new material outside of their school classroom. This way, the participants would also feel a sense of accomplishment that they had learned something new that their peers in school might not know.

Unlike the other categories, there were five statements for the education value category. There was one more statement because it was desired to see if the girls had gained any new knowledge from the workshop. The statement, *"The experiment introduced me to new things"*, was used to see how much of the electrical engineering background the girls had already

known, prior to the lessons and testing. The statement, "*I would like to learn more about this subject*", helped to see whether or not the workshop stimulated the girls' interest in the engineering field in general, as well as learning more about circuits, resistors, and capacitors. The statement, "*This experiment helped me see the importance the engineering*", was a rather important part in the survey and the workshop, as it showed whether the goals of this project and the goals of Camp REACH were met. Other statements that were given to the girls for evaluation were:

- *"I learned a lot from the experiment"*
- *"The experiment was good hands-on experience"*

Besides asking the girls for responses to the comments that were given them, they were also asked for their background information. From their background, they were asked for their age, grade, hobbies, favorite subjects in school, and possible career choices. They were asked for their age and grade because it was desired to if the age difference amongst the girls made a difference to implementing the kits and working together in a group. The reason why they were asked for their hobbies, favorite subjects, and career choices was to see if they were already interested in going into the field of engineering.

In the last portion of the evaluation form, the girls were asked four questions, to which they would write their own thoughts in, and one question to which they were allowed to give any free comments they had.

The first two questions were primarily dedicated to finding out what the girls liked. The first question, "*What did you generally like about this experiment",* allows the girls to tells us which part of the experiment they liked the most; for example, finding the values of resistors, soldering, etc. The second question, "*What did you particularly dislike about the*

experiment?", tells what the girls disliked particularly about the experiment so that it could either be improved or taken out completely from the workshop.

The third question, "*Can you suggest anything to improve the experiment?",* was to determine, from the girls' perspective, what should be done or not done to improve the workshop so that it would be better for future participants of Camp REACH. The fourth question, "*What were the pros and cons for working in your group?",* is a question that can also fall into the "teamwork" category. It was asked to see what the girls thought about working in a group, only this time, instead of giving answers in a score, they wrote down what they thought personally. The last question was opened to any comments that the girls may have had to cover any points which the girls may have felt were missed.

In summary, the evaluation form that was given to the girls during the pilot testing of the workshop was divided into different sections. The first section was to see what the girls thought about the organization of the workshop, how interested they were, how much they learned, and what they thought about the team effort within their groups. The next section was used to find out the girls' background information to see if they knew anything about what they were learning prior to the workshop. The final section of the evaluation form was for the girls to write down their own thoughts, and not just giving scores according to statements.

Project Selection

On the day of the experimentation, a survey (see Appendix A for the survey and the responses that were obtained) was given to the girls to analyze their personal perceptions of the experiment. After careful analysis of the data collected from the experimentation, the Alarm Kits were selected for the final project for REACH 2001. Based upon the answers that were received from the evaluation form, and other aspects, it was concluded that the Alarm Kits would be better suited for the workshop of REACH 2001. Aspects that were considered consisted of the girl's perceptions and comments, the budget, time needed to implement, and the overall beneficial profit. This section describes the analysis that was used to reach this conclusion using responses from the evaluation form and statistics of the responses.

The girl's perceptions towards the projects were primarily measured through the 'Personal Perception' section of the survey. A large percentage of the responses that were received from the girls working on the robots and the girls working on the alarm kits were similar. For further analysis, the questions of similar categories were examined within their own groups. Some of the questions that were taken into deeper consideration were those that reflected on how organized and educational the projects were. Also determining if the project stimulated the girls' interests in engineering was a chief concern. The following part of the report will provide results from questions of this section of the survey that were more significantly different.

To better visualize the data it was useful that it be represented in the form of graphs. The graphs were based on a scale of one through four. A score of one signified that the girls strongly disagreed with the corresponding statement; two signified that the girls disagreed with

the statement. While scores of one and two showed how much the girls disagreed, scores of three and four showed how much the girls agreed with the statements.

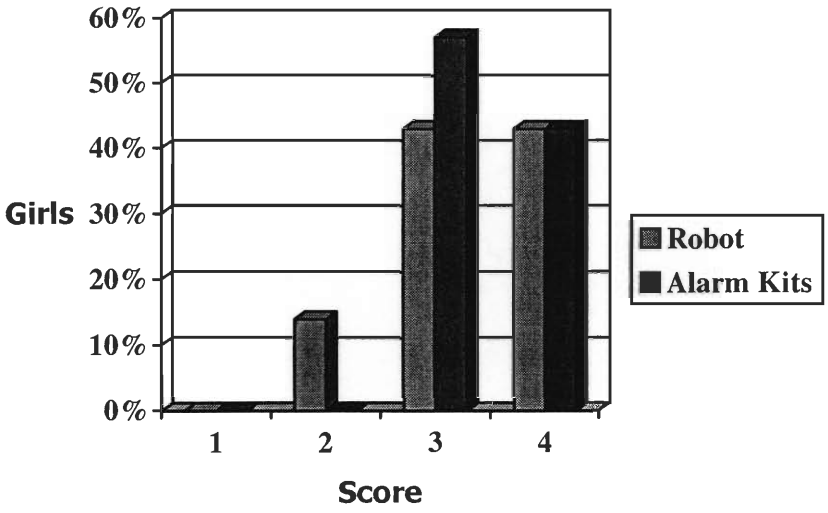

Figure G-1 The experiment introduced me to new things

After analyzing the data and reviewing Figure G-1, it was evident that the alarm kits project had opened the eyes of the girls to more material than those who had worked with the robots. This is an important factor as one of the goals is to teach the girls new material, rather than subject them to the ordinary topics introduced at school

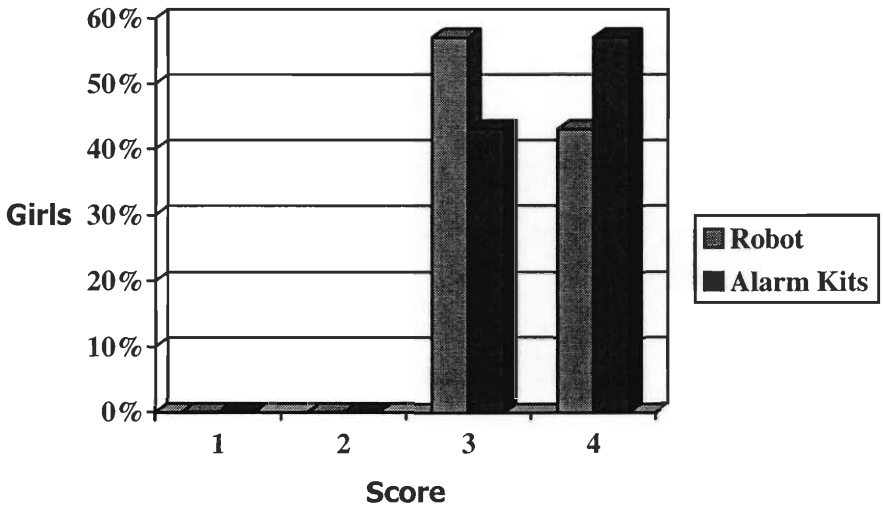

Figure G-2 Experiment stimulated my interest in engineering

As shown in Figure G-2, the graph is skewed right, indicating that both projects had evenly stimulated the girls' interests in engineering.

When new topics are introduced, there is usually a bit of confusion amongst the students. For this reason, the girls were asked whether or not they felt confusion during the experimentation. The responses that were received showed that fifty-seven percent of the girls that were working on the alarm kits were not confused and twenty-eight were only slightly confused, while half of the girls working on the robots felt confusion during the testing. The remaining half of the girls working on the robots were at the borderline where they did not experience great confusion but it was still present.

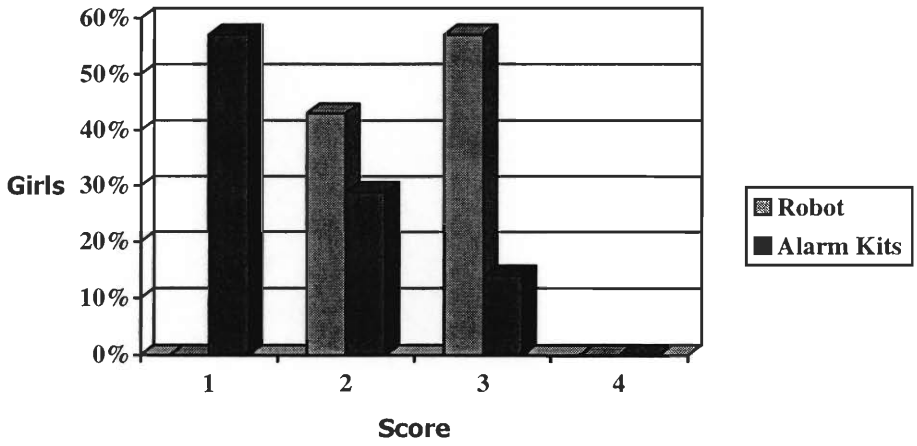

Figure G-3 I felt confused during this experiment

Besides determining whether or not the girls were interested in learning more on the subject and how confused they were, the workshop was also implemented so that the girls could learn things outside of what is usually taught at school. When the results were compared on the projects, it was evident that the girls that were working on the alarm kits self-evaluated themselves as having learned more than the girls working on the robots, this can be seen in Figure G-4. This response may have resulted because the girls working with alarm kits were taught to find the nominal value for resistors and the girls working with the robots only had to match resistors colors to a provided chart.

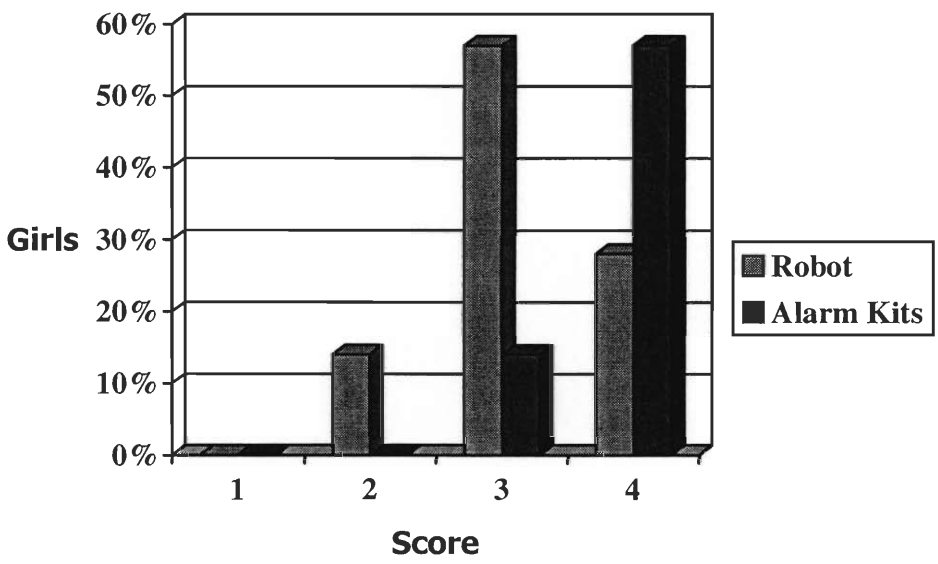

Figure G-4 I learned a lot from this experiment

Another statement that contributed to the project selection was the girls' responses on whether or not they would like to participate in their projects again. The girls who were working on the alarm kits showed that they would be more willing to participate in the experiment than the girls working on the robots. A graph of this is shown Figure G-5. Although the graph portrays positive answers from both groups (answers of 3 or 4), the girls working with the alarm kits gave more responses of a four.

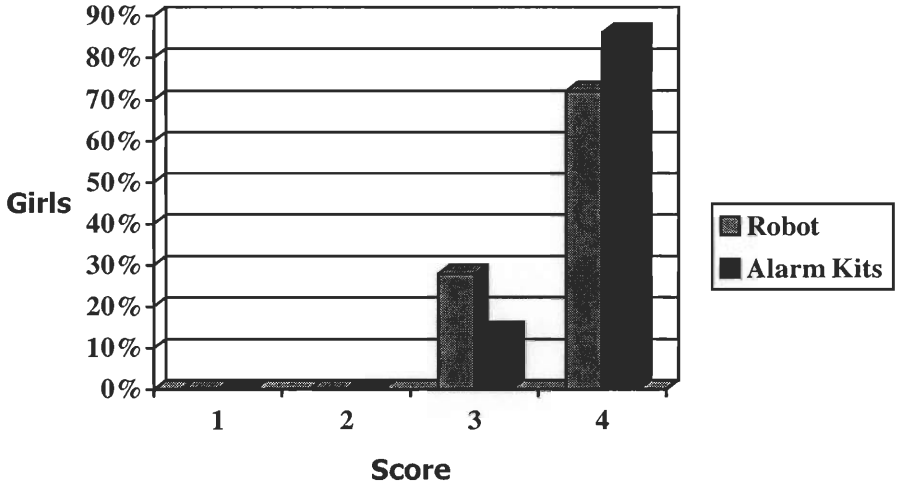

Figure G-5 I would like to participate in this experiment again

After careful analysis of each one of the statements from the 'Personal Perception' section it was necessary to separate them into their respective groups for additional examination. The groups that these statements were arranged in were organization, interest, education, and group value. The results received were added with the other results of the same group and then divided by four to see how closely to a perfect score that category received. Figure G-6 shows the distribution of the results. These results show that both projects did well because both of the projects did not receive average scores under three. The alarm kits performed better than the robot in almost every category other than team or group-work value. This may have been the result due to the lack of equipment provided. On the day of the testing, the requested amount of soldering irons were unavailable, this caused girls working on the alarm kits to be idle during various times of the testing. This hypothesis can also be

verified by one of the questions from the 'Written Comments' section of the survey, which will be discussed in detail later in the report.

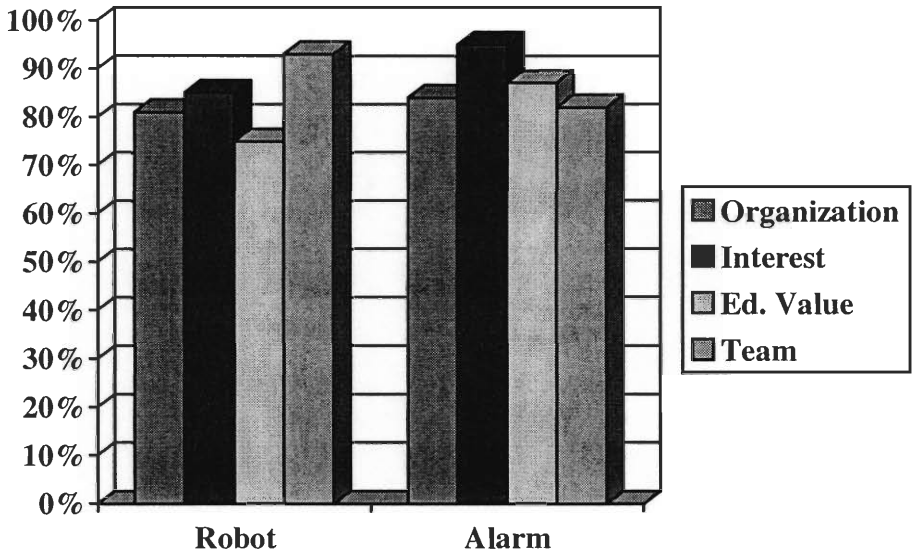

Figure G-6 Results of the categories of questions

Figure G-6 shows the percentage of how many "good responses" each category received. For example, 80% of the girls working on the robots gave a score of either three or four for the questions that pertained to the organization category.

Other than having the girls score statements, the survey also contained a portion for the girls to respond to open-ended questions. Many of the girls that were working on the same project gave similar comments to the questions.

The first question that was asked was 'What did you particularly like about this experiment?'. The comments that were received for this question were similar for both the robots and alarm kits, most of the girls said that they enjoyed the hands-on experience. They also particularly like soldering the components. It was also fulfilling for the girls to see their working end product.

The next question that the girls were asked was 'What did you particularly dislike about the experiment?'. The girls working on the robots stated that they didn't like making mistakes and some complained of not having replacements parts. The girls working on the alarms disliked waiting for a turn to use the soldering irons.

The girls were also asked to suggest any changes that could improve the experiment. The girls working on the alarms suggested that working with smaller groups would be beneficial. Better instructions were suggested by the girls who worked on the robots.

The fourth question asked in this part of the survey was 'What were the pros and cons for working in a group'. Both the girls working on the robots and the girls working on the alarms said that a good part of being in a group was that they could help each other. The girls working on the robot made no comments about the cons of the experiment, but once again the girls working on the alarm kits complained of waiting for the soldering iron.

The final question of the Written Comments section just asked the girls for any comments that they thought would benefit the testing. Many of the girls left this section blank, of the ones who answered they all stated that the project was fun and that it was an overall good project.

Besides the girls' responses, the time allowed for the workshop and the budget was also taken into consideration. During the workshop experimentation, it took the girls more than three hours to work on one robot, and the robot still could not be completed within that time frame, while it took approximately forty-five minutes to complete one of the alarm units. The robot taking longer to build and complete was not the only problem, though. The circuitry on the robot also took longer to debug than that on the alarm units. This will be a major factor when working with thirty girls at the workshop during the camp.

The other factor we had to consider was our budget. The final target for the actual implementation is $240. If the robot kits were selected, fifteen robots would be purchased and each group would work with a robot, leaving 15 of the girls with nothing to bring home as a souvenir. If the alarm kits were selected, each group would get two alarm kits to work with, and every girl would get something to bring home. The cost of the fifteen robots came to $405, not including shipping, well above the intended budget limit. The cost of thirty alarm kits would cost only $209, not including shipping. The alarm units were clearly better suited for the allowed budget limit.

Overall, through thorough analysis of the responses received, and in consideration of all the mentioned aspects, it was decided that it the alarm kits were more appropriate chose for further implementation for the workshop for Camp REACH. It was shown that the girls in the alarm kits group learned more new material than the girls who had worked on the robots. The alarm kits also aroused the girls' interests in engineering, as well as aiding them to see the importance of engineering. After careful analysis and consideration the alarm kits were selected for the workshop of REACH 2001.

Final Workshop Description

This workshop will primarily involve the area of electrical engineering. The girls will be asked to put together a series of alarms through the use of soldering irons, and circuit board components. There will be a total of thirty girls participating in the REACH program, each girl will get one of the three alarm kits chosen for this workshop. The kits that were chosen are the Insanity Alarm, Manual Siren Kit, and the Secret Alarm. Although each girl will have their own individual alarm kit, they will be working in groups of two girls.

Through this workshop we would like to communicate the importance and relevance of electrical engineering, in hopes of attracting more females into the science and engineering fields.

Project Improvements

After conducting the pilot testing and selecting the project it was necessary to make modifications and improvements to the selected project. The changes are based on the data from the survey, follow-up questions, and observations from the day of the testing. After the data from the surveys were analyzed, the areas that received lower scores were considered further for improvement. Follow-up question were then created based on these areas and emailed to the girls who participated.

The areas that received relatively low scores were the categories 'team value' and 'educational value'. As explained in the *Project Selection* the low scores received for the 'team value' category is due to insufficient amount of soldering irons. Many girls suggested that the groups should be smaller from the *Written Comments* section of the survey. Since the groups consisted of three to four girls, the groups for the final workshop will only contain two girls each.

Two questions received low scores in the 'educational value' area of the *Personal Perceptions* section of the survey, 'I would like to learn more about this subject' receiving an average of 82%, and 'This experiment helped me see the importance of engineering' receiving an average of 75%. Another question, unrelated to this area that received low scores was 'The instructions were clear and informative, averaged at 75%. These three questions, not including the questions from the 'team value' section, obtained the lowest averages. To further examine the problem causing the decrease in averages for these questions, follow-up questions were given to the girls via email (see Appendix F). The questions that were asked are as follows:

1. What should be done to the instructions to make them easier to understand and follow?

2. Can you remember a good learning experience from your past? Please explain.

3. What should be added to the experiment to help others see the importance of engineering?

Of the girls who replied, three worked on the alarm kits. We took their answers into consideration when making changes to the original project.

In response to the first question, one girl complained that the labels on the instructions and the labeling on the circuit boards should be better. Two girls suggested that the original instructions were too vague. They suggested that more visuals and more written text was needed to understand the instructions. The suggestions given by the girls provided clear objectives to improve on. For the final workshop, instead of using the instruction that originally came with the kit, we developed our own with more labeled diagrams and step-by-step instructions. Also, a list of pointers to keep in mind will be included in the modified instructions.

From the second question, we hope to find an effective way for the girls to learn from asking for examples of good learning experiences. The girls who answered this question all

described experiences that were both visual and hands-on. To incorporate visuals into the workshop, pre-built samples of each alarm will be given along with demonstrations and explanations. The handouts for the girls (see Appendix I) are very visual with a lot of examples and pictures. Also, if computers with Internet connection are available, all handouts will be available online with questions and answers.

After participating in the pilot testing, some girls did not think that the importance of engineering was presented. All the girls that responded suggested that the effects of engineering should be given. Examples of how electrical engineering effects everyday life and also how important alarms are, were topics that were given by the girls. To improve the workshop and to help the girls see the importance of electrical engineering, there will be a small discussion given at the beginning of the workshop. This discussion will talk about applications were circuit boards are involved, sample circuit boards will be shown from everyday items, and famous people involved in electrical engineering.

Subsequent to these adjustments we hope that the workshop will be more effective. Actual responses from the girls who participated in the pilot testing can be seen in Appendix A.

Project Comparison

The REACH program already consist of numerous workshops that help girls realize and become interested in science and engineering. If this project were to be implemented during REACH, it would need to replace one of the existing workshops. To see if this project should be done during REACH, the girls who participated in the pilot testing were asked for there preference between an exiting workshop and this project (see Appendix F). The workshop that was chosen for comparison was the workshop "*How much does it cost to heat your home?*". This project was chosen because all the girls who went to REACH have participated in this workshop, and it also deals with electrical engineering. The girls who were part of the pilot testing received an e-mail asking them to choose which project they would rather take part in. We received eleven responses from the fourteen girls. To see the actual email sent to the girls and their responses see Appendix F.

From the replies it was evident that majority of the girls would rather work on the alarms and robots than the home heating workshop. 90% of the girls who responded preferred this project. The one girl who preferred the home heating experiment gave a reason for her choice. She explained that she liked how that project integrated the use of computers. Despite this fact, 27% of the girls commented that that they found the home heating experiment boring. Also, 45% of them gave additional comments of the alarms and robots being fun.

Conclusion

The goal for this project was to develop a workshop that would stimulate the girls' interest in the engineering field, show them the importance of engineering, increase their self esteem, introduce new topics, have them learn how to cooperate with each other in a group, and lastly, to have fun.

During the project, there were different project ideas to choose from. By giving the Camp REACH alumni brief descriptions of each individual project, two projects, the Robot Kits and Alarm Kits, were narrowed down and chosen for further implementation. The alumni of Camp REACH was contacted once again and invited to participate in a pilot testing for the two projects. An evaluation form was given and collected from them to see what their perspectives of the projects were. After reviewing the responses that were received from the evaluations, it was decided that the Alarm Kits project was the better, as well as the more beneficial, workshop for Camp REACH. Improvements to make the workshop better were then made according to what the girls said on the evaluation forms. Since the kits were given away to the girls at the pilot testing, new kits were reordered and built so that the instructors would have a sample model of what the kits are supposed to look like after assembling. Handouts for the instructors, as well as better handouts for the participants of Camp REACH, of the workshop were made also made.

After implementing the workshop with the alumni of Camp REACH, it was seen that the goals for this project were achieved. Based upon the responses that were received from the girls, it could be told that they had gained interest in the engineering field, and new topics were introduced to them. Although there were too many girls in a group, they were still able to

work well together in a group. Lastly, from the responses and emails received after the testing, it could be seen that the girls had fun.

For the students that would wish to continue this project and create other workshops for Camp REACH, we would highly recommend creating a survey following the seven intelligences, discussed in the methodology, and finding a way to implement it. We recommend this because by doing so, the girls could actually be paired up with peers that are of different intelligences. This way, they can learn from each other and perhaps new and better ways to approach problems.

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Appendix A

Surveys colleted during pilot testing

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 (2) 3 4
2. The instructions were clear and informative.	1 (2) 3 4
3. The experiment was within my abilities.	(1) 2 3 4
4. The experiment stimulated my interest in engineering.	(1) 2 3 4
5. I learned a lot from the experiment.	(1) 2 3 4
6. The experiment was interesting.	(1) 2 3 4
7. The experiment introduced me to new things.	1 (2) 3 4
8. The experiment was fun.	(1) 2 3 4
9. The experiment was pointless and boring.	1 2 3 (4)
10. The experiment was a good group project.	(1) 2 3 4
11. I worked well in my group.	(1) 2 3 4
12. I enjoyed working in my group.	(1) 2 3 4
13. My group members had equal participation.	(1) 2 3 4
14. I felt confused during the experiment.	1 (2) 3 4
15. I would like to participate in this experiment again.	(1) 2 3 4
16. I would like to learn more about this subject.	(1) 2 3 4
17. This experiment helped me see the importance of engineering.	1 (2) 3 4
18. The experiment was good hands-on experience.	(1) 2 3 4

PART II – Background Information

Please fill in the information requested.

1. Age: 14
2. Grade: 9
3. Hobbies: softball, music, writing
4. Favorite subjects in schools: science & band
5. Possible career choices: not sure
   engineering
   marine biology
   writing

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
I thought the experiment was interesting and fun to do.

2. What did you particularly dislike about this experiment?
Near the end the instructions were vague so we had to keep taking it apart (the robot) and putting it back together.

3. Can you suggest anything to improve the experiment?
Maybe explaining the putting together of the robot would help.

4. What were the pros and cons for working your group?
I knew the people so it was easier to work with them.

5. Other Comments?
It was a cool idea.

Which experiment did you participate in? (Robot) EE Kits

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 3 4
2. The instructions were clear and informative.	1 2 3 4
3. The experiment was within my abilities.	1 2 3 4
4. The experiment stimulated my interest in engineering.	1 2 3 4
5. I learned a lot from the experiment.	1 2 3 4
6. The experiment was interesting.	1 2 3 4
7. The experiment introduced me to new things.	1 2 3 4
8. The experiment was fun.	1 2 3 4
9. The experiment was pointless and boring.	1 2 3 4
10. The experiment was a good group project.	1 2 3 4
11. I worked well in my group.	1 2 3 4
12. I enjoyed working in my group.	1 2 3 4
13. My group members had equal participation.	1 2 3 4
14. I felt confused during the experiment.	1 2 3 4
15. I would like to participate in this experiment again.	1 2 3 4
16. I would like to learn more about this subject.	1 2 3 4
17. This experiment helped me see the importance of engineering.	1 2 3 4
18. The experiment was good hands-on experience.	1 2 3 4

PART II – Background Information

Please fill in the information requested.

1. Age: 14
2. Grade: 9th
3. Hobbies: reading, sports
4. Favorite subjects in schools: math, science
5. Possible career choices ?

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment? The soldering part was fun and so was putting the actual robot together, except we kept messing up.

2. What did you particularly dislike about this experiment? We kept putting things together backwards

3. Can you suggest anything to improve the experiment? The directions should be clearer.

4. What were the pros and cons for working your group? Our group worked well together and we got things done fairly quickly

5. Other Comments?

Which experiment did you participate in? (Robot) EE Kits

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 (3) 4
5. I learned a lot from the experiment.	1 2 (3) 4
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 3 (4)
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 3 (4)
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 3 (4)
13. My group members had equal participation.	1 2 3 (4)
14. I felt confused during the experiment.	1 (2) 3 4
15. I would like to participate in this experiment again.	1 2 (3) 4
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 3 (4)
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 13
2. Grade: 8th
3. Hobbies: Poetry, reading
4. Favorite subjects in schools: Language Arts, Math
5. Possible career choices ???

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?

The hands-on experience

2. What did you particularly dislike about this experiment?

---

3. Can you suggest anything to improve the experiment?

A little more organized

4. What were the pros and cons for working your group?

Pros: we helped eachother out

Cons: Not everyone got equal time

5. Other Comments?

FUN!

Which experiment did you participate in? (Robot) EE Kits

ME

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 3 (4)
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 3 (4)
5. I learned a lot from the experiment.	1 2 (3) 4
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 (2) 3 4
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 (3) 4
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 (3) 4
13. My group members had equal participation.	1 2 (3) 4
14. I felt confused during the experiment.	1 2 (3) 4
15. I would like to participate in this experiment again.	1 2 (3) 4
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 14
2. Grade: 8th
3. Hobbies: reading, basketball, roller blading
4. Favorite subjects in schools: science
5. Possible career choices engineering, teacher

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
making something

2. What did you particularly dislike about this experiment?
the small parts got lost easily, and there were no extra

3. Can you suggest anything to improve the experiment?
no

4. What were the pros and cons for working your group?

5. Other Comments?
no

Which experiment did you participate in? (Robot) EE Kits

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 (3) 4
5. I learned a lot from the experiment.	1 2 (3) 4
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 3 (4)
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 (3) 4
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 3 (4)
13. My group members had equal participation.	1 2 3 (4)
14. I felt confused during the experiment.	1 (2) 3 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 (3) 4
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 13
2. Grade: 8
3. Hobbies: swimming
4. Favorite subjects in schools: English, math
5. Possible career choices electrical engineer
   robotic engineer

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?

I liked soltering.

2. What did you particularly dislike about this experiment?

The pieces should have been labeled more cleary. ~~[illegible]~~
It was a little long.

3. Can you suggest anything to improve the experiment?

Have replacement pieces in case someone messes up.

4. What were the pros and cons for working your group?

pros = work split evenly for soltering
could get help if confuse
cons = ~~[illegible]~~ people sometimes neglected work towards end.

5. Other Comments?

Which experiment did you participate in? (Robot) EE Kits

Phyllis (Lily) Goodman

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 3 (4)
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 3 (4)
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 (3) 4
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 3 (4)
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 (3) 4
13. My group members had equal participation.	1 2 (3) 4
14. I felt confused during the experiment.	1 (2) 3 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 13
2. Grade: 8
3. Hobbies: Singing, Acting, dancing
4. Favorite subjects in schools: English, Math, Science.
5. Possible career choices Actress, Singer, Electrical Engineer

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
I liked soldering

2. What did you particularly dislike about this experiment?
Nothing

3. Can you suggest anything to improve the experiment?
Not really.

4. What were the pros and cons for working your group?
Pros
- we all helped Eachother
- If someone was confused the other person helped them out.

5. Other Comments?
This project was really fun, and I hope to do it again.

Which experiment did you participate in? (Robot) EE Kits

only Katie Rooney

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 (3) 4
4. The experiment stimulated my interest in engineering.	1 2 (3) (4)
5. I learned a lot from the experiment.	1 (2) 3 4
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 (3) 4
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 3 (4)
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 3 (4)
13. My group members had equal participation.	1 2 3 (4)
14. I felt confused during the experiment.	1 2 (3) 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 3 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 14
2. Grade: 9
3. Hobbies: sports, writing, building things
4. Favorite subjects in schools: biology, english
5. Possible career choices
   engineering, something with sports

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
i though it was really cool, there wasn't really a part i didn't like, except when we put the wrong things in the wrong hole. well, i kind of liked soldering...

2. What did you particularly dislike about this experiment?
I hated putting things in the wrong hole, soldering them & then having to take them out

3. Can you suggest anything to improve the experiment?
More time should be allotted

4. What were the pros and cons for working your group?
We were all friends @ camp

5. Other Comments?
none.

Which experiment did you participate in? (Robot) EE Kits

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 (3) (4)
4. The experiment stimulated my interest in engineering.	1 2 3 (4)
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 (3) 4
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 (2) 3 4
11. I worked well in my group.	1 2 (3) 4
12. I enjoyed working in my group.	1 2 (3) 4
13. My group members had equal participation.	1 2 3 (4)
14. I felt confused during the experiment.	(1) 2 3 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 (3) 4
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 14
2. Grade: 9th
3. Hobbies: Basketball, Football, Stomp, hanging out
4. Favorite subjects in schools: Math
5. Possible career choices

   Doctor; Lawyer

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?

I liked that it was hands ~~at~~ on, and you learned alot and also had fun.

2. What did you particularly dislike about this experiment?

I disliked you worked in big groups it would of been better if we worked in pairs or alone.

3. Can you suggest anything to improve the experiment?

nothing really ~~at~~ have it so there's two in a group. :-

4. What were the pros and cons for working your group?

you got more help ~~and~~ if you were confused it was someone to lean on and a con is you got to do everything but you had to wait.

5. Other Comments?

Which experiment did you participate in? Robot (EE Kits)

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 3 (4)
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 3 (4)
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 (3) 4 small groups
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 3 (4)
13. My group members had equal participation.	1 2 3 (4)
14. I felt confused during the experiment.	1 2 (3) 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 3 (4)
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 12
2. Grade: 7
3. Hobbies: Field hockey, soccer
4. Favorite subjects in schools: math
5. Possible career choices I have no idea

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
I liked soldering & putting it together.

2. What did you particularly dislike about this experiment?
waiting for my turn

3. Can you suggest anything to improve the experiment?
groups of 2 - not 3 or 4

4. What were the pros and cons for working in your group?
Pros- fun, interesting.
cons- had some time doing nothing

5. Other Comments?
this would have been fun to do at camp

Which experiment did you participate in? Robot (EE Kits)

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 3 (4)
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 (3) 4
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 (3) 4
8. The experiment was fun.	1 2 (3) 4
9. The experiment was pointless and boring.	1 (2) 3 4
10. The experiment was a good group project.	1 2 3 (4)
11. I worked well in my group.	1 2 (3) 4
12. I enjoyed working in my group.	1 2 (3) 4
13. My group members had equal participation.	1 2 (3) 4
14. I felt confused during the experiment.	1 (2) 3 4
15. I would like to participate in this experiment again.	1 2 (3) 4
16. I would like to learn more about this subject.	1 2 (3) 4
17. This experiment helped me see the importance of engineering.	1 (2) 3 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 12
2. Grade: 7
3. Hobbies: field hockey, basketball, swimming
4. Favorite subjects in schools: Spanish
5. Possible career choices

?

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
   I LIKED TO SEE HOW WHAT WE DID TURNED OUT IN THE END.

2. What did you particularly dislike about this experiment?
   I DIDN'T LIKE WEARING THE GOGGLES WHILE SALDERING.

3. Can you suggest anything to improve the experiment?

   NOPE

4. What were the pros and cons for working your group?
   PROS - PARTNERS USUALLY KNOW YOUR QUESTION WHEN YOU DON'T.
   CONS - SOMETIMES LARGER GROUPS ARE HARD TO WORK IN.

5. Other Comments?

Which experiment did you participate in? Robot (EE Kits)

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 (3) 4
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 (3) 4
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 (3) 4
11. I worked well in my group.	1 2 3 4
12. I enjoyed working in my group.	1 2 (3) 4
13. My group members had equal participation.	1 2 (3) 4
14. I felt confused during the experiment.	1 (2) 3 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 (3) 4

PART II – Background Information

Please fill in the information requested.

1. Age: 12
2. Grade: 7th
3. Hobbies: sports, art, compoter, Science,
4. Favorite subjects in schools: Science, math,
5. Possible career choices Marine Biologist, writer artist, ~~[illegible]~~ teacher, engineer.

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?

I liked soldering.

2. What did you particularly dislike about this experiment?

Makeing mistakes and putting the peices in the ~~r~~right spot

3. Can you suggest anything to improve the experiment?

More soldering devices & smaller groups.

4. What were the pros and cons for working your group?

Cons- it didn't get to work all the time Pros- It was fun.

5. Other Comments?

Which experiment did you participate in? Robot (EE Kits)

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.
1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 (3) 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 3 (4)
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 4 (5)
7. The experiment introduced me to new things.	1 2 3 (4)
8. The experiment was fun.	1 2 3 ~~4~~ (5)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 (3) 4
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 (2) 3 4
13. My group members had equal participation.	1 2 (3) 4
14. I felt confused during the experiment.	(1) 2 3 4
15. I would like to participate in this experiment again.	1 2 3 4 (6)
16. I would like to learn more about this subject.	1 2 (3) 4
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 4 (6)

PART II – Background Information

Please fill in the information requested.

1. Age: 12
2. Grade: 7
3. Hobbies: Swimming / Reading
4. Favorite subjects in schools: Lunch
5. Possible career choices in Engineering (Any field)

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?

Sodering

2. What did you particularly dislike about this experiment?

Waiting

3. Can you suggest anything to improve the experiment?

Working in pairs

4. What were the pros and cons for working your group?

~~Other~~ We got to make cool alarms

5. Other Comments?

None

Which experiment did you participate in? Robot EE Kits

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative. (on kits)	(1) 2 3 4
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 (3) 4
5. I learned a lot from the experiment.	1 2 (3) 4
6. The experiment was interesting.	1 2 (3) 4
7. The experiment introduced me to new things.	1 2 (3) 4
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 2 3 (4)
11. I worked well in my group.	1 2 3 (4)
12. I enjoyed working in my group.	1 2 3 (4)
13. My group members had equal participation.	1 2 3 (4)
14. I felt confused during the experiment.	(1) 2 3 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 (2) 3 4
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 16
2. Grade: 10
3. Hobbies: reading, model airplanes & power point
4. Favorite subjects in schools: math, science & German
5. Possible career choices : ~~[illegible]~~ aeronautical or mechanical engineering

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?
building & soldering

2. What did you particularly dislike about this experiment?
the confusing kit directions

3. Can you suggest anything to improve the experiment?
less people (2or3) per group
explain more about the circuits

4. What were the pros and cons for working your group?
pros: "2 heads(or more) are better than one
Cons: & toomany people mean someone isn't doing anything

5. Other Comments?
explain the ~~cost~~ resistors before starting & give everyone a chart

Which experiment did you participate in? Robot (EE Kits)

Camp REACH Evaluation

December 2, 2000

PART I – Your Specific Perceptions

Please circle the number that indicates your feelings towards each statement.

1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

1. The experimentation process was well organized.	1 2 (3) 4
2. The instructions were clear and informative.	1 2 3 (4)
3. The experiment was within my abilities.	1 2 3 (4)
4. The experiment stimulated my interest in engineering.	1 2 3 (4)
5. I learned a lot from the experiment.	1 2 3 (4)
6. The experiment was interesting.	1 2 3 (4)
7. The experiment introduced me to new things.	1 2 3 (4)
8. The experiment was fun.	1 2 3 (4)
9. The experiment was pointless and boring.	(1) 2 3 4
10. The experiment was a good group project.	1 (2) 3 4
11. I worked well in my group.	1 2 (3) 4
12. I enjoyed working in my group.	1 2 (3) 4
13. My group members had equal participation.	1 2 (3) 4
14. I felt confused during the experiment.	(1) 2 3 4
15. I would like to participate in this experiment again.	1 2 3 (4)
16. I would like to learn more about this subject.	1 2 3 (4)
17. This experiment helped me see the importance of engineering.	1 2 (3) 4
18. The experiment was good hands-on experience.	1 2 3 (4)

PART II – Background Information

Please fill in the information requested.

1. Age: 12
2. Grade: 7
3. Hobbies: swimming, reading
4. Favorite subjects in schools: Math, Social Studies
5. Possible career choices Scientist

PART III – Written Comments
Please answer following questions.

1. What did you particularly like about this experiment?

I enjoyed puting everything together.

2. What did you particularly dislike about this experiment?

Nothing.

3. Can you suggest anything to improve the experiment?

Smaller groups.

4. What were the pros and cons for working your group?

Pros:
I liked working with people I know.

5. Other Comments?

Which experiment did you participate in? Robot (EE Kits)

Appendix B

Letter to camp REACH alumni (notification e-mail) sent October 10, 2000

From: Robin Ngo [mailto:robbie@wpi.edu]
Sent: Tuesday, October 10, 2000 10:13 PM
To: campreach@wpi.edu
Subject: Camp REACH

Hello, how are you doing? My name is Robin Ngo. My friend, Jennifer Look, and I are two undergraduate students currently attending Worcester Polytechnic Institute. We are writing to you because we are designing a workshop for Camp REACH, supervised and advised by Professor Denise Nicoletti, and we would like your help in selecting a possible project. The projects that we have come up with are:

1. Sound Sensitive Robot
   This is a robot that reacts to high pitched sounds (such as a hand clapping) and vibration (bumping into objects). When it comes across the high pitched sound or collision with objects, the robot backs up, rotate left for a certain amount of time and continues to go forward again. The plan for this workshop is to have you build it, test it and have a little fun with it first, than put it through a maze to see if you can guide it through the maze.

2. Triathlon
   This project is basically an idea from the Olympics this year. The plan is
to build a solar powered motor car, have it transport an object (egg, eraser, etc. anything not too heavy or big) to a certain distance where a crane will be waiting for the object, pick it up, and pick it on a steam powered boat. The boats will than have a race to a finish line.

3. Alarms
   In this little activity, you will learn how to build an alarm and sound devices.
   --Burgular Alarm:
   --FM Wireless Mic:
   --Insanity Alarm:
   --Secret Alarm:

These are the ideas that we have so far. We will greatly appreciate it if you could choose a project from the list above that interest you the most and email us the choice. We will most likely be asking for your help in the future to test the choosen project. If you have and questions or concerns we will be happy to answer them! Thanks in advance!

From,
Robin Ngo, Jennifer Look

Appendix C

Invitation letter to Camp REACH Alumni sent November 10, 2000

Dear Camp REACH Alumni,

Hello, my name is Robin Ngo. My partner, Jennifer Look, and I are students at Worcester Polytechnic Institute (WPI). We are working on our Interactive Qualifying Project (IQP) this year and we are implementing a workshop for Camp REACH. We'd like to invite you to help us test our project. The project will be to build:

A Sound Sensitive Robot

This is a robot reacts to high pitched sounds (such as a hand clapping) and vibration (bumping into objects). When it comes across the high pitched sound or collision with objects, the robot backs up, rotate left for a certain amount of time and continues to go forward again. The plan for this workshop is to have you build it, test it and have a little fun with it first, than put it through a maze to see if you can guide it through the maze.

Various Alarm Units

In the alarm units, you will learn how to build an alarm that turns on when there is light, and an alarm when there is no light.

We would greatly appreciate it if you could come and help us out. The testing of the project would take place at WPI. The anticipated date on which the testing will take place is December 2nd, 2000. The activity will be from 1:00pm until 4:00pm. Snacks and drinks will be provided. Please contact me **BEFORE NOVEMBER 20, 2000** if you are interested. My contact information is given below.

*****IMPORTANT!!! PLEASE NOTE THAT THE FIRST SIX GIRLS TO CONTACT ME VIA EMAIL OR PHONE BEFORE NOVEMBER 17, 2000 WILL GET TO COME FOR FREE. DUE TO OUR LIMITED BUDGET, OTHERS WILL HAVE TO PAY A PRICE OF $10.00 FOR THE EQUIPMENT THAT WILL BE USED*****

If you have any questions about the experimentation you can contact me (Robin Ngo) at:
617-909-5878 or email: robbie@wpi.edu

or questions for any other concerns:
Prof. Denise Nicoletti at:
508-831-5257 or email: nicolett@wpi.edu

Again, your help is appreciated, thank you very much.

Sincerely,
Jennifer Look
Robin Ngo

What: IQP testing
When: 12/2/00 1:00pm-4:00pm
Where: Worcester Polytechnic Institute
TO COME FOR FREE CALL OR EMAIL ROBIN
617-909-5878 email: robbie@wpi.edu

Appendix D

Sample invoice of order total $201.80

PITSCO
INNOVATIVE EDUCATION.
shop-pitsco.com

ONLINE CATALOG

1•800•835•0686

HOME | REGISTER
ORDERING
VIEW CART
CHECK OUT
CONTACT US

4
name
identifier
description
keywords
search_results
ID181201652076
name

Product Search
Policies & Info

Checkout Shopper Information **Billing Information** Change
Shipping Information Change jen Ngo 100 Institute rd quincy, MA 01609 US jen Ngo 100 Institute rd quincy, MA 01609 US

checkout | ID181201652076 | updateCart

Contents of your cart: #

Identifier Name Price Qty. Total Remove?
1. W51071 Burglar Alarm Kit $7.95 2 $15.90
2. W548 FM Wireless Microphone Kit $8.00 2 $16.00
3. W51066 Insanity Alarm Kit $6.50 2 $13.00
4. W51070 Manual Siren Kit $6.95 2 $13.90
5. W51072 Secret Alarm Kit $7.50 2 $15.00
6. W56264 Hyperpeppy (unassembled, requires soldering) $27.00 4 $108.00

Update Qty. and Remove

Total: $181.80

ID181201652076 | checkout | updateShipAndP | 0

Please choose payment method Method: --- Select One --- | On-line

Credit Card Information Name on card: Card Number:

Expiration Date: - Month - | - Year -

Please choose shipping method Method: 2nd Day Air ($20.00)

Comments:

You must click UPDATE after entering comments or billing and shipping information. Update

Total cost for your order: **Item Total: $181.80** 2nd day air delivery
Shipping charges are estimates only. The actual shipping cost is determined at the time the product is actually shippe
The actual amount is usually less than the amount displayed here. **Shipping: $20.00** Additional taxes added as required by state **Tax: $0.00** **Order Total: $201.80**

Back | order | ID181201652076 | 0

Appendix E

Copy of the letter sent to campus police, sent in November

100 Institute Road • Worcester, MA 01609-2280
Phone 508-831-5000 • Fax 508-831-5753 • http://www.wpi.edu/

To: Campus Police

From: Denise Nicoletti, Electrical and Computer Engineering, x5257

Re: Access to Atwater Kent

Date: November 27, 2000

I have two IQP students, Robin Ngo and Jennifer Look, whom are working on a workshop for Camp REACH with me. We have reserved rooms AK 317A, and AK 113 for December 2, 2000, from 9:00am to 6:00pm for an implementation of the workshop. This implementation will involve 14 12-15-year-old girls, all past participants of the REACH program.

I plan to be present at the testing.

This letter is to notify your office and so my students can be allowed to go into Atwater Kent that day. Thank you very much

Appendix F

The follow-up email survey received from the girls

Responses from girls from the follow-up questions:

From: Paula A Pope [mailto:papope@massed.net]
Sent: Tuesday, January 16, 2001 5:29 PM
To: Robin Ngo
Subject: Re: More follow up questions- SORRY!!!!!

Dear Robin, Here are the answers to your questions:

1. I think that it is hard to tell what what parts go in what hole on the alarm kits. Maybe you should point out the top, bottom, left, and right on the board as in comparison to the diagram, this would make it easier. You should tell the girls to count the the number of spikes and then the number of holes before they put each part in because some use two holes and others use three or more.

2. The best learning experiences I had were in 8th grade algebra. We learned about graphing by making a coordinate plane on the floor and then each person was assigned a point to be on the graph. It helped to visualize the problem. The other was in the same class, but we were doing quadratics, so we played parabola kickball. We had to say the formula before we touched first base or we were out!
It was a lot of fun, which is how the information should be presented, in a fun manner. If it isn't fun then nobody will pay attention and then the workshop will be a waste! Maybe a human demonstration would be cool to show exactly what resistors do.

3. Maybe explaining what helps people that involves alarms and/or robots. Such as, a prosthetic robotic arm or burglar alarm. This would show them how engineering is used in the real world and not just in a workshop or lab.
Hope that helps!
-Jenelle Pope

From: Crazyart1@aol.com [mailto:Crazyart1@aol.com]
Sent: Tuesday, January 16, 2001 7:09 PM
To: robbie@WPI.EDU
Subject: Re: More follow up questions- SORRY!!!!!

1.There should be an easy to follow an easily understood word description writtn on paper along with the picture. There should also be a list of do's and don'ts (just to be on the safe side).

2. I remember doing a school project that involved science and for the most part was engineering. I invented a trash-o-matic and by doing this I was able to figure out the positive/negative conjunctions and the ways electricity can help many people (even though it costs a lot of money). I had deadlines to follow and the actual working model didn't take more than a day to finish. The fact that I did that on my own (with a little parental help) definitely gave me a boost of courage for future projects.

3. More sodering irons and a story that expsplains how helpful alarms are.
Without them MANY people wouldn't be able to sleep at night.

From: Lily Goodman [mailto:wildlily@saintly.com]
Sent: Wednesday, January 17, 2001 8:28 PM
To: Robin Ngo
Subject: RE: More follow up questions- SORRY!!!!!

hi! don't worry about emailing me, i don't mind the questions at all! :)

1: I think the instructions could be made a little easier by putting all the parts in bags that are labeled. All of the pieces were in different bags, and it was hard to find some of the pieces. The bag could have a letter A or a number 1, and on the directions put "see #1", or "see letter A".

2: Last year, I did a different robotics workshop, which was a good learning experience. We got a tour of the robotics workshop at WPI, and we got to play around with something, it was very hands on. The instructions for the robots we made were very easy, and the robot was semi-easy to make.

3: I think, the experience in question number 2, showed how robotics are important by the tour. I did the robot part of the project with Jennifer. Maybe, in that part, you could explain how and why engineers make these types of robots, and why they are so important, before, or maybe after the workshop.

Lily Goodman '99

From: sweet_holly_d@gurlmail.com [mailto:sweet_holly_d@gurlmail.com]
Sent: Thursday, January 18, 2001 3:24 PM
To: robbie@WPI.EDU
Subject: Re: More follow up questions- SORRY!!!!!

1. What should be done to the instructions to make them easier to understand and follow?
they would be easier if they were a little more visual, i don't know if you can do that but...

2. Can you remember a good learning experience from your past? Please explain. In what way was the learning material presented?
?????

3. What should be added to the experiment to help others see the importance of engineering?
Maybe make the experience have some kind of worth (other then the basics)
like to show how the lil robot or alarms can effect someting. maybe give
more info on the background of the subjects, i dunno

Responses from Girls for Project Comparison Email:

From: Jewles3000@aol.com [mailto:Jewles3000@aol.com]
Sent: Tuesday, December 12, 2000 7:20 AM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

i prefer to do the alarms!!!

~*Julie*~

From: Crazyart1@aol.com [mailto:Crazyart1@aol.com]
Sent: Tuesday, December 12, 2000 9:57 PM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

Hey Robin,
If I were given a choice of which project to do I probably would have chosen the Alarms and robots to the insulation and housing. This was a really cool project and I am glad that I was able to be involved in it. Thankyou VERY much
Sincerely,
Samantha

From: Paula A Pope [mailto:papope@massed.net]
Sent: Wednesday, December 13, 2000 5:17 PM
To: Robin Ngo
Subject: Re: Follow-up for IQP

Robin,
I would rather have done the alarm or robot project. It was really cool and
A lot of fun! Could you please let me know where I can find one of those robots? I would like to build one on my own.
Jenelle Pope

From: Elizabeth Johnson [mailto:heavenlyfire17@hotmail.com]
Sent: Wednesday, December 13, 2000 5:47 PM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

Dear Robin,
I personally would rather build the robot than test the insulation.
Elizabeth Johnson

From: Samantha Wilner [mailto:sammyswimmer@hotmail.com]
Sent: Thursday, December 14, 2000 3:05 PM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

i would have liked to the robot project instead of the project where we had to measure the temp and stuff. the robot was a ton of fun but i wish we had more time to finish.
samantha wilner

From: Katie 574 [mailto:katie574@hotmail.com]
Sent: Thursday, December 14, 2000 11:37 AM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

Dear Robin,

Yes, I do remember that activity, and I remember that I found it was a little boring. I do prefer yours and I enjoyed making the robot. Thanks for holding that activity!

katie imber

From: NyloracNot@aol.com [mailto:NyloracNot@aol.com]
Sent: Thursday, December 14, 2000 6:58 PM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

I think I would prefer the temperature box over the EE alarms, because I liked how I could control it on the computer. But I liked them both a lot.
Carolyn Purington

From: Lily Goodman [mailto:wildlily@saintly.com]
Sent: Friday, December 15, 2000 5:32 PM
To: Robin Ngo
Subject: RE: Follow-up for IQP

Hi!
I would rather do the robots. Although the box thing was fun, it wasnt as fun as the robots.
Thanks!
Lily

From: Calicao@aol.com [mailto:Calicao@aol.com]
Sent: Friday, December 15, 2000 8:26 PM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

Hi,
I preferred doing the alarm systems that we did on December 2nd. I would have much rather done this. It was fun plus it makes noise.
~Cal

From: sweet_holly_d@gurlmail.com [mailto:sweet_holly_d@gurlmail.com]
Sent: Wednesday, December 27, 2000 7:46 PM
To: robbie@WPI.EDU
Subject: Re: Follow-up for IQP

Hey sorry for the late reply but i liked the robot better the insulation one was sort of well boring... hehehe
holly

From: LIBnyl1134@aol.com [mailto:LIBnyl1134@aol.com]
Sent: Wednesday, January 03, 2001 7:49 PM
To: robbie@WPI.EDU
Subject: re: followup for IQP

I enjoyed making the robots, and it was a bit confusing. Two of my friends from the same year as I (1998) had a bit of trouble with them, and I'm not sure if it would be the greatest idea for eleven year olds because it was a bit confusing - not that Holly, Sarah and I aren't smart. Even though the box experiment was a bit on my nerves, I think i would prefer to do that. My sister ruthie will reply sometime about the alarm experiment.

Mary Kate Toomey

Appendix G:

Implementation of workshop

Workshop Description

This workshop will primarily involve the area of electrical engineering. The girls will be asked to put together a series of alarms through the use of soldering irons, and circuit board components. There will be a total of thirty girls participating in the REACH program, each girl will get one of the three alarm kits chosen for this workshop. The kits that were chosen are the Insanity Alarm, Manual Siren Kit, and the Secret Alarm. Although each girl will have their own individual alarm kit, they will be working in groups of two girls.

Through this workshop we would like to communicate the importance and relevance of electrical engineering, in hopes of attracting more females into the science and engineering fields.

Preparations for workshop

For any project, there should always be several steps that should be followed beforehand. In order to implement the Alarm Kits workshop for Camp REACH, the first step that should be taken is to order the alarm kits from www.pitso.com. The appropriate alarm kits that should be ordered are the Manual Siren Kit, the Insanity Alarm Kit, and the Secret Alarm Kit. Since there are presumably thirty girls participating in Camp REACH, a total of thirty kits should be ordered; ten of each of the three above mentioned kits. This way, each girl will have her own alarm kit to work with to bring home. The next step is to find the appropriate tools to build the circuits. What would be needed are wire cutters, long-nose pliers, goggles, soldering irons, rosin core solder, wet sponge to clean the soldering tip, and paper and pencil so that the girls can find the nominal values of the resistors. These materials can be found in any Radio Shack and hardware stores.

When implementing the pilot testing for the workshop, there was one group that consisted of three girls, and another group that consisted of four girls. The responses received from the girls in the evaluation form showed that they felt the project would be good for groups of two people. The reason for this was because there were not enough soldering irons for the girls and, as a result, most of them were idle and were waiting for their turns to solder. Because of this, it would be wise to divide the girls into fifteen groups of two. Each group should share a soldering iron; fifteen soldering irons should be obtained, as well as solder (rosin core is recommended over acid core solder, the kit will be conducting voltage to various points where it should not and the kit will be destroyed). Approximately one foot of solder per group should be enough.

Overall, the steps that should be taken prior to the workshop should be fairly easy. Below is a list of the material that is needed.

- Manual Siren Kit (10, from www.pitso.com); identifier # W51070, Price: $6.95
- Insanity Alarm Kit (10, from www.pitso.com); identifier # W51066, Price: $6.50
- Secret Alarm Kit (10, from www.pitso.com); identifier # W51072, Price: $7.50
- Wire cutters (15)
- Pliers (15)
- Goggles (30)
- Soldering irons and wet sponge (15 each)
- Rosin core solder (15 feet; 1 foot per group, more may be desired)
- Paper and pencil

Optional components (if components are lost or broken):

Manual Siren Kit

- 6.2 Kohm (6200 Ohm) resistor; 5% tolerance (30)
- 68Kohm (68000 Ohm) resistor; 5% tolerance (30)
- 10Kohm (10000 Ohm) resistor; 5% tolerance (30)
- 82Kohm (82000 Ohm) resistor; 5% tolerance (30)
- 0.01uf Mono Capacitor (103) (30)
- 100uf Radial Electrolytic Capacitor (30)

- 2N3906 PNP Transistor (30)

Insanity Alarm Kit

- 51Kohm (51000 Ohm) resistor; 5% tolerance (30)
- 1.5Kohm (1500 Ohm) resistor; 5% tolerance (60)
- 24Kohm (24000 Ohm) resistor; 5% tolerance (30)
- 0.01uf Disc Capacitor (103) (60)
- 2N3904 Transistor (60)

Secret Alarm Kit

- 22Kohm (22000 Ohm) resistor; 5% tolerance (30)
- 200Kohm (200000 Ohm) resistor; 5% tolerance (30)
- 470uf Electrolytic Capacitor (30)

Workshop Schedule

- Project Description (10 - 15 min)
    - What will be done
        - Description of each alarm
            - Insanity Alarm
            - Manual Alarm
            - Secret Alarm
    - Importance of electrical engineering
        - Applications of electrical engineering
        - Sample circuit boards
        - Famous people in electrical engineering
    - Distribution of Kits
        - Form groups
- Electrical Engineering Lesson (5 -10 min)
    - Capacitors
    - Transistors
    - Resistors
    - Circuits
    - Current/Voltage
- Soldering Lesson (5 min)
    - Demonstration

    - Inserting pieces
    - Soldering pieces
    - Cutting excess wire
- Build Alarm Kit 1 (45 - 60 min)
- Break (15 min)
- Build Alarm Kit 2 (45 - 60 min)

Minimum Time 2hrs 5min ***Maximum Time 2hrs 45min***

Workshop Schedule Description

Project Description (10 - 15 min)

What will be done:

The workshop will begin with a description of what project the workshop hopes to accomplish. The staff will explain to the girls that there will be a series of three different alarms which will be worked on. A description of what each alarm and what it does will be given during this time, also a pre-built sample of each alarm will be available for demonstration.

Importance of Electrical Engineering:

It is one of the overall goals that the girls see how important electrical engineering is through this workshop. This section will be used for a short discussion to help the girls relate engineering to everyday life. They will be given examples of everyday applications of electrical engineering (see Appendix , and also shown sample circuit boards from common appliances.

Distribution of Kits:

During this time each girls will be given an alarm kit and groups will be formed.

How the kits will be distributed:

There will be a total of 30 girls participating in REACH 2001. These girls are to be divided up into 15 groups of 2 girls each. Each of the 15 groups will be given 2 different alarm kits.

Alarm Kits:

* 10 Insanity Alarms
* 10 Manual Alarms
* 10 Secret Alarms

Both the kits and the groups will be formed randomly.

Random Assignment Procedure:

* Label the Alarm Kits
  10 of the Insanity Alarms are to be marked with the letters A - J
  5 of the Manual Alarms are to be marked with the letters A - E
  5 of the Manual Alarms are to be marked with the letters K - O
  5 of the Secret Alarms are to be marked with the letters F - J
  5 of the Secret Alarms are to be marked with the letters K - O

* Each girls is given one Alarm Kit

* Two girls with matching letters on their kits will be in the same group.

Electrical Engineering Lesson (10 min)

The girls will be introduced to the different components that they will be using to build the kits. A few facts will be given about transistors, capacitors, resistors, circuits, and voltages. Also, it will be necessary to teach the girls to find the nominal value for the resistance.

Soldering Lesson (5 min)

During this part of the workshop the girls will be shown how to connect the components to the circuit boards. The staff members will give a demonstration to small groups of the method used to attach a component. They will need to show the correct way to insert the component, correct way to solder, and how to cut the excess wire. Also, it is very important that the girls are informed of the safety issues.

Build Alarm Kit 1 (45 - 60 min)

The girls will then be asked to build one of the alarm kits.

Break (15 min)

After finishing one alarm kit the girls will be given a short resting period to relax and rejuvenate for the second alarm kit.

Build Alarm Kit 2 (45 - 60 min)

The girls, after the break, will be asked to build the second kit.

Appendix H

Handouts for Instructors

This appendix contains the information for the instructors of REACH to follow when performing this workshop. Detailed steps of how to perform the workshop along with any preparations that are needed are provided in this appendix. A detailed schedule with descriptions is to be followed step by step during the workshop. All the information that the instructor will need to know for teaching and building the alarm kits are all located here, as well as trouble shooting guides and handouts.

Descriptions of alarms

The Alarm workshop is designed to interest girls in the electrical engineering field. In this workshop, there will be three different types of alarms that the girls will be able to implement. The three different alarms are listed below with a description of how each one operates and what each alarm consists of:

1. Insanity Alarm: This alarm stays off when the lights are on. When the lights go off, however, it gives a high-pitched irritating sound. This alarm operates on a 9V battery, capacitors, resistors, diodes, and transistors.

   The Insanity Alarm Kit consists of a two-transistor oscillator which drives a small piezoelectric speaker. This oscillator is configured to provide a high pitched tone as long as the base of the transistor (leg B) closest to the speaker is positive. A CDS (cadmium sulfide) cell (the light detector) is placed between the base and emitter (leg E) of the transistor. When light hits the surface of the CDS cell, its resistance is low enough to change the sign on the base to a negative. With a negative sign on the base of the transistor, the oscillator stops working and the kit becomes silent. As soon as the CDS cell is in darkness, its resistance goes high, thus causing the base of the transistor to be positive and turns the oscillator on.

2. Secret Alarm: This alarm operates exactly opposite to the Insanity Alarm; it stays off when the lights are off, but goes off in the presence of light. The alarm contains the same components that are required for the Insanity Alarm.

   The Secret Alarm Kit uses an SCR (Silicon Controlled Rectifier) and a buzzer to create a light sensitive alarm. The SCR "turns on" when the gate (leg

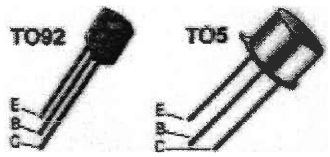
G) of the SCR is positive. The gate receives a positive sing through the path of the CDS (light detector) cell and trimmer resistor. The capacitor holds the gate at a negative potential, preventing the kit from turning on until after it discharges. After the capacitor has been discharged, the CDS light detector will trigger the SCR on when light shines on it. This is because CDS has a low resistance when light hits it, the exact opposite of the Insanity Alarm kit.

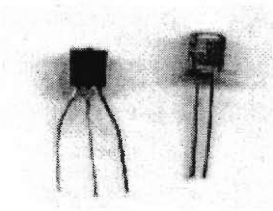
3. Manual Siren Kit: This kit produces a wavering wail of a police siren as a push button is pressed and released. The kit is small in size but produces a loud tone from a small speaker. It operates on transistors and IC circuitry. The kit requires a 9V battery.

   The Manual Siren Kit uses a 555 IC (integrated circuit) configured in a multivibrator mode to drive a PNP transistor. The transistor amplifies the output of IC and drives a small speaker. When power is first applied, the 100uf capacitor is charged positive through the 82KΩ resistor to the positive side of the battery. As the switch is depressed, the 100uf capacitor is discharged slowly through the 10 KΩ resistor. This discharge and charge, caused by the depressing of the switch, causes the upward and downward screech of the siren.

Transistors

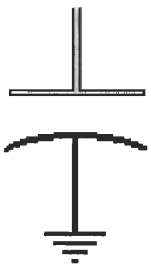
- Transistor: a three-terminal semiconductor device that can perform two functions that are essential to the design of electronic circuits: **amplification** and **switching**
- Two very important devices: bipolar junction transistor (BJT) and field-effect transistor (FET)
- BJTs and FETs form the basis for computers and electronic communication and are found in almost every product that is partly electrical in nature
- Has three legs (or layers) called the emitter (E), base (B), and the collector (C)
- Example: Radio. The difference in the extremely weak signals coming through the atmosphere are magnified and output through a speaker. This process is the amplification operation of the transistor.

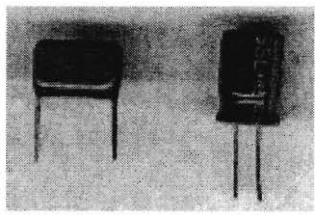




Capacitors

- Capacitor: a device that stores electric potential energy and electric charge
- Capacitors: formed by any two conductors that are separated by an insulator (called the dielectric, which is nonconducting).
- Limited in the amount of electric charge they can absorb (like us, we absorb in too much, we get hurt!! Ever been electrocuted before??)
- Are able to take in direct electrical currents for only a short amount of time
- "Charging the capacitor": when each conductor initially has zero net charge, and electrons are transferred from one conductor to another
- Example: springs in the suspension of an automobile help smooth out the ride by absorbing the energy from the jolts and releasing that energy gradually; in an analogous way, a capacitor in an electronic circuit can protect sensitive components by smoothing out the variations in voltage due to power surges.



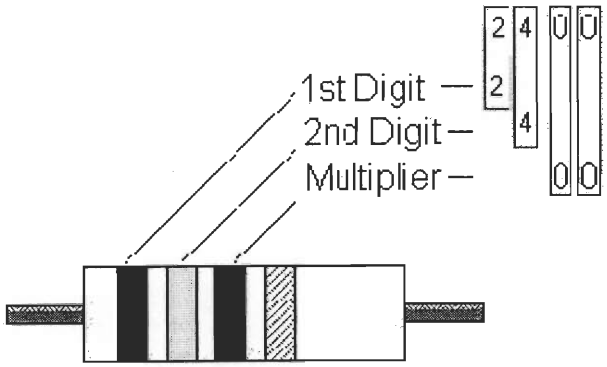


Resistors

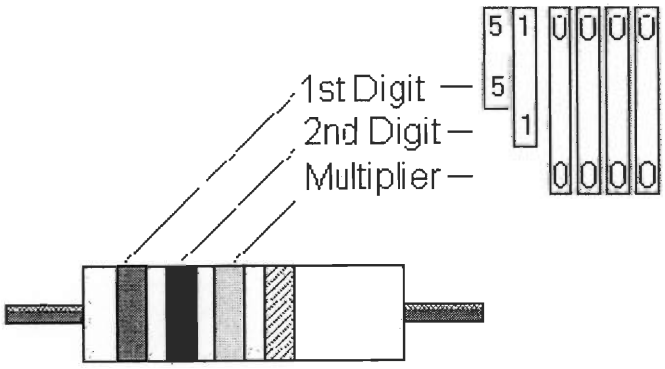
- Resistor: A circuit device made to have a specific value of resistance between its ends.
- lowers the flow of the electrical current that is going through the circuit (of a computer or radio, for example) so that there is not too much electrical currents flowing through
- Individual resistors used in electronic circuitry are often cylindrical in shape, a few millimeters in diameter and length, with wires coming out of the ends.
- The resistance may be marked with a standard code using three or four color bands near one end
- The first two bands (starting with the band nearest an end) are digits, and the third is a power-of-ten multiplier.
- Example: yellow-violet-orange means $47 * 10^3\ \Omega$, or $47k\Omega$.
- The fourth band, if present, indicates the precision of the value; no band means $\pm 20\%$, a silver band $\pm 10\%$, and a gold band $\pm 5\%$.
- See Appendix I for more detailed instructions on finding resistor values
- help in dividing voltages, and can help change voltages for a specific electrical design, such as an alarm or lamp
- An important characteristic of a resistor is the "maximum power" it can disperse without damage

Example answers:

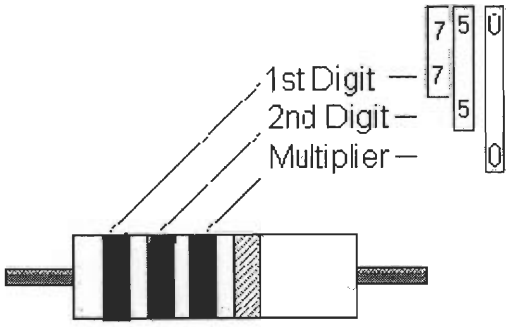
Answer: 2400 Ohms



Answer: 510000 Ohms



Answer: 750 Ohms



Electrical Engineering Experiences

In the modern world today, almost everything is run electronically and has a circuit inside of it. For the workshop that is designed for Camp REACH, the girls learn how to build different types of alarms. Through building these alarms, the girls also learn about the importance of electrical engineering, as well as how the operation of an alarm relates to everyday life and why it is important.

What's so important about an alarm?

Listed below are different types of alarms and exactly why they're useful

- Alarm clocks: wakes people up so they won't be late for work, school, appointments, etc.
- Burglar Alarms: keeps unwanted people out so you can live safer
- Fire alarms: without these, many buildings could burn down and many people can die
- Alarms the girls are about to build: to bug somebody that they really don't like!!!

Applications to Electrical Engineering

As can be seen, through their circuits, alarms are a part of electrical engineering. Electrical engineering is all around us in the things that we use everyday in our lives. Even the simplest electronics are created with circuits. Below is a list of things that have circuits inside of them:

- Television
- Computer
- Stereo
- Calculator
- Lamp

For an example of a simple circuit board, show the Insanity Alarm Kit and demonstrate.

For an example of a more complex circuit board, show the radio and point out the different components (capacitors, resistors, transistors).

NOTE: Even a more difficult circuit board contains the same components as that of a simple circuit.

Trouble Shooting Hints

1. Check to see if the right resistors were used.
2. Check IC1 to see if in right direction (Manual Siren Kit)
3. Check battery wires to see if it is the right color
4. Check to see if any excess solder connected the circuit
5. Check if solder joints are good
6. Check if transistors are facing the right direction
7. Check Buzzer to see if it is soldered completely (Secret Alarm Kit)
8. Check SCR to see if it is facing right direction (Secret Alarm Kit)
9. Check polarity on transistors (Secret Alarm Kit)
10. If kit is soldered incorrectly use a solder vacuum (if available)

Appendix I

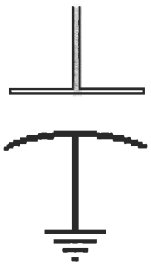
Information for Girls Participating in Workshop

This appendix contains all the necessary information for the girls who will be participating. This appendix includes three handouts that are to be given to the girls during the workshop. The handouts include a brief handout on electrical engineering, a description of the proper way to solder, and also assembly instructions for all three alarm kits.

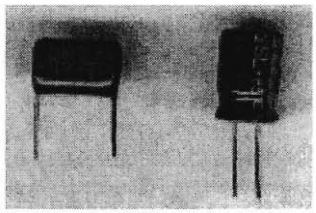
WPI REACH

Quick Lesson on some Electrical Engineering

Capacitors



Symbol for capacitor

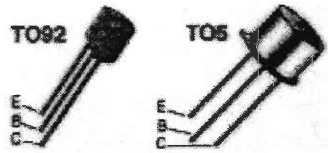


0.1 F and 100UF capacitor

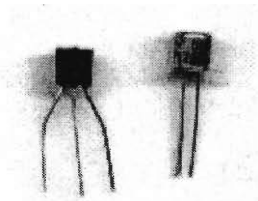
Capacitors……

- a device that can be used to store an electrical charge or energy
- has two parallel metal plates that are separated by a nonconducting layer called the *dielectric*
- limited in the amount of electric charge they can absorb (like us, we absorb in too much, we get hurt!! Ever been electrocuted before??)
- are able to take in direct electrical currents for only a short amount of time
- work very well as conductors in circuits where the electrical currents split up
- units are "Farads" (F)

Transistors



Symbols for transistors



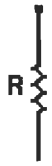
2N3906 and 2N2222A transistors

Transistors……

- semi-conductors with the ability to amplify
- Has three legs, called B (base), C (collector), and E (Emitter)
- Needed by radios so music can come out of the speakers
- The functions of a transistor are "Amplification" and "Switching"

Resistors

Picture of 100Kohm resistor



Symbol of Resistor

Resistors……

- part of an electric circuit that lowers the flow of the electrical current that is going through the circuit (of a computer or radio, for example) so that there is not too much electrical currents flowing through
- cylinder shaped; a few millimeters long with wires at both ends to connect them to the circuit
- often color coded by three or four color bands that tell their specific values
- help in dividing voltages, and can help change voltages for a specific electrical design, such as an alarm or lamp

Resistor Color Code

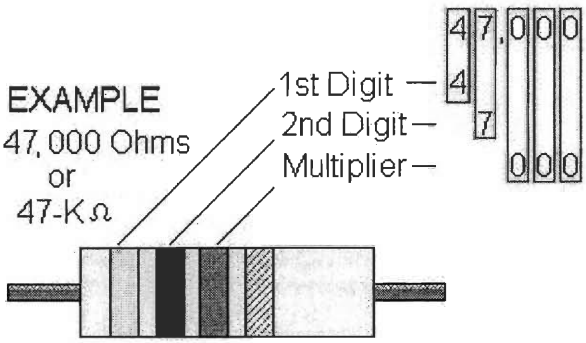
		Multiplier
BLACK	0	_____
BROWN	1	_____0
RED	2	_____00
ORANGE	3	____000
YELLOW	4	__0, 000
GREEN	5	_00, 000
BLUE	6	000, 000
VIOLET	7	
GRAY	8	
WHITE	9	

When finding values of resistor:

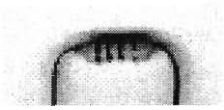
1. hold the resistor so that the gold or silver band is at the right
2. look at the 1st color band at the left and the 2nd color band; find out its color
3. next, look at the above chart and match the digit for the first and second color bands; write the number down
4. look at the third color coded band; this is the multiplier
5. match the third color with the value under "Multiplier"; if the color were red, then the multiplier would be 100, if the color were green, then the multiplier would be 100,000
6. to pull it all together now, multiply the first 2 numbers (1st number in the tens column and 2nd in the ones column) by the Multiplier

Units in which resistors are measured in is called "ohms"

Example:



4 (yellow) 7 (violet) * 1000 ➔ 47*1000 = 47,000 Ohms.



Now try one yourself with the colors (going from left to right) violet, green and brown.

You should get a value of 750 Ohms.

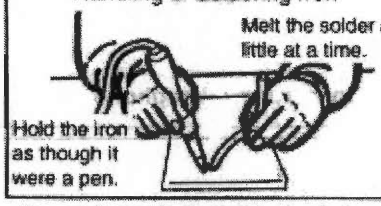
Soldering Techniques

The correct way to soldering is very important because it could lead to damage of the circuit board. It is also very important that you take caution in each step of soldering. Here is the proper technique for soldering the alarm kits:

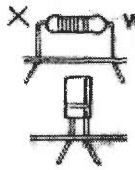
CAUTION

Do not use paste flux when soldering. Flux can cause corrosion and also act as an electrical conductor resulting in a defective circuit. Also, do not use acid core solder.

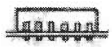
Handling of Soldering Iron



Correct way to install electronic parts.

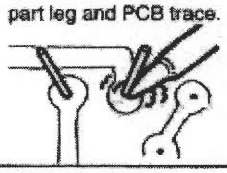


Do not force the legs into the holes. After inserting the legs, bend them slightly.



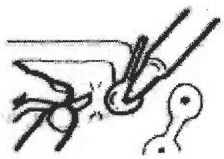
Soldering Procedure

1. Preheat the area to be soldered by placing the iron tip on the legs and PCB trace for approximately 2 seconds. Make sure to heat both the part leg and PCB trace.

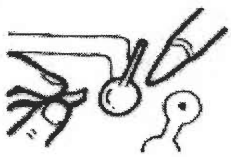


2. Keeping the iron in place, bring the solder to this area and melt it for 1-2 seconds.

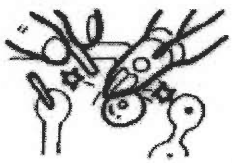
3. First, pull the solder away.



4. Then, pull the iron away.



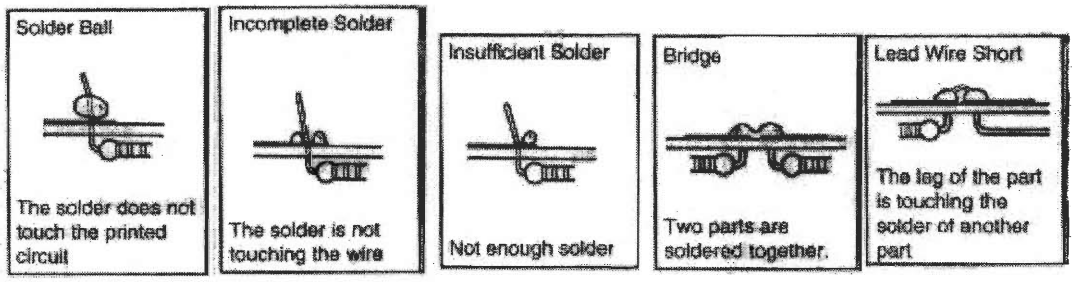
5. Cut the excess leads with a diagonal cutter. The solder should cover both the leg and PCB trace.



A properly soldered connection will have a good fillet contour and a smooth bright finish.

Bad soldering examples:

If your alarm kit does not work, a possibility could be due to bad soldering. If this is the case, check the examples below to see if your kit is not soldered correctly.

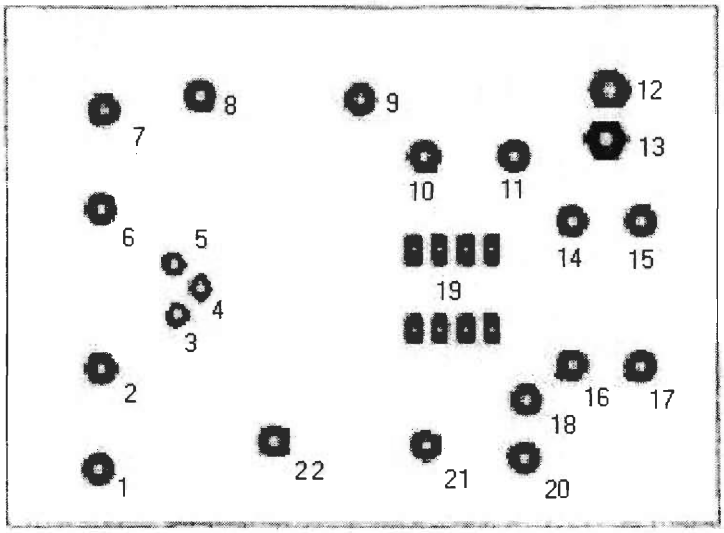


Assembly Instructions

In the assembly instructions for the alarm kits, included is a diagram of the complete circuit, a parts list, and a diagram of the circuit with numbered holes. To build the circuits, simply match the numbers that are next to each component in the parts list to its corresponding number on the diagram of the circuit with the numbered holes. For example, in the manual alarm kit, the numbers to capacitor (C1) are (10, 11). Simply match this number to the corresponding number on the diagram of the circuit board with the numbered holes. Follow the handout "Soldering Techniques" for proper soldering of the kits.

KIT Assembly Instructions
Manual Alarm

Solder all components to the underside of the board. (Side with foil pattern)



C1 _____ .01uf Mono Capacitor (103)	(10, 11)
C2_____100uf Radial Electrolytic Capacitor	(18, 20)
Q1 _____ 2N3906 PNP Transistor	(3, 4, 5)
R1 _____ 6.2K Resistor	(8, 9)
R2 _____ 68K Resistor	(22, 21)
R3 _____10K Resistor	(15, 17)
R4 _____82K Resistor	(14, 16)
IC1 _____ 555 Timer IC	(19)
SPK ____ Small Speaker	(7, 6)
SW1 ____ N.O Pushbutton Switch	(12, 13)
9VDC	(1, 2)

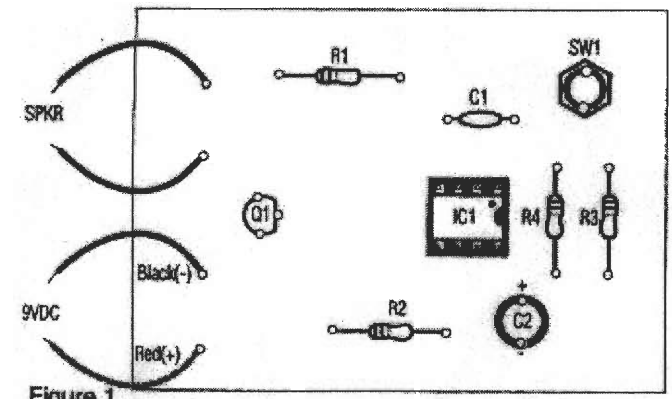
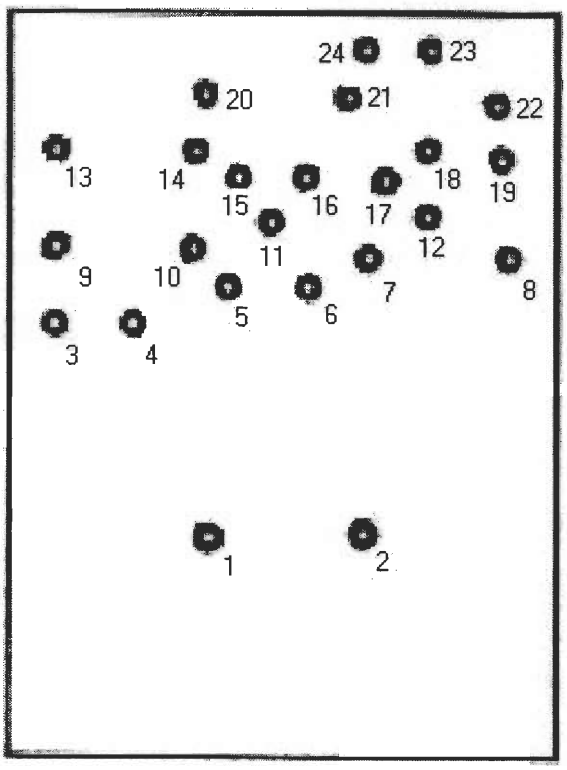


Figure 1
Parts Layout

KIT Assembly Instructions

Insanity Alarm

Solder all components to the underside of the board. (Side with foil pattern)



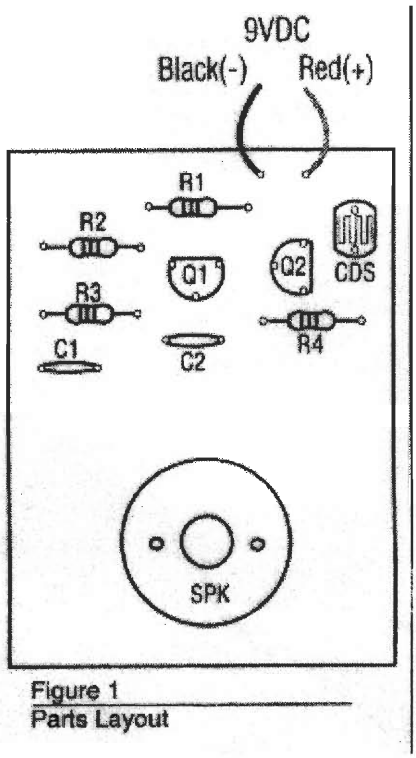
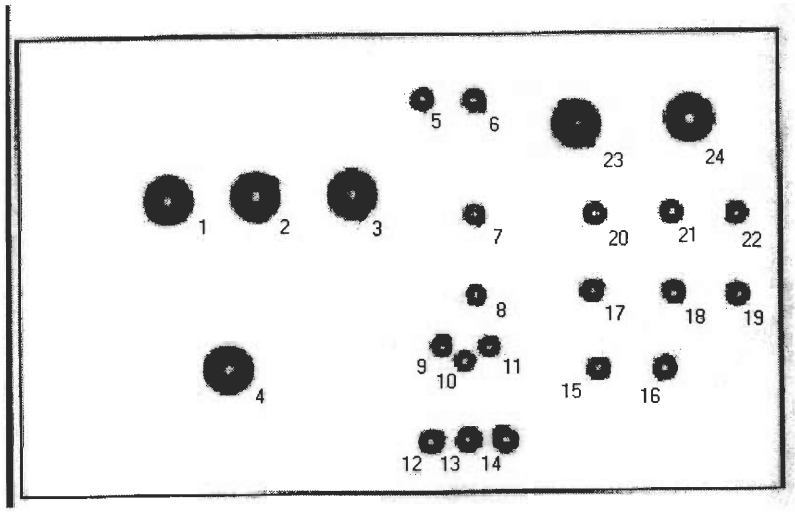


Figure 1
Parts Layout

C1 _____ .01uf Disc Capacitor	(3, 4)
C2 _____ .01 Disc Capacitor	(5, 6)
Q1 _____ 2N3904 Transistor	(11, 15, 16)
Q2 _____ 2N3904 Transistor	(12, 17, 18)
R1 _____ 51K Resistor	(20, 21)
R2 _____ 1.5K Resistor	(13, 14)
R3 _____1.5K Resistor	(9, 10)
R4 _____24K Resistor	(7, 8)
SPK ____ Piezoelectric Speaker	(1, 2)
9VDC	(black = 24, red = 23)
CDS Cell	(19, 22)

KIT Assembly Instructions

Secret Alarm



Solder all components to the underside of the board. (Side with foil pattern)

9VDC	(5 = red, 6 = black)
BZ _____ 9V Buzzer	(1, 2, 3, 4)
C1 _____ 470uf Electrolytic Capacitor	(15, 16)
CDS ____ CDS Cell	(19, 22)
P1 _____ 500K Trimmer Resistor	(20, 21, 23, 24)
Q1 _____ 106 SCR	(9, 10, 11)
R1 _____ 22K Resistor	(7, 8)
R2 _____ 200K Resistor	(17, 18)
S1_____ Toggle Switch	(12, 13, 14)

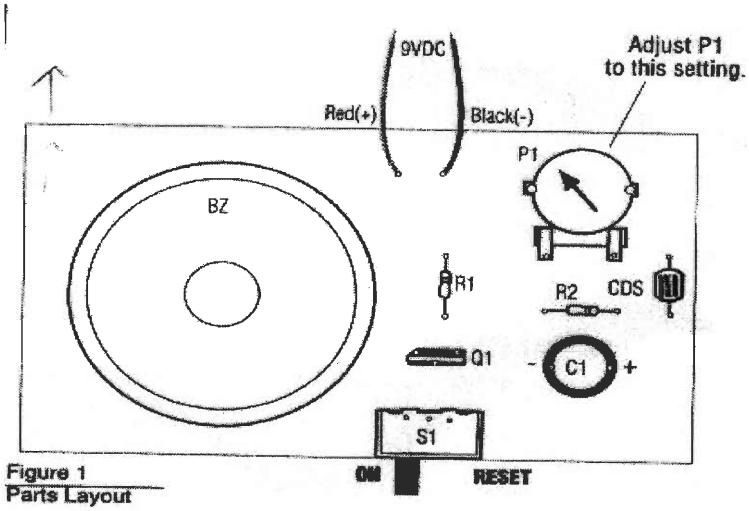


Figure 1
Parts Layout

Appendix J:

Pros and Cons of Each Project

Sound Sensitive Robot

Pros
- get experience in ME and EE
- learn how to solder

Cons
- too expensive ($27.50/kit; 15 groups = $412.50; $172.50 over budget)
- may take too long
- not every girl would be allowed to keep one (expensive)

Triathlon

Pros
- get experience in ME
- would require girls to present their communication skills

Cons
- too time consuming (would require more than 1 day)
- too many girls in one group (2 different groups to form 3 mini-groups of 5 girls)
-not every girls would be allowed to receive a souvenir

Learning How to Build Various Kinds of Alarms

Pros
- get to work with different kits
- opens their eyes to electrical engineering
- allows them to find resistor values
- inexpensive
- learn to solder

Cons
- may not be hard enough
- only allows electrical engineering experience

ME or EE?

Pros
- get experience in electrical and mechanical engineering
- would require girls to present their projects to each other (communication skills)

Cons
- time consuming (Triathlon and building Alarm kits would take too long)
- too many girls in a group for ME project