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A Future Scientists and Engineers Club for Worcester South High School

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A FUTURE SCIENTISTS AND ENGINEERS CLUB FOR WORCESTER SOUTH HIGH SCHOOL

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by

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Transcript Abstract

An extension of the "Future Scientist and Engineers Club" initiative which began at Doherty High School, was the effort to establish a similar club at South High School. Again, college students from WPI interacted with selected high school students to spark interest in possible careers in science and engineering. We conclude that the club is a very effective way to not only encourage students to pursue technical careers in general, but also to assist students overcome specific obstacles they face applying to college.

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Introduction

The South High project was part of an effort by 10 WPI students to create Future Scientists of America Clubs in five area high schools. Five teams of two fanned out over Doherty High School, Burncoat High School, North, South and Worcester Technical High School in Worcester Massachusetts. The team that went to South Worcester High School consisted of myself, Matt Frasier, and my partner Nick Ambrosino, both Civil Engineering majors, planning to graduate in May of 2008.

Since the pilot study the previous year was at Doherty H.S., the first step that had to be taken for the project was to identify an advisor for the club on the H.S. faculty. We wanted to network from the advisor of the Doherty Club to a colleague of hers at South High in order to avoid the inordinate delay that had occurred the prior year getting from the central administration to the teacher at the school. This referral was complicated due to union rules about pay for after school assignments. As an insider the teacher could request permission to start a club and avoid much of the red tape. However in our case this was not working out, as no one would return any e-mails or phone calls made in attempt to reach the people at South High. Unbeknown to us the teacher at South wanted official approval from the Principal, who wanted approval from central administration before saying anything that might encourage us. Meanwhile the superintendent didn't want to officially request that they cooperate, as that had budgetary implications, but was willing to "endorse" a local initiative, so a delay was

unavoidable while all of this negotiation was going on. The same problem that had nearly destroyed the project starting the prior year at Doherty, (and had killed a similar effort North High) was impacting us at South. The Worcester Public Schools did not know how to accept a "gift" of volunteer effort of this kind without getting tangled up in their own rules about after school work compensation. The good news was that a year later, both the Doherty and North High projects got off to a relatively smooth start as the system had had a year to work the problem after the H.S. club advisor's were identified and agreed to forego the pay that they were due under rules. The key was to have a specific local teacher able to do this volunteering. Our problem was finding the teacher willing to make that request.

At Doherty there was a science teacher who had been attempting to set up such a club for years and when an influx of WPI resources made it possible, it was fairly certain she was going to volunteer. At North High the process had involved sending a WPI student who was a North High Alumnus back to the school and having him network with a WPI Alumnus on the faculty. A year later the club started. At Burncoat they got lucky, and with no contacts at all their advisor just called and e-mailed the Principal, implying that his school would be "left out" if an advisor was not found. In two weeks a WPI Alumnus teaching math was identified and after some phone tag, he got in touch with the WPI team. The head of the department at the Tech H.S. placed his team in a physics class where all the students most likely to go to college were concentrated. That left us, the group that supposedly had a network contact from Doherty but was

not actually hearing from them. We waited the longest to start our club. However, the tide was turning in our favor. It was now South High that was in danger of being "left out" due to being slow to act and holding things up until all the Principals had their monthly meeting with the Superintendent. At that meeting, South was revealed as the laggard in acting on an idea accepted everywhere else and things finally started to happen. At long last an advisor at South High was identified. It would be Walt Talbot, a math teacher.

Walt seemed to be the perfect fit because not only was he a passionate teacher, but he was also a professional engineer for nearly twenty years in the field of mechanical engineering. It took a little while to get everything set up due to the lag time in e-mail response. He was very busy in trying to perform his daily tasks. We were finally able to pin him down for about an hour one day and discuss our plan and how exactly he would fit into our idea for the club. Once the meetings started Walt was very helpful because he could help explain the details of engineering practice that Nick or I could not explain in detail as we did not have any real world experience as practicing engineers yet.

While we were in the application process we still had weekly meetings with our WPI advisors to go over ideas for weekly meeting activities at the after school clubs and to go over important areas that were still under scrutiny. There were discussions of funding, the number of meetings that would be held, how each meeting would be conducted, and when meetings could be held so as to fit everyone's schedule. Ultimately the schedule of the advisor in the high school would be the critical constraint but we tried to get everything else in readiness.

Several topics were discussed during the time period as ideas for possible demonstrations by professors and possible field trips. All this had to come together in proposals to both the school system and WPI for funding. We were hoping that a modest level of support from WPI would allow us to compensate the H.S. advisor and have a field trip.

We were told to be specific in the proposals to the high schools. Don't ask what we should do, propose something and get feedback to adjust the plan. So in the proposal we included what we wanted to do with the students, when we planned to do it, how long the meetings would be, and in some cases mentioned possible candidates for club advisors. We then had to go through a CORI application process in order to be cleared by the police to enter the high schools and work with young adults. All volunteers entering the school had to do this and the system was seriously backed up. We waited over a month for this step to be cleared.

Upon submission of the proposals to actual advisors at the individual schools we could have a meeting and work out the site specific logistics involved with the clubs.

While this long process of networking and approvals was working itself out, our job was to make sure we had a specific plan, proposal, and agenda to be revised when the central administration was satisfied and let the local schools review a plan and work out the implementation.

Once everything was established and meetings were finally held we had a smaller turnout than we had originally planned for. We were hoping to have

about 15-20 kids, and wanted at least 7-10 of them be females. Our final numbers were about a dozen kids per meeting with approximately one-third of them being females. Still, it was a better start than the first year effort at North High had been.

Club Objectives

This club started out with one objective, and that objective was to create a place where SHS students tentatively interested in science or technology as a college major could find out what engineering and science at the college level and possibly pursuing a technical career is all about. It was to support those already interested and possibly persuade a few more who were on the fence to pursue a career in engineering or science. We hoped to do this by presenting technology as a field of interesting challenges that could be fun.

There were multiple reasons behind our decision to accept this challenging IQP. First we believed in the importance of the mission and remembered when we faced that decision not so long ago. Some of us wish we'd had more information, a role model, and some support. Second, America is starting to lag behind China and other leading nations in the engineering and technical fields. About 7% of American students have an interest in engineering while 25-30% of Chinese students are interested in technical fields. It is not known whether this is caused by a greater push for the study of sciences and engineering as social policy in other countries or if it is because of a negative stereotypic (nerd) image of engineering in the eyes of American students. Our job to help them realize the potential benefit of entering one of these fields, the range of resulting opportunities, and the fact that most engineers don't fit the stereotype.

One thing we realized is that engineering was presented to us as challenging, hard to do, and not for everyone. Our aim was to reinforce the idea

that a normal H.S. student could succeed at engineering, if they really wanted to, by just being themselves. One possible way to make this point was to have students perform hands on tasks so they could experience what it was like to face challenges similar to those faced by engineers on a daily basis and personally experience success as well as finding it interesting.

We felt that if we could convince these students that not all engineers fit the stereotypical image of nerdy over-achievers they might be more willing to look into the science and engineering fields. We also felt that if these 5 clubs were accepted by the faculty and students at the high schools, there would be an opportunity to create an ongoing IQP initiative. Every year WPI students in Worcester who were interested in performing a service for the students of the high schools, (and for technical universities looking for talent) would then be able to do so.

Technical colleges all over America are seeking more young adults interested in engineering and science and they are especially looking for Black, Hispanic, and Female applicants. Worcester's public school student body is only 50% white and its females tend to outperform the males academically. If this high school population started to be disproportionally interested in science and engineering the implications for diversifying the technical talent pool were large. Further, Aspiration Surveys administered to the 11th graders in Worcester by Marslandated (2006) all indicated that about 20% of the males were tentatively interested in engineering and 5% interested in science. Among the females it was 5%for engineering and 5% for science. Hence, one could approach the

nation average of 7% going on in engineering even among the females in Worcester, and 3 times the national average could be recruited among the males if everyone with the inclination were reached, encouraged. They would have to be supported and shown how much fun it could be and how large the opportunities are but there was a chance to make a difference. Further, that was 11th grade data after interest in science had waned a bit.

Among 8th graders about 30% of both males and females said science was their favorite subject, and our club would be open to 9th and 10th graders. It was also going to be designed to be female friendly. By the 11th grade a third of the females wanted to enter the medical profession. In our club they were going to hear about fields like biomedical engineering and civil and environmental engineering. We had other plans for part of that pool of females not afraid to tackle medical school, who would have to pass organic chemistry courses and anatomy and physiology as well. We wanted them to consider engineering, at least as a backup plan.

Finally, South High School in Worcester is located in a heavily Hispanic working class neighborhood. Success here would be a big deal given the national data on participation of ethnic groups in the technical professions. If all five clubs succeeded, we had hopes that that our efforts in these 5 high schools would lay the ground work for the future clubs following us. If they did not experience the same startup difficulties that we did they could demonstrate the full potential of the club concept. Given the good second year starts at Doherty

and North, we had some hope that our pain would result in a major gain for our successors.

As we progressed, the club initiative took on more objectives, but the main objective was to still to encourage students to look into science and engineering as a possible career path after high school. Engineering, like music, involves specialized college programs not available at all colleges, though some colleges are completely devoted to those fields. Finding and supporting the people who should consider doing something radical like going to WPI or Berklee school of music was something the schools were not set up to do systematically. We could do an experiment using WPI as an example.

It is much easier and safer for a guidance counselor without specialized knowledge of such colleges to encourage a student to go to a university which offers all the fields, or a wide range, but excels at none of them. Another goal that the club took on was trying to expose the students at these high schools to the possibility of being part of the Space Program. The possibility of colonization on the Moon or Mars was a theme of the space conference at WPI the day they were to visit. The students were exposed to a multitude of ideas for advancing these possible programs in the Pugwash Space Conference that was held at WPI. They heard presentations about plans to build a moon base starting in 2020, technological advances for space such as solar sails, ion drives, gathering oxygen in space, potato farming on the moon, and the possibility of a bionic leaf to support such farming. The bionic leaf it is not necessary but would be an

improvement over what you have to do without one – which is to grow things at least ten meters underground and still get solar energy to the leaves.

Other smaller objectives for ourselves that were accomplished during the project were to enhance our communication skills, whether it be with the high school students, our peers working at other high schools, our professors or our city sponsors, at the ACSW(Advisory Committee for the Status of Women). We had to improve our ability to manage time since we were restricted in the amount of time we had to give demonstrations and form groups to perform tasks during the meetings. However the real education we experienced was in how to deal with a medium sized bureaucracy. The one that is involved in any sort of government funded public school system is particularly rigid, rule bound and risk adverse. There were many layers of supervision that had to be penetrated in order to get approval to enter the high schools and that's was just to present our proposed club ideas to prospective advisors. CORI checks were needed to actually meet and work with the students. We spent 3 times as long preparing proposals, budgets, and doing access planning and paperwork than we did delivering the program. A final smaller objective was to promote WPI in public high schools near WPI.

Most of these area schools do not have substantial placement rates at WPI, indeed only 1(Doherty, which is home to the Engineering and Technology Academy of Worcester, ETA,), of the 5 does. Therefore we hoped the clubs could help the students looking for a local engineering program, as well as help WPI by increasing the diversity of the student population at WPI. The fact that

these students do not all come from high schools that are strong in math and science is an issue but, in principle Worcester students can transfer to the Engineering Technology Academy (ETA) at Doherty H.S. during the 9th grade year. Then they will get a special math and science intense program designed to prepare students for a technical college major. They cannot start this program as a sophomore or junior so they have to hear about it in 8th or 9th grade. We were working with 9th graders, so the students who could still do an 11th hour transfer and recommendation letters from a club advisor or ourselves might carry some weight at ETA. Alternatively, they can take Honors and AP level math and science courses at their regular high school, and Future Engineering and Scientist club participation noted on the WPI admission essay and application would be likely to help them make their case for admission with any necessary financial aid.

Meeting with Advisor

At the meeting

The objectives of our first meeting with co-advisor Walt Talbot were two-fold. First we simply wanted to introduce ourselves, and second, we wanted to discuss our plan for club activities and get his reactions to them. We brought an outline to show him what type of events we had planned for each meeting and how long each meeting was likely to be. We wanted to get some input from Walt as well. He explained how he wanted it to be a very interactive club. If it was just us giving power point presentations or handing out sheets that described what the different fields of engineering were and what the average salary range out of college was it would not be worth doing. He did not want this club to be like a class of lectures and PowerPoint presentations. It had to be fun and interactive. We agreed.

A major objective of ours was to get female students interested in science to consider going into a science or engineering field after high school. It was likely that these students were currently aspiring to medical careers for some reason. This was a major goal of our WPI advisors due to the lagging involvement of women in engineering and science fields, and very important to our cause sponsor, the City Manager's Committee on the Status of Women (ACSW). A female friendly club needs to look like one from the point of initial publicity on and we had no female organizer to send a signal of this type. Hence publicity and networking would be key for us. There was also the question of

logistics. We had to finalize what would be the best time of the day to meet, and which would be the best day of the week to meet before we could do any publicity. We also wanted to run the idea by Walt of having him bring a group of his students to WPI for a space conference later on in the year as that involved additional logistics. A minor objective of the first meeting was to get acquainted with the administrators, mainly the principal, and let them know we had a long term effort in mind. It was no secret what we planned to be doing in the school and we thanked the administrators for their co-operation as it would help our successors. Secondly, we wanted to get her thoughts about the project concept and see if there was anything in particular that she wanted us to emphasize at our club meetings. If this was a good fit with any school agendas, we wanted to know that and play our part. The principal seemed to be very excited with our plan for the club and thanked us for our interest in helping students in her school become more well informed about possible career paths, and told us to let her know if there was anything she could do to help us.

Once we arrived at South Worcester High School we met with Walt Talbot to introduce ourselves and to give him a general overview of the project. We also explained what is special about WPI, how WPI is a very project oriented college. We told him of the three different projects that most students at WPI had to complete in order to fulfill the requirements needed to graduate. We then explained how the IQP was a project that most students at WPI completed in their junior year at school and how it tries to tie engineering and science together with some aspect of how technology can or does effect society in a specific way.

In our case we noted that we were trying to address the person power question for the technical professions. Our society needs more engineers and technically literate citizens. However, just finding warm bodies won't do. We need to find, support and nurture the potentially creative technologists. The USA needs to find these willing to think outside the box and put in the time and effort needed to make improvements. Rates of invention during the next 20-50 years are of economic interest in terms of global competition. We explained our backgrounds to the school advisor and told him that we had chosen the project because of our interest in informing high school students about technical careers. Since we never were told about the different types and jobs within engineering before we need to choose a calling and major, we wanted to do better by the students in this school near WPI.

Walt then took the time to describe his own path in life. He told us how he had attended Lehigh University in Pennsylvania and graduated with a degree in mechanical engineering. After graduation Walt took a job with Ingersoll Rand working in their manufacturing division. He described the type of projects he typically worked on while at IR. After more than 20 years at IR, Walt decided to become a teacher instead of continuing to work in industry. Walt explained how he felt that he had done his part in the engineering field and that he just decided one day that he wanted to help kids by becoming a teacher. He told us that he was very strong in mathematics and that he felt he could benefit students the most becoming a tenth grade math teacher. Walt told us of the struggles that most of the students in his class faced with trying to pass the MCAS math test at

the end of the year. He described how he related mathematics to everyday problems so that the students could relate to them and understand how to solve them.

After getting acquainted with Walt we got down to specifics about the club. First, we discussed the target group to be recruited for the club. We wanted to mainly target freshman and sophomores who hadn't really made any decisions about what majors they wanted to pursue after high school. This was our goal because we felt they would be more open minded towards hearing about possible technical fields to look into as possible career choices and the courses they took in the 11th and 12th grade would affect their ability to go to a school like WPI or Lehigh. We also explained how we were very interested in getting as many females to come to the meeting as possible.

Walt then told us that he planned to advertise the first meeting by making posters and flyers to put all through the high school. The three of us discussed when would be the best time to have the meetings and we came to a decision to have them on Thursday at 2pm after school. It was decided that the meetings would need to be limited to one hour. Walt felt that an hour meeting would be good since it would be fairly hard to keep the students attention much longer than that. It was also necessary to consider that 9th and 10th graders can't drive, so they need to take public transportation and if the club met longer than one hour, these students would have to be highly motivated to stay for the club and we wanted people still on the fence about a technical career to consider this option. It had to be convenient to do so.

Finally at the end of the meeting we went and met the Principal. She seemed to be very enthusiastic about a club that would focus on informing adolescents about the possible engineering and science fields as well as trying to get more young women involved. She told us to come to her if we had any problems or if we needed anything. She also told us that she would also endorse the field trip to WPI if the students in the club felt like going. What more could we ask? It was an encouraging event, especially after our slow project start to that point.

Results

The results of this meeting were very positive. The South High club could now be established as the advisor was found and the CORI checks were completed. Walt seemed to be extremely knowledgeable and excited about creating the club. The South High group was starting to take on an identity. We finally had a distinct direction approved and it was the one that the club wanted to go in. A specific time and place had been established to have the first introductory meeting and see what kind of turnout the club might have. The two of us were also able to determine what kind of things Walt and the administration were going to want to accomplish by establishing this engineering club at their high school. The three of us were able to discuss what kinds of hands-on projects could be done that would be of interest to the students and would also demonstrate what types of challenges engineers face and how they determine the best possible solution for the problems.

We had also learned how passionate Walt seemed to be about teaching and helping young people succeed in the classroom. The two of us felt that Walt and the administration also realized how eager we were to help them. They knew us now, and knew that we considered it urgent to get the club underway and try to inform these kids about all the possibilities associated with the science and engineering fields. Nick and I were also able to determine what we could do at our first meeting and what the students could gain from the civil engineering project.

Summary and Conclusion

The third phase of our project was now possible after we met with Walt. The first two steps had been taken. First planning and networking had been completed. Secondly approval had been given and we were introduced to our club advisor, now we were able to try and execute club meetings. The last two hurdles were going to be publicity and recruitment of club members and engaging the group that appeared at the first meeting, so that they would join and continue to participate.

Meeting 1 (Lego Project)

Objective

One of our objectives at the first club gathering was to introduce ourselves to the students and explain what the club was about. We also wanted to find out what kind of turnout we would get with just normal publicity. We hoped to be able to start the club immediately. However, it was possible that another aspirations survey would have to be administered to find and invite the pool of students we wanted to reach. In addition, we wanted to introduce Walt, since not everyone at the school would know who he was at least in terms of his engineering background. He was a major asset to the club. Another objective was to gather information about the students that showed up at the first meeting to see who we were reaching out of the available student pool. Gender, grade level, interests in school, and their academic strengths and weaknesses were all of interest.

Assuming that we had at least ten, we'd launch the club. At the first meeting, if anyone showed up Nick and I would describe our majors, the field of civil engineering and how there were so many different things one could do with a civil engineering degree. If the three of us were launching the club, we would tell the group about all the possible things we wanted to do with the club and get an idea of what their preferred activities were, since with a late start our group would only get to do a few of them.

Nick and Matt wanted to be sure to mention the field trip to WPI that would let them enhance their knowledge about space and surviving in space as sort of a “coming” attraction. That would provide a pretext to put in a plug for WPI and describe what WPI had to offer to students and what it took in terms of preparation to get into WPI. All that could take no more than twenty minutes, the two of us wanted to present the hands on activity for the day as well. The task for this club meeting was to construct a building with LEGOS that had been assigned different monetary values to build the tallest possible tower that could also survive a wind shear test at the end of the meeting. The team using the least amount of money to construct a tower strong enough to survive the wind test would win- with tower height used to break any ties.

At the Meeting

Our first meeting started with Nick introducing the two of us as well as introducing Walt as the club’s advisor. He then told the group a little bit about himself. Nick told the group about his major, about the pressures involved with going to a technical college, and finally talking about those pressures being magnified due to his commitment to the football team. He also talked about what types of things WPI had to offer and what types of qualities they were looking for in students applying to the school. Finally, he talked about the specific requirements needed to get in, such as the necessary tests you must take and grades you should try to get to improve your chances of acceptance. Matt then introduced himself and

talked about some major activities and where he was from. When he was finished he introduced Walt and let him talk about himself. He told the students about his background as an engineer and some of the typical problems he faced in industry. He also told of the great sense of pride and self fulfillment you get when working in such a challenging environment.

Next he explained what influenced him to make the transition from engineering to teaching. Finally, he described the expectations he had for the group and turned the floor back over to Nick and myself. Nick took some time to explain what exactly the field of civil engineering was and what types of challenges one could expect to encounter upon entering the real world as a civil engineer. Matt then took some time to explain the area of project management that is associated with civil engineering. Matt explained how time consuming it can be and what types of issues project managers faced such as complications with scheduling, materials and equipment not being delivered on time, and subcontractors not performing to the standards of the contracting company. Finally Matt described how the project manager's main goal is to try and minimize costs while still creating a project that meets standards set forth by the industry as well as the owner of the project and the architect.

Next Nick introduced what the group would be doing for the day. The task at hand would be trying to construct the tallest and most stable tower they could from LEGOS while minimizing cost. This was done by assigning different values to different types of LEGOS. The students had to try to spend the least amount possible yet make the tower as tall as possible. Not only did it have to be tall, it

had to be able to pass a wind shear test at the end of the meeting. The two of us then broke the group into three teams and let them begin. At the end of the time Nick used a fan to determine whether the towers were all stable, and Matt figured out who had used the least money during construction. The meeting ended after we announced the winning team and told the students when the next meeting would be.

Results

Our first meeting went off very smoothly with what we considered to be a good turnout. We had 18 students for the first meeting, 6 females and 12 males. Seven of them were freshman, 9 were sophomores, and two were juniors. The students seemed to be very interested in what Nick and I had to talk about. They seemed to be very friendly and open to any ideas we had for club meetings. They gave us a few suggestions of what they would like to see, and what they would not be very interested in. The students worked very well together in attempting to deal with the problem that was presented to them. They asked Nick and I questions about what they could do to make themselves more appealing to colleges. What kind of extracurricular activities looked best to an engineering and science school was the main concern. They also seemed to be very interested in what type of salaries engineers typically made.

The students were particularly curious to hear about the different types of projects that Nick and I worked on at WPI. They asked questions about civil engineering projects such as large bridges and buildings, and how they were

able to stay standing. On a whole Walt, Nick and I thought the first meeting went very well and felt there was definitely a case to launching and maintaining a future technologists club at South High.

Conclusion

At this first meeting we learned that there was a large need to be met at South High in term of informing students about careers in science and engineering fields. We were able to get a sense of what types of fields the students wanted to get more information about as well as the ones that they were not so interested in. Walt was able to get a feel for what type of advertising to do for the club and where posters and handouts about meetings should go. He wanted to pass the word about the club and knew word of mouth and visibility were key.

Secondly, Nick and I had finally had a chance to get a feel for what type of students were at South. As mentioned earlier most of the students at South high were middle or working class Hispanic and African American, but the club was drawing the middle class end of the spectrum. We could now plan meetings so as to meet the needs of the students and draw on Walt's strengths. Not only could we now attempt to design activities that would fit these students, we could check with some of the other teams and find out which ones from the pool of ideas we had developed together had worked best with students at their respective schools.

Walt seemed very pleased with how Nick and I presented ourselves as well as how the potential topics were presented to the students. Nick and I were able to go see the Principal at South High and present her with the good news that the first meeting and activity had gone very well and that we would be back the next week to present a new topic and activity to the student club.

Finally, Nick and I were eager to present good news to our WPI advisors about the attendance level in general and female attendance in particular. After a slow start and many doubts about whether there was enough student interest at South to support a club we'd finally gotten something started. The aspirations survey data previously collected was right about the existence of an audience for this type of club. If 1/3rd female students, Future Scientist and Engineers club advised by an ex-engineer developed at South High (and was representative of the ethnic diversity of the school) it would be an important outcome for the High School and later WPI. We also now knew that there was enough interest in our major of Civil Engineering to play to our strength a bit as well. What was not so encouraging was that we were at a mostly working class and Hispanic school, but had drawn only a few middle class Hispanics and relatively few Hispanics at all.

Meeting 2 (Chocolate Asphalt)

Objective

The objective of our second meeting was introducing another field of civil engineering as well as starting to introduce the students to mechanical engineering. We wanted to introduce them to some of the materials that are used in civil engineering but Nick and I decided that just a slide show on metals and concrete would be quite boring. Instead we focused on hot mix asphalt. We made this decision based on the fact that we could perform a very interesting project, the chocolate asphalt lab, with the class.

Walt decided that first he wanted to take time at the beginning of the meeting to tell the group about mechanical engineering and some of the specific areas, such as bio mechanics and machine design. He planned to use his experience with Ingersoll Rand as a basis and expand on that. As a complement, Nick and I would tell the students about some of the projects that our friends had been working on at other clubs- such as an egg drop contest, a bridge design constructed of popsicle sticks contest, and a robot design event.

Next we would present some facts about concrete and metal and how they are used in combination in many of the projects of civil engineering. Once they were oriented we wanted to get the students involved with the “lab” activity. It was also important to give them an idea of what we had planned for the next meeting, the paper airplane contest. Finally, we wanted to give share some specifics on what types of presentations would be at the space conference at

WPI, as well as tell them about the Admissions presentation they would hear at the beginning of the school day long tour of WPI.

At the Meeting

The meeting began with Walt giving a short presentation about what types of work mechanical engineers do. He first described how mechanical engineers mostly work with mechanisms. When talking about mechanisms he meant anything that has moving parts. He spoke about the large air compressors and small air tools he designed and worked on while he was at IR. He explained the basics behind an engine and how it functions. Next he talked about the field of bio mechanics, which is when mechanical engineers work with mechanisms that go to the body, such as new joints, as well as outside the body in the form of prosthetics. He ended by opening the floor and the students had many questions about the topic and seemed to be fascinated with possiblities.

After the students had finished asking Walt about mechanical engineering Nick and Matt began our presentation on construction materials. We began by talking about steel and what types of projects steel is used in such as buildings and very tall buildings. We described how steel is an excellent material to be used in tension projects, such as bridges. By tension, we mean when a load is stretching the material. Matt then began to explain how concrete was another very important building material and how it is used all the time for foundations and shorter buildings. Matt tried to explain how concrete is very strong when used in compression situations, when something is pushing down on it, and how

it is not as useful when something is pulling at it. Next Nick tried to explain how the two are often used together in combination due to steel being good in tension and concrete great in compression. We noted that how they work well together because of the fact that the two tend to expand and contract at fairly similar rates.

Finally, we moved on to explain what hot mix asphalt was and how it is used in almost all road construction in the New England climate these days. We discussed the materials that go into pavement such as the asphalt, and the different types of aggregate and discussed how the different aggregates could affect characteristics of the mix such as durability and the smoothness of the road. We then explained what they would be doing in the lab.

We passed out three chocolate bars for them to melt down and use as the asphalt and gave them rice krispies, nuts and reese's pieces to use as the different types of aggregate, whether it be fine or coarse. Their objective was to decide which types of aggregate to use, and how it would affect the road characteristics.

When they finished we examined the three different samples and evaluated how each turned out. We described to them what the road would be like, either one that would last a long time and have a rougher ride, or be one that would have an extremely smooth ride but would wear out rather quickly. The last item of the day was an overview of the paper airplane contest we planned for the next week and what we wanted them to try to accomplish during this activity.

Results

This was another successful meeting of the science and technology club at South, but only half of the students from the first meeting returned for the second. On the other hand there were new faces. The students seemed to be very interested with what Walt discussed about the field of mechanical engineering and the types of projects this type of engineer does. They were very interested in the bio mechanical field (judging by the questions) and how it seemed to be very beneficial to society. They also seemed to really enjoy the "road building"project that they completed. The teams worked well together in trying to decide what they wanted to accomplish with their road durability or ride. It was not really a competition. They seemed to grasp how the proportion of different aggregates affected the outcome of the road surface. We also were able to nail down what types of presentations they would be most interested in hearing at the space conference, and hoped to get them scheduled for when they would be present.

The turnout was nine males and three females. Like the first meeting, there were mostly males. We split them into four groups with a female in each of three groups to try to help make each group as diverse as possible. This worked out very well, each team seemed to work easily with one another and they all had something to show for (and eat) at the end of the project.

Conclusion

Some of our final thoughts about this meeting were that the students seemed to be really enjoying themselves at the meeting as well as showing lots of interest in the technical fields that were being described for them. Some of the students from less affluent families had started to show an interest but then proved to be very worried about not being able to afford to go to an engineering school. Nick and I took the time at the end of the meeting to explain to a few of them how grades could affect what type of funding they got for college, whether it be in the form of grants, loans or scholarships. We also explained to them that colleges try to be “need blind” and are extremely helpful to students whose parents do not have a large income.

What was significant about this meeting was that we were drawing more broadly from the student population. There were quite a few minority students who came to the second meeting that were not at the first meeting, although it was more of a turnover than a larger meeting group. We felt good about this because the engineering and science fields tend to be underrepresented by people from the minority populations as well as women. We also felt that we were starting to meet our goal in terms of convincing these students that you don’t have to be a straight “A” student from a middle class family to be an engineer.

Matt felt that these students were starting to understand that they could really make a difference in the future as part of these technical fields. Further, they could participate if they put the effort to get at least a “B” average. If they

needed scholarship support they would have to do better than that, but an aid package that was mostly loans would be available to any solid student. They were starting to become very interested in doing some of the smaller things that get noticed by colleges such as being active in extra-curricular activities such as sports and leadership clubs.

On a whole, our club was rapidly progressing in showing the vast range of opportunities that were available in these fields, and how to take advantage of them. It did not hurt our case for the club that participating in a Future Engineers Club was the kind of activity that enhances a college application. Certainly a recommendation letter from Walt would open doors for them as well. No one else seemed to have talked to 9th and 10th graders about what they should be doing to have a scholarship worthy record in 1-2 years, when they would need to apply to college as juniors (or early in senior year at the latest).

Space Conference

Objective

The space conference was a WPI chapter of Student Pugwash sponsored event. The original idea was to hold the event at WPI for WPI students. It catered to those WPI students planning to do projects building on those completed this year in their IQP projects next year. However, the club had budgeted for a regional conference with an outside speaker and people coming from other chapters in New England, which did not happen. Another chapter hosted the regional meeting. So, they decided to expand the local audience for their last event by bringing the students from the five high schools participating in the Future Scientist and Engineering clubs to the WPI campus. The high school students would increase the audience for the several Space IQP presentations by WPI students, and an outside speaker.

One of these presentations focused on future technology that NIAC (NASA Institute for Advanced Concepts) has been working on to advance United States endeavors into space. Others were on things NASA should be working on (if it is not), like the growing of potatoes on the moon in order to support a colony of humans living on the moon. So far NASA is only talking about a semi-permanent base at the South Pole for scientific exploration and to practice for a mission to Mars but its general aim is colonization of Mars. Even the first Mars mission would involve a year on the ground there until the orbits of the two planets get close enough for a return trip.

Other presentations explored the idea of a space elevator; a way to refuel in Low Earth orbit with locally gathered propellant and fusion reactions. Indeed, the luncheon speaker was not a WPI student, but an entrepreneur from Florida who presented his company's idea of establishing a base on Mars for humans to live in permanently. His company, the 4 Frontiers Corporation, was trying to fund one way trips for Mars homesteaders, and they were already hiring design engineers and planning to build a mock Mars base in Florida that potential pioneers might visit.

Prior to these presentations, the high school students toured the WPI campus and watched a video introducing programs offered by the school. There would also be a question and answer session afterwards dealing with questions about WPI and getting admitted into college in general, run by a member of the WPI admissions department.

The idea of having a space conference and presenting it to high school students was to show them that people their age are the ones that will be going to space and following through on these ideas. NASA will start building a moon base in 2020.

At WPI

The conference was held on a Wednesday. The students were bused in from each school at around 8:30 AM and arrived to campus around 9 AM. They first met in the wedge in Morgan Hall where they were introduced to what they would be doing for the day and then headed for Olin Hall for an admissions video

presentation. The video described the WPI campus, how admissions selected students to be accepted into the school, possible fields of study, and extra-curricular activities. Afterwards the students had many questions dealing with both WPI and college in general. It seemed like the majority of students didn't plan to apply to WPI specifically, but were more interested in the college search process and what they would have to do to get into any college, but some had to do with technical majors.

The students ranged from freshmen to seniors from each school. South High was unable to attend the event because there was a field trip the day before that focused on math and took Walt Talbot off campus. This had been planned far in advance of our conference and took priority. This event made it difficult to excuse many of the same students two days in a row and since Walt couldn't go, that created other problems as well.

Our South High advisor, Walt Talbot, was very excited at the possibility when the idea of the field trip was brought up in the initial meeting, but unfortunately the date just did not work out. We would have had to go at another time, but would not be able to pay for the bus. Pugwash had the funds for that, our project based budget request was not funded, and they used their money to transport people on that one day, so we considered it a lost cause. Later WPI would approve just bus money from our budget, but it was too late then.

Following the admissions presentation, the 65 students who got to go to WPI moved to Salisbury Labs to watch the IQP presentations. Three groups presented their projects to the High School students and other interested WPI

students. This lasted until about noon, when the students were then served lunch.

The presenter for the 4 Frontiers Company was supposed to present during lunch, but things were running a bit late. This made it difficult for the students to eat, see his presentation and leave by 1PM which was the scheduled bus departure time made mandatory by the school district. The students ate while the presentation was going on, going up to the buffet table in groups. This made it difficult to focus on what was being presented. Because of the time constraint, the High School students were forced to leave prior to the completion of the Mars presentation. They boarded the busses just after 1 PM and headed back to their respective schools. Logistics marred the event, but it clearly had potential and we wished our students had been able to go. We think 15-20 would have participated if it had been possible.

Results

There was a very positive feedback from the students about the first half of the day. It helped address many questions the students had about college and they were able to see what a real college campus looks like, hopefully inspiring them to apply to a technical college. Few wanted to go to college this close to home, so WPI was probably not going to get many applications, except as a backup plan. It is too bad that our students weren't there, since the working class students we talked to were not so concerned about leaving home. They

were just hoping to go to a good college, and doing so locally had some advantage for them.

When asked about the Space presentations, they were not as thrilled. They were very uninterested because it got off to a slow start and it was monotonous to hear one talk after another. They needed to do something and it was difficult to pay attention for more than an hour. The presentations were very detailed and in depth, but the high school students were not the right audience for them. The presentations were really designed to orient the next wave of WPI students who would continue these projects. It was sometimes difficult to follow the presenters because the speakers had no microphones and the language was very advanced. Some were talking about topics many high school students had no idea about, like nuclear fusion and solar sails, before they came into that room.

The lunch was not sufficiently organized for the audience size. There was plenty of leftover food but many students had very little to eat because it was rushed and very disorganized with people trying to get food, eat and watch the 4 Frontiers presentation all at the same time as the departure time approached. The original plan, which was to have boxed lunches prepared rather than a buffet table, would have been wiser. A different room with food table set up in the back, rather than by the front door, would have helped as well.

Conclusion

Organization was the main problem in the Space Conference was its physical setup; however the audience mix was also a problem, since these were not high school seniors, but mostly 9th and 10th grade students. If the conference is to happen in the future, it needs to be planned out much more carefully with the invited audience in mind. There was a lack of communication between our group, the advisors and the Pugwash chapter organizers. Our group had planned on being responsible for the students getting to and from the campus, organizing the tours around campus and feeding the students. We also decided in one of our weekly meetings which three student presentations would go on for the students based on our own interest and what we thought they would find most interesting. A list was made on the board and we thought it was set, but apparently we needed to deliver that message to the Pugwash organizing committee – personally and insist.

By contrast, they were worrying about scheduling the presenters so that the WPI students would not miss classes that day. We also did not hear the dry runs, coach the presenters and veto the groups that were still rough (or dry) from presenting in the time slots when the high school students were to be present. We also did not organize the food situation as well as it could have been. If this is ever done again, pizza or box lunches should be served because of its ease of distribution and relatively cheap price.

Still, the admissions tour and presentation went very well. It sparked even more interest in WPI and college for many students. It was very interactive, which is always a positive with high school students.

Events like the Space Conference have the potential to be very successful for this age group, however organization and planning is the key to success. It is also essential to follow the itinerary and stay on schedule, which was difficult to do with the number of events squeezed into a short time period. The first presentation was on fusion reactors and that was the worst. The WPI presenters were hard to understand, that led to a lot of questions and clarification from the floor and suddenly the whole event is ten minutes behind. However the high school students would have been totally confused and off to a really bad start without the clarification.

The second talk on growing potatoes on the moon was easy to follow and stayed on schedule, so that was better. We recommend that there is some leeway scheduled into the day because of possible unexpected problems that occurred (i.e. many questions for admissions, presentations lasting longer than fifteen minutes, problems with lunch). Making sure the presentations are interesting, able to be understood by the students and somewhat interactive would make it a much more successful day.

The 2007 WPI Space Conference had its problems, but a lot can be learned from them about how to do future conferences for a high school audience. From our standpoint, with no budget of our own, it was this opportunity to get the high school students to campus, or not at all. We took it

and are not sorry, but could have designed a better tour day of our own (along the lines of what Duncan and Dorchik wanted to do the year before) if we had not been hostage to the agendas of the WPI admission department (which wanted to do its standard junior talk for a 9th and 10th grade audience) and Pugwash, since they had all the resources we needed. If done well, a field trip could be a very fun, beneficial and enlightening experience for the interested "future scientist and engineers" in the clubs.

The tour idea clearly has potential. What we were lacking in the case of the Space Conference was the link between these projects and future technical careers as part of a new space race with the Chinese or in terms of the moon base initiative. We were told that one of the presentations scheduled after the high school students left dealt with this topic. That is really poor scheduling from a high school audience standpoint. That talk should have led off in place of the fusion talk that the WPI team was not really ready to give yet. They needed a dry run, didn't get it, and it showed. We should have been in a position to override the Pugwash organizers who made them the leadoff presenters for a high school audience, because none of the five presenters had a class at that hour.

Meeting 3- The Paper Airplane Contest

Objective

The goal of the airplane contest was to introduce aerospace and mechanical engineering to the students. The two previous meetings had both concentrated on civil engineering, so we thought it would be important to show them at least one other type of technical activity before the end of the year. Unfortunately we were only able to have three meetings, though we didn't know this was the last one until after it was completed. The meeting was advertised around the high school using flyers Walt Talbot put together.

The students were given a limited amount of material, similar to the Lego project, and were asked to come up with a design they thought would be the most efficient in the sense of going the farthest. This is a common exercise to develop creative thinking in engineering. Forming the participating students into groups also emphasized teamwork, a skill needed to be a successful engineer. After the teams developed their ideas they were given a limited amount of time to construct their final design and it would be tested sort of competitively, like the towers had been.

At the meeting

The turnout was similar to the two prior meetings. A total of twelve students participated in the contest. There were eight males and four females

ranging from ninth grade to eleventh grade. Nine had attended one of the two prior meetings and three were new to the club, attending their first event.

At the beginning of the meeting we introduced ourselves to the new students and explained what was going to happen in the meeting. We then gave everyone a short background on Aerospace and Mechanical Engineering. Since we are both majoring in civil engineering, there were some questions we were not able to answer in any depth. Mr. Talbot helped answer a few questions and explain a few concepts based on his background in Mechanical Engineering. The students had many questions and a few seemed very interested in aeronautics as a possible career path.

Following the introduction, the students were divided into four groups of three students. Three sheets of standard 8 ½ by 11 printing paper, five paperclips and a roll of clear scotch tape were handed out to each group. They were then told that they had twenty five minutes to devise the design they believed would be the most successful in gliding a long distance. They could use the time to draw the design out, construct some models with the three pieces of paper or do testing on the design to figure how hard and at what angle to throw it. They were also told how the scoring system worked. Each team would get three tosses in the hallway behind a taped line and distance would be measured with a measuring tape to where the plane first touched the floor. The shortest throw would not be counted and the other two throws would be averaged. This was to emphasize that the models needed to be somewhat consistent in performance or the design was not being evaluated as much as the launcher.

We then allowed the students to work while we walked around and assisted them with any questions or problems they were having. They seemed very excited to get started and test their ideas. After about five minutes most of the teams were in the hallway testing their designs. Finally after working up their three prototypes, the twenty five minutes was up.

We then passed out one final sheet of paper which was to be used as the final model. They were given another five minutes to construct their final design unless they really liked one of the prototypes, which they were allowed to use for the final competition. If they used paperclips in the prototypes they had to transfer them to the new model. Only a few groups chose to use the paperclips because they believed these would weigh the plane down. We did not question their logic on this matter before the contest.

Finally it was contest time. Each group stepped up to the line and threw their final designed airplane while we judged where it hit the floor and measured it out with a tape measure. Some takeoffs were smoother than others. Many went either straight up or straight down, giving them a very short run in terms of distance. The longest flight ended up being twenty six feet, four inches. This team won the competition with a second best throw of twenty four feet, eight inches. This was an average of twenty five feet, six inches. The winning team received first choices from a bag of candy - and of course, bragging rights.

Conclusion

This contest meeting went very well but there were a few small improvements which would have made the day a little better, and we recommend them to future club organizers. One suggestion we have is to mention this meeting the week before it is held, so that the students can prepare and practice. If they research some designs online, or however they would like to, they will learn more and the average plane performance will be better. A few students were asking to use the computer in order to look up some designs they had either made themselves or knew were unusually effective from experience. We should have encouraged that.

Another suggestion is to do a quite a bit of research on aerospace and mechanical engineering if the future club organizers aren't majors in those fields. We had many questions about these majors which we weren't ready for, so it will be important to be prepared in the future by having a mechanical engineering major present on this day, unless a professor from that field (or an alumnus with a career story to tell) can be recruited.

As an activity, this was a very successful and smoothly run meeting. The two prior meetings went well also, but we believe experience from running those two made the final meeting the best. There were fewer unexpected problems because it was very straight forward and the students had a great time. Had we known it was going to be our last meeting we would have brought some treats and made it into a party as well.

Being surprised by the abrupt end of the club also left us with no opportunity to gather suggestions and get systematic feedback. Thus, we have only our impressions to report. Despite a late start, missing the field trip and having no party at the end, we still think we made a good impression, demonstrated the potential in the idea and drew a group that was 1/3 female. That is not far off of the proportion 3:1 males to female that the two aspirations surveys indicated were typical of all the schools and specifically South High School. However, our group was much smaller than the actual pool of nearly 1 in 5 South High students expressing at least tentative interest in a science or engineering career. We demonstrated the potential and over all three meetings saw about 24 students at least once, though the typical meeting size was about half of that. We were still reaching “new” recruits when the program was abruptly ended due to the vacation schedules of WPI and public schools being out of sync. Then the end of the WPI school year arrived in early May, more than a month before the end of the public school year.

Discussion

After planning for a seven week term in November and December, we still had trouble getting the club started in late January early February, due to delays in locating a club advisor in the high school assigned to us. During this downtime we tried first to find presenters from either the WPI faculty or among the graduate students to run the club events. Many efforts were made to contact professors in every major at the school, but some were only available for one or two meetings, while many others did not respond at all after repeated contacts. Next, the ten person club organizers group as a whole decided to create its own presentations based on each member's major area of study. We brainstormed and created ten to twelve possible presentations which would either be rotated to each high school or presented by each school's specified group. The problem with this approach is the fact that the presenters were always us, WPI students. Further, the only ones who could make the school schedule work for them were the ones assigned to each school.

We never figured out how to go run the civil engineering events at other high schools and have mechanical engineers run our air event. Maybe an all civil engineering team was bad idea. Perhaps school assignments should be made with an eye toward having two majors covered. Most questions could have been answered by students within the major being presented. We were all mechanical and civil engineering majors, and two of the civils went to South High and did not travel around. On the other hand we designed two activities that most of the clubs used successfully. Much of the time activities were presented by out of

major students who did not necessarily know much about the area of engineering or science illustrated by the event. Thus, they could not make the most of it. A professor would have been the ideal guest presenter to answer questions in more detail, but we believe that our knowledge as students was sufficient for the 9th and 10th grade audience we typically had. A club dominated by (or catering to) upperclassmen in the process of applying to colleges would require a more knowledgeable pool of presenters.

After meeting with Mr. Talbot, we sensed a positive outlook towards the future potential in the club program. He was very excited to use and expand the ideas we had brought to him dealing with different aspects of engineering. Following the first meeting, we talked to students to get their reactions and most were very positive. They were very entertained and interested in the activities as well as asking many questions and focusing on the task at hand. In most cases we managed to connect the activity to the field and the career opportunities in it, but we were lucky. Our high school advisor had been a practicing Mechanical Engineer and could help us out with that. We still needed an Aerospace major there for the final meeting to make best use of that activity, and did not have one.

Conclusion

The goal of this project was to introduce and spark interest in science and engineering as a possible field of employment in the future. The school we were chosen to work at, Worcester's South High School, is an inner city school with a heavily Hispanic student population that is mostly lower-middle class or working class. Some are really poor. We were told that too many students do not even have homes to go when the school day is over. South High has some of the worst score averages in the city on standardized tests. Worcester does not do that well statewide, but does do better than Lowell, Lawrence, Boston and Springfield, the other large cities. Still, only a small percentage of students who graduate from South High actually get into and can afford college. Only half bother to take the SAT. This made our experience very different from some other high schools.

Based on these facts, Mr. Talbot recommended we simplify many of the presentations we had proposed to him. Anything he felt would be boring or not interactive, we immediately eliminated as an activity. We believe this made our club more successful. At each of the three meetings we had, there were between ten and fifteen students who all participated and stayed the entire time an extra forty-five minutes to an hour after school ended. That we did not get this core group to WPI for the tour is frustrating.

Many of the older students had questions about college in general, questions that guidance counselors were not always able to answer. They were interested in what everyday life was like, how difficult classes were compared to

high school, how anyone could balance the class load with sports, which colleges had which majors. They also wondered about what they had to do to actually get into college, what kind of SAT scores and GPA they would need. What they could do at this point in their high school careers to increase the chances of getting in was a topic that came up naturally. This was very interesting given the goal of the club.

Many of these questions came at the end of each meeting, which we believe proves that we may have gotten them interested in the topics and they started thinking about what they could do as a possible future career. All of the students had been in math class with Mr. Talbot, so we believe that the personal touch is important in recruiting. Having a popular science or math teacher as a high school club advisor is one key to success, however, the target audience was larger and at this point we don't know how to reach it. On the other hand, a single teacher's network of student contact through classes can support a small club of a dozen and reach twice that number if it lasts for even a month of weekly meetings.

Another goal of this project was to try to encourage female students to pursue a career in math, science or engineering. Many believe that these fields are dominated by "dorky" men, when actually it is becoming very diverse. Our presence was one way we tried to change the "nerd" perception of engineers. We explained how the female population is increasing every year here at WPI and women can be just as successful as men in the field. Although there were more males than females at each meeting, the number of females increased

every week so by the last meeting, it was 1:2 females to males' ratio. We believe the reputation of having a fun activity and learning about college spread through the school and helped increase the attendance of females. Our Club succeeded in being known as a "female friendly" club, and we are proud of it.

We also believe the project was a success. Although we cannot really tell how many and which of the students are considering pursuing a technical career, we are pretty sure that we sparked some interest and at least some of them are now considering such a career more seriously. The students and school administrators requested that the afterschool program be continued the following year, and we received direct positive feedback from both the students and our advisor, Walt Talbot. With some minor changes, the club could be quite a successful club activity. In principle, we believe a fully developed club at South High could attract more than thirty students a week, half of them female and at least half minority. If so, it could change some lives and give hope and encouragement to students who would like to go to college. In the end we helped them dream a little, and sometimes dreams come true.

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APPENDIX A

South High Engineering Club

Find out why Engineers:

- Help to solve the world's most challenging problems
- Use technology and common sense to make things work
- Learn to lead, plan and supervise others
- Are the highest paid Bachelor's degree graduates
- Really enjoy their profession

First Meeting will be Thursday March 15 at 2 PM in Room 241
Activity: "The Great Lego Construction Race "

Please see Mr. Talbot in Room 241 to sign up and to learn more

APPENDIX B

The Lego Tower

South High Science and Engineering Club
3/15/07

Background:
Civil engineering is a broad field of engineering dealing with the planning, construction, and maintenance of fixed structures, or public works, as they are related to earth, water, or civilization and their processes. Most civil engineering today deals with power plants, bridges, roads, railways, structures, water supply, irrigation, the natural environment, sewer, flood control, transportation and traffic.

Goal:
to plan and construct a tower made of the given legos to be as tall as possible while considering the expenses of material and strength of the tower.

Materials:
252 Lego pieces at different values
The value can be found by the number of circles on the top of each lego piece. Each circle represents $1.

White Red Blue Yellow Green Mixed

Value	#	Value	#	Value	#	Value	#	Value	#	Value	#
4	4	2	20	2	20	6	2	8	2	2	10
4	14	4	2	4	4	6	2	6	2	4	6
6	2	4	14	4	14	4	2	8	2	6	2
6	4	6	2	6	2	8	2	4	6	4	2
4	2	6	4	6	4	8	4	3	2	8	2
8	2	4	2	4	2	6	2	4	2	2	10
8	4	8	2	8	2					3	2
12	2	8	4	8	4					4	2
6	4	12	2	12	2					6	2
12	2	6	4	6	2					2	6
		12	2							4	4
										2	8
										2	6
										4	4
										4	2
$236	40	$268	58	$240	56	$92	14	$82	16	$206	68

Total Possible Pieces: 252
Total Possible Money Spent: $1124

Wind Test:

A fan will be placed 1 ft from the tower and will be turned on at 3 different speeds. If the tower stands for 5 seconds after the fan starts it will receive credit for that wind speed. Each speed is worth 100 points.

Points System:

Height	Every inch tall multiplied by 35
Wind Speed	Setting 0-3 multiplied by 100
Money	subtract 1 point for every dollar spent

Example:

Tower is 25 inches tall, resists speed 2 winds and spends $820.

The total score is (25”x35) + (2x100) - ($820) = 255

The team with the overall highest score wins!

APPENDIX C

Chocolate Pavement Presentation

Materials needed:

- Selected chocolate candies
- Cooking utensils (bowls, spoons, aluminum foil)
- Heating device (microwave, stove top)
- Power point presentation equipment

Presentation Agenda:

- Short introduction into the materials that make-up the HMA pavement that is used in everyday construction.
- Discuss the properties that are needed for an acceptable batch of pavement.
- Also discuss the relationship between the materials we brought (chocolate) and the actual materials used in pavement (aggregates, asphalt cement).
- During short curing process we will also show slides of different places where pavement can be and has been used.
- Discussing the different types of locations and the different properties and additives that are required for these locations.
- Once the chocolate pavement is dry we will enjoy its delicious taste.

APPENDIX D

The Paper Airplane Contest

South High Future Scientist and Engineering Club

Goal: To design and construct the paper airplane that flies the longest distance.

Background:

Aerospace engineering is the branch of engineering that concerns aircraft, spacecraft, and related topics. Aerospace Engineering was originally known as aeronautical engineering and dealt solely with aircraft. The broader term "aerospace engineering" has replaced the former in most usage, as flight technology advanced to include craft operating outside Earth's atmosphere. Aerospace engineers on average make the following starting salaries with the given degree:

Bachelors - $50,993
Master's - $62,930
Ph. D. - $72,530

Materials:

-4 Sheets of normal 8.5 by 11 printing paper
-5 Paperclips
-Unlimited clear Scotch tape

Procedure:

- Students will break up into teams of 2-3
- Each team will get 25 minutes to design the paper airplane they believe with fly the farthest. 3 sheets of paper can be used during the design process. Practice tests can be done to figure out just how hard and at what angle the plane must be thrown.
- Each team will then get 5 minutes to construct their final design
- The final testing will be done by giving each team 3 throws. The shortest distance will be dropped, while the other two longer distances will be averaged. This means you want to have a plane that not only flies far, but is consistent with its distance. The team with the longest average of the two best throws wins!