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North High School:
Science and Technology Club

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Abstract

This project is a continuation of a pilot project started last year to create a Future Scientist and Engineers Club at North High School. Our goal was to encourage students to take an interest in science and technology and consider this as a career option. It fell to us to start the actual club as the prior team focused on planning and getting the necessary permissions as well as recruiting an advisor on the HS faculty.

The Club idea was inspired by the results of a an aspirations survey of Worcester high school juniors- especially when they are compared to data collected from 8th graders in the same city. Both gender imbalance and the decline of the number of students interested in technical subjects and careers by 11th grade were of concern. It is of particular concern to the sponsor (Advisory Committee on the Status of Women) to support female Students with technical interests since women are underrepresented in the technical fields. The North High Club project took place in a high school with a special program devoted to heath careers. A similar program devoted to engineering careers was in another high school in another part of the city.

The project was declared a success by the student participants, who responded to a survey, and the high school faculty advisors. We also consider it a success, but more for the potential it revealed and the promising start made than what was actually achieved this year. The need for technically oriented sophomores to get some kind of help as they plan their junior years schedules and consider the possibility of college,

especially a technical college, is pressing. The impact that a simple one day field trip to WPI had, just to look around and ask questions, was astounding.

A Club like this could become a major in school resource for students who want to try on the idea of a technical career for size, without making any serious commitment. It also countered prevailing stereotypes about engineers fairly well and disproportionately attracted attention from females. Role models our age seem to have considerable credibility with this age group and our encouragement and willingness to answer questions, some of which were very basic, seemed to matter a great deal.

Acknowledgements

We would like to thank WPI faculty member John Wilkes and staff person Elizabeth Tomaszewski for creating and continuing this interdisciplinary project. Without their help, guidance, and relentless efforts it would not have been the great success we feel it was. We would also like to thank the North Faculty, especially Greg Morse and Sandy Holmes for their support and dedication to the furthering of this club. They believed in the idea from the beginning to the end and helped to make the plan a reality. Alan and I also appreciate the efforts of our fellow teammates, and for the inspiration they gave us to develop fun and inspiring activities. We would also like to thank Tiana Carrasquillo for not only agreeing to come to the schools and speak with the students, but also to assist in the planning of the field trip. Lastly, we would like to thank the WPI community for opening itself up for the field trip and providing the best academic event in their high school experience.

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Foreword

Since the “Science and Technology” club was well received at North High School this academic year, we both recommended to our advisor that WPI maintain this club in the future academic years at all the high schools in the Worcester Public School system. There was always a need for a project of this magnitude to help teenagers identify their career goal and interest. One of our team’s members, Alan Ngo, is an alumnus of North High. Four years ago, he recognized the need of this club, had it existed by the time he was a high school’s senior.

“By the time I was a senior at North High, I started to look forward to my career goal. I knew exactly that I should attend college in order to help myself become a productive and effective citizen. However, the difficulty that I had faced was that I could not figure out which career field I wanted to be in. Well, I received a lot of help from my high school’s guidance counselors. They recommended me to pursue a technical and engineering career since I was good at mathematics. But when I asked them which type of engineering I should focus on, they could not answer my question because none of them pursued a technical career. Then I asked almost every teacher that I met to learn more about different engineering majors, but my efforts were unsuccessful. As a result, I went to college (WPI) without identify a major, and I had changed my major three times during the first year at WPI. Therefore, I believed the “Science and Technology” club would be the best way to communicate with the high school’s students about technical careers and also coach them on

identifies their career goals. This was the main reason why I selected this project as my Interactive Qualifying Project. I hoped that I could use my knowledge of technical career to assist the high school's students identify their career interest. I do not want to see them stuck in the same situation that I had experienced four years ago."

-North High alumnus: Alan Ngo

In the recent year, there were a significant number of high school students who went to college with an undecided major. Even if they had selected a major; most of them changed their major at least one time during their four years of college. Therefore, it would be very helpful to high school students in the Worcester community if the "Science and Technology" club continues to exist within the Worcester Public School system. This club would provide students the opportunity to expand their knowledge about technical careers and different majors in engineering. It also helped students figure out how to pursue the right career and select a major that suits them when they enter college. In addition, the students could learn about the college culture and college students' life even before they apply for college. Importantly, the "Science and Technology" club was designed to inform and encourage students with technical interests to pursue engineering or technical careers, and help the students who wanted to explore this possibility to identify and pursue their dream.

Another important issue we wanted to discuss was that only seven percent of high school students in the United States expressed interest in pursuing an engineering degree in the last academic year. Meanwhile the number of students who pursued engineering and technical majors is more than double that and has continued to grow in many

developing Asian countries such as: China, India, Thailand, and Vietnam. Therefore, we must ask the question: “Why is there less interest in engineering on the part of the students in the United States?” According to Alan Ngo, who had both Asian and American education background, he believed the education program in the United States is one of the main reasons for the lower interest level in engineering of American students.

“The education program in the United States and Vietnam, the country where I grew up, was two different worlds. At the time I studied in Vietnam, all students required to take physics, chemistry, algebra, and geometry since sixth grade until twelfth grade. When the students completed their senior year in high school, they required to pass the senior’s exam in order to graduate. This exam had included six different subjects such as: calculus, physics, chemistry, biology, language art, and foreign language (English or French). Therefore, most teenagers had well prepared for pursuing engineering and technical careers because they had strong knowledge and education background in science and mathematics when they graduated from high school.

When I arrived at the United States, I went to high school at North High in Worcester, MA. At North High, I only required to complete any three science courses in the four years of high school. I figured out that most high schools in the United States offered only one course of physics, and students could not take this course until their junior year. I also experienced that very few numbers of students took physics and pre-

calculus courses because these courses were not the requirement. On the other hand, most of the engineering and technical majors required students to have good knowledge in both calculus and physics. Therefore, most high school's graduate decided to pursue their careers in different areas rather than engineering and technology because they had very little knowledge on engineering.

Well, I agreed the United States is one of the countries that provide the best education in the world. However, I think the United States education department should bring in more physics and higher level of mathematics courses into the middle school and high school. Additionally, the high schools must require the students to pass at least two physics courses and pre-calculus course in order to graduate. I believe this would help increasing number of students who will pursue engineering and technical careers in the United States.”

-North High alumni: Alan Ngo

Overall, we believed the combination of “Science and Technology” club and the improvement in education program (required students to take physics and pre-calculus) would help the students gain knowledge about science and technology. This would be a good way to encourage the students to pursue engineering and technical careers. Hopefully, the number of students who are interested in engineering would increase significantly in the Worcester area (and the United States) in future academic years.

1. Introduction

1.1 Project Sponsor

The project's sponsor for this year as well as last was the Advisory Committee for the Status of Woman (ACSW). They are involved in the project due to issues with gender inequality within engineering. This is one problem that is being addressed through the implementation of the science and technology club, which can help to stimulate the interest of women in engineering by providing information regarding careers that cater to their interests. A study performed by Nora Rizkalla and Zachary Gautreau, presents the results of a survey given to 8th graders that is similar to one given to the 11th graders by Marsland et al. The goal of this is to compare the information received and attempt to draw conclusions based on the data.

Of concern were the two subjects most important in preparing for a career in engineering and technology, science and math. The data taken from 8th graders suggests that while a gender bias does exist with regard to mathematics, science is reported by 20% of both males and females to be their favorite subject. The 11th grade data suggests that the number of students who indicate science as a potential career choice is a mere 5%, however, 20% of the males express interest in engineering compared to 5% of females. It is interesting to note that approximately three times as many females as males express interest in a medical profession by the 11th grade. Nora hypothesizes that the interest in science for the 8th graders translates into biology for the females and physical sciences for the males for reasons related to

gender stereotyping. However, at that grade level Worcester is offering an integrated science course that involves exposure to physical sciences other than just biology.

Judging from the results it would appear as if the critical time in which their interest in science related subjects is reflected by the data is between the 8th grade and 11th grade. Early high school, 9th and 10th grade, must be when the major decline occurs. Not only does this overall decline in interest in science occur, but also it affects the females more than the males. No definite reason has been determined for the decline of interest in science among the females being greater than among the males, but it is thought that this decline in science as the primary subject is due to the introduction of chemistry and physics in high school. Science throughout middle school is a combination of disciplines that emphasizes biology, chemistry and Earth science. In high school, specifically 11th grade, the majority of students are enrolled in either chemistry or a physics class that is vastly different from the descriptive biology the 8th graders experienced. Science has taken on a different meaning, partially resulting in the decline found in the data.

The small school system in place in the Worcester Public Schools is at odds with policies that place 8th grade students into the respective high schools based on their residence within the district rather than their interests. In the system there is currently only one small school that caters to those interested in engineering. This small school, the Engineering Technology Academy (ETA) is located at Doherty High School. In principle, those interested in engineering are encouraged to enroll in this academy, which will govern their high school class schedule, but in practice few (20%) are aware of the small schools and even fewer are prepared to leave their

districts. If the technically interested student had clustered around ETA, one would think that there would be little interest in a science and technology club in the other schools. However, knowing what is really happening one would expect about 75% of the students interested in technical fields to be in the other high schools. Marsland et al's aspiration survey results show that this is what one finds, and that more than a few students at each high school are interested in such a program. The students with technical interest have not concentrated at ETA, so someone has to reach out to them and provide information and support. In a way we are the ETA outreach program. It was at the WPI field trip that the Doherty Students in ETA met the students interested in engineering from the other high schools.

In the case of North High, not all of the Club members aspire to be engineers. They are browsing and some are equally interested in medicine. Keeping one's options open at that age is something we tried to encourage. We were told that with some modifications, such as a different meeting time that has fewer time conflicts with other activities, attendance at our club meetings should increase substantially. The club advisors stated that they believed a good number of students who they felt would ordinarily attend were involved with other after school activities. If so, just a portion of the pool of students interested in technology at this high school was enough to support a club. One aspect of this project that was controversial was how an all male and non-stereotypical group of engineers would be received by the females?

Since one of the goals was to attract females who were interested in exploring the possibilities in technical fields ,it was thought that a team of Club leaders including one male and one female would be more successful than an all male team. It was for

this reason that the success of our group came as a surprise to all those involved. The team at North succeeded in attracting anywhere from eighteen percent on the lower end to seventy two percent females at the high end to the Club meetings. While it is important to involve WPI females and future clubs would benefit from female role models, the results achieved this year without them are encouraging. This good start should not be undermined by taking a year off next year if no female club leaders are available. The project is still in the building phases and the positive image of a technical career portrayed this year was an important one. It should be built on immediately. The goal of fostering gender equality is not dependent on having females from WPI set up clubs- judging by the success of this year, but it would be beneficial overall to seek gender balanced teams in the future. . Typically, engineers have gotten the image of being nerdy and unable to effectively communicate with others. This is an image that is untrue, one that we wished to dispel and think we dealt with that issue quite successfully.

1.2 Overview of North High Project last year

“Members of the guidance department at North High School were concerned about the small number of students entering technical colleges. Many more seemed interested in such careers than successfully applied. It was proposed that WPI students, who have successfully been through the college application process, coach sophomores on how to position and present themselves. In the course of bureaucratic review and modifications, the proposed interaction program evolved into an extracurricular “Future Scientists and Engineers” club. A survey was carried out to identify sophomores who should be invited to join. However, delays made it impossible for us to execute the plan and three other WPI students were recruited to do that later.”

The above is the abstract taken from the report written last year by North High team members Jason Hwang and Tri Lai. “Entitled Coaching Students and Analyzing Urban Education”, the project’s goal was originally to take a survey of the students at North High and apply the data to a coaching program similar to one that was piloted at Doherty High School the same year, but a term later. Due to setbacks and time constraints, they were not able to apply their knowledge learned through the survey into the coaching portion of the club project. Their results and conclusions from the survey data will be discussed below.

Drawing from data collected in 2005 when a team of WPI students administered a survey to the juniors enrolled in the Worcester Public School Systems (WPS), the data collected was given to the high school guidance counselors as well as used during the initial development of the project. It was found that the large majority of students were interested in attending college, either a four-year college or a two-year college. There were, however, a few concerns expressed by those students who did respond to the survey. Among these concerns were financial, grades, test scores, and potential success. The larger focus beyond this survey data was to address the issue of gender and ethnic

inequality within engineering. These results were presented to the Advisory Committee on the Status of Women (ACSW), which sponsored the project.

With the survey having been administered, the project goals were developed.

Initially they were as follows:

1. Begin a general study that will be concluded by a later team that will determine if early interaction changes the percentage of college enrollment.
2. Meet with a sample of seniors whom participated in the previous project to establish a baseline for interaction purposes
3. Survey sophomore class at North High (Class of 2008)
4. Increase the survey response rate to at least 80%
5. Interact with high school sophomores interested in careers in engineering/physical sciences and possible WPI candidates at North High School
6. Minimize interference with teaching time

The timeline states that a survey will be distributed to the sophomores to determine interest in the club. From this, students will be identified and will receive an informational handout as well as a permission slip. The club would be created from this group of identified students and interaction would begin shortly thereafter.

While attempting to identify those interested in participating, the issue arose as to whether to administer the survey during class time or send it home as a “homework” assignment. Since administration wanted to minimize the amount of class time interference, it was given as a take home activity to be returned. The initial response goal was 50%, and judging from the previous year where the response rate was 71 percent, it was determined that a minimum of 50% would be adequate to make generalizations about the career aspirations of the students at North High. As a result of the decision regarding a take home survey, the response rate was much lower than anticipated, 46% among the sophomores and a mere 26% among the juniors. Since the pool of students to be identified to join the club was supposed to be taken from the survey, other means by

which to identify the students needed to be found. At this point in time it was too late to have much of an impact on the students, as the sophomores had already chosen their classes for their upcoming year. This combined with hesitance by administration to let WPI students into the school resulted in the elimination of the coaching portion of this project and only the planning phase was completed.

The final project goal was modified to center on reporting the results of the survey and determining whether or not North High fit the typical model of a large urban high school. Reflecting back on their experience trying to do (at no pay) something that administrators at the school had asked for, they wondered if this kind of resistance to change was typical. While they concluded that North High was actually better equipped than the typical urban HS, and had a good program because of the relatively small size of the city and the special health care oriented programs in place, that bureaucratic problems of the type they had encountered were typical and well documented in the literature.

Tri and Jason also noted that the real issue was not the Club, but the survey they wanted to use to initiative it and their role vis a vis the guidance dept. The general theme of the aspirations survey project was criticized by the central office guidance administration. Key leaders believed that the survey was too general and that the data taken from it was not helpful in determining the college plans of HS students. They did not consider it relevant that student aspirations focused on careers such as medicine and law since that is not the decision they are making at this time. Those careers require additional schooling after selecting undergraduate college and major., and they might easily change their minds while in college. Only a few schools, such as engineering school or a music conservatory, which affect only a few students, specialize for a

profession t the undergraduate level. Hence, the aspirations survey was not providing useful information to a counselor focusing on helping a student gain admission to a selective undergraduate college. Understanding their view does not need that one has to agree with it. Liberal arts colleges differ greatly in their records at preparing future politicians, doctors, lawyers, businessmen and scientists. College admissions officers would be very interested in the aspirations data that the guidance counselors considered to be of questionable value.

Lack of support from guidance, resulted in inadequate aspirations survey data response rates at North High. The study was more successful elsewhere, especially at Doherty, where the survey was done in school, not as homework. As noted, the North High team changed its analytical focus from the students to the administration of urban education, in an effort to put their own experience in perspective. They concluded that the problems, according to last year's team, lay within the central administration, rather than at the school level. However, the interaction between school, central administration and unions all of which had larger agendas and ongoing power struggles were the key to their failure, as they saw it. These rendered any efforts to assist a specific school trying to improve its guidance function for the students interested in technical fields useless- even after they had recruited an alumnus of the school to come back and help others do what he did- get into a good engineering school.

The lengthy delays that killed their project they attributed to fear that a precedent might be set in which a "useless" survey they did not want to run each year might get institutionalized or that volunteers might come in and do a guidance job for free, setting the stage for further staff cuts. If the faculty took over the job, they would want money to

work overtime running an after school club. Without complete and total support from all parties a defensive atmosphere was created in which key administrators tried to kill the project through delays without having to say “no” outright.

The authors found it unfortunate that the administration was so willing to kill a very low cost project the main focus of which was to help them identify their student’s dreams and figure out how to better help their students realize those future aspirations that involve getting a technical education. It was their hope that the findings from the survey would continue to flow and that the organizational problems they encountered and identified would be resolved within the next year. They were willing to be sacrificed to a learning experience if that meant another team would return to North the next year and build on their efforts to achieve their original goal of providing informal college coaching to the members of a new science and technology club. That had found an advisor in Chemistry teacher and WPI graduate, Brian Morse.

The most important legacy of the project was a plan to avoid approaching the Worcester high schools through central administration. If the local school wanted the project, made that clear, and had a potential advisor (who did not demand pay) identified as well as college students ready to develop and implement a plan, all the central administration officer had to do was give his or her blessing. A grassroots insurgency strategy was formed in place of going through channels and getting central administration’s blessing in advance. Wanting permission from central administration is different from getting Central Administration to use its authority to back an initiative. When central administration asks a school to do more it makes the local schools defensive and they ward off the pressure to do more with less by asking for money. In

this case there are union rules to hide behind as well. Once the plan is official, from the top, union rules about pay for after school activities are activated. This creates a multitude of problems in a situation in which good programs are being cut and people are losing jobs. Even volunteers will be viewed as a treat.

What was needed was a situation in which all the central administration had to do was say, “sure, go ahead and do what you (the local school) want to do, but I cannot provide a budget, you are on your own”. This was the strategy we followed next year, with great success. Get the school to find an advisor through networking among the teachers, then the teachers and WPI team get permission from the Principal who then goes to the Central Administration. There, a friendly hearing by Albert Vasquez, Manager of Secondary School Initiatives has already been arranged, by project co-advisor Elizabeth Tomazewski. No money is needed, so no problems are encountered. The teachers are volunteering their time at their own initiative, and guidance is not involved if the survey is dropped as a recruitment mechanism.

1.3 Evolution of Goals

The goal of this club evolved throughout the planning as well as the implementation stages of the project. It evolved further once it was determined what the students wished to get out of the club. It was originally thought that the best way to go about hosting this club would be a combination of lectures by WPI students and professors. The team of Duncan and Dorchik that had gone to Doherty High School last year had a similar idea in mind, which they said worked well with a few exceptions.

The first recommendation of theirs was to ensure that the presentations were interactive and featured hands on activities rather than solely a lecture format. With the students sitting in class for 6 hours previous to the club meeting, this would be a more effective method of communication. The second recommendation was to carefully monitor the potential presentations that would be given by the WPI faculty. Last year a robotics demonstration was given by Prof. Stafford that utilized a few Massachusetts Academy students that was not well received. Prof. Stafford had thought that Mass Academy HS students would be easier for the Doherty students to relate to, but there are tensions between ETA at Doherty and Mass Academy, and student stereotypes. Unfortunately, the Mass Academy students fit the prevailing stereotype, (that Mat and Brian had been undercutting), and were poorly prepared presenters as well. Clearly, Dr. Stafford should have been advised to come with WPI student presenters, preferably a male and a female.

The Doherty team did, however, have a few suggestions that, in retrospect, they felt were crucial to ensuring that their club was a success. The first was to hold at least one meeting that introduced the various types of engineering in more detail. While this

did not have to be the first presentation for the club, and it was recommended that it was not, they felt that it was important so that the students could grasp some understanding of how the activities they were performing related to real life career possibilities and practical applications. The second suggestion was centered on the field trip that was supposed to take place. While time did not allow a field trip last year, the teams this year had plenty of time to put together a field trip to WPI. It would provide a great way to showcase WPI as a college, opening up to show otherwise unknowing students about college life and academics. At a point in time in their lives where the choice of whether or not to attend college has to be made, this experience could guide them in the right direction. Their last suggestion was to develop a good relationship with the club advisors, since these are the people that spend the day with the HS students. By passing ideas through them for constructive criticism, it can be guaranteed that the chosen activities are likely to be popular and encourage participation. Word of mouth advertising is also important and their club became increasingly “female” over time, suggesting that they were getting good word of mouth in the female friendship networks. This female participation shift seems to have started right after their talks about biotechnology and environmental engineering, fields that were new to the Doherty students. Their image of engineering seemed to have been shaped by Mechanical Engineering.

During the initial planning stages, it was suggested that the teams from each of the high schools should develop a potential presentation or activity they could give to all the clubs if requested. Drawing inspiration from experiences in classes the members had taken, there were various topics being covered. With the majority of the teams made up

of mechanical and civil engineers, the ideas were good, though they did lack diversity. Since one of the initial goals was attempting to identify interested females, overly focusing on topics that have not proven themselves in previous experiences to cater to females would only result in exclusion of potential members. For this reason many of the suggested presentations were modified to reflect this sentiment, eliminating some of the presentations that have not proved in the past to be of interest to the female side of the student population.

1.4 Goals

The main goal of this project is to provide an atmosphere in which the members of the club can have a fun time while learning about science and technology that they otherwise would not hear about. By complementing the traditional science classes that are offered in high school, we hope to be able to provide them with a wealth of knowledge and information about possibilities that extends beyond the traditional curriculum.

By creating a club that introduces the students to science and technology, they are able to get some hands on experience with subjects that they have never been exposed to before and are emerging areas in which there will be future career opportunities. The hope of this project is that at least a few of these students will realize that they have an interest in science or technology, that they might want to pursue. If they keep this option open, as they select courses and make plans, that is all we ask.

It is also our goal to establish this project as one that is worth continuing in the following years. It has come to our attention that it will be evaluated following this year

to determine whether or not it should be continued. Personally, the team members wished that a club like this were present while they were attending high school as it is seen as a great resource. Hopefully we can make a good enough impression this year on both the students and the club advisors for them to recommend that this project be continued.

1.5 Overview

This project comes as a continuation of the efforts by teams last year to set up Science and Technology clubs within the Worcester Public Schools. While the Doherty team was fortunate enough to make it into the school and host some meetings, the team assigned to North High did not have that same opportunity and was unable to get past much more than a single meeting. What it did do was identify a potential advisor, which we learned was a great advantage. As a result of that we were able to hold twice as many meetings by the end of the year as the clubs that had to start by identifying an advisor at the high school.

Since the North High club last year got into the school too late to properly evaluate whether or not the club would be of value to the students, one of our concerns deals with the value of our club to the school. If it were determined to be popular enough to garner interest again next year, as well as the approval of the current club advisors, it would be recommended that the club be continued in future years for the student's benefit.

North High currently has a system in place that takes three small schools into account. One of them is the Health Science Academy, the second the School of

Technology and Business, and the third being the Social Systems and Justice small school. According to information analyzed by last years team, it was determined that students coming from middle school into the high school did not make their decision based on which small school they wanted to attend. This factor alone nearly negates the purpose of having small schools, as it is useless to teach a curriculum to students who are not interested in the subject material.

The program is “enriched” only for the students interested in the subject(s) emphasized by that high school. In this case, that is health and medicine for the technically inclined. For this reason it is not unimaginable to assume that there are a number of students within North High who are interested in science and technology. Indeed, 15 – 20% are potentially interested in these fields according to the prior aspirations surveys by Hogan and Handler (2006) and Marsland et al. (2007)

Speaking with the students, it is clear that North High lacks any real technically oriented classes, with the exception lying in the recent addition of a computer-based class. For students interested in the further study of science or technology this is insufficient. While ideally the guidance department would be responsible for guiding the students in the right direction by helping them to choose a course load that reflects their interests, this is simply not possible. It is hoped that the information presented during this club activities, along with input from other sources, will help the students make educated decisions. Basically we are being positioned where we are accessible so we can be asked questions as they come up, and try to provoke people to ask a few.

The situation at North is an interesting one because of the presence of the Health Sciences small school. Of the many students interested in medicine, many of them with

not have the grades or will not be able to make the time or financial commitment required to follow through on this career aspiration. It requires not 4, but 8 years to become a professional in this field. It appeared throughout the course of the project as if there was little to no knowledge about how engineering is related to medicine. Perhaps by creating a greater awareness for these biomedical technology careers that still provide the opportunity to help people much like a doctor would, it gives these individuals an alternative choice in case their initial aspirations do not work out.

By creating an awareness of other careers within the field of science that cater to the greater good of mankind; high school students would broaden their career aspirations to areas other than medicine. One can be a professional engineer in 4 years after high school, and while selective, engineering colleges are not as restrictively selective as a medical school. One can even go to a medical school after graduating with a biology, chemistry, or a bio-technical degree. This expansion of opportunities would allow for the increased success of these students in pursuing a field of their interest.

1.6 Issues

The biggest issue that we had dealt with involved the time required to receive approval to get into the school. For this reason it proved extremely difficult to organize presentations by WPI faculty, as well as schedule the meetings, meet and discuss possibilities with the club advisors, and plan the field trip. A little foresight could have eliminated this problem. However, since a Create a Club project had never been undertaken on this scale before (4 schools at once) it is understandable that some lack of experience issues would be encountered. Discussed below will be the proposed solutions that should help to alleviate these problems for next year's group.

The first requirement to get into the schools is submission and approval of the CORI background check. This background check takes several weeks and in our cases partially delayed our initial entrance into the school. While a few CORI forms were processed at the end of last year in anticipation of this project the upcoming year, the majority were not and the slow turn around time was an issue. Since the interested individuals have already been identified for next year, it would be recommended that their CORI forms be submitted before the end of the school year to the WPS so that they have the opportunity to step foot in the school and get things organized upon arrival in the fall.

It was this large time delay getting all of the necessary approval that impeded the scheduling of meetings that included demonstrations from the WPI faculty. Some hesitance was also present on the part of the WPI faculty to perform the same demonstration five times over in each of the respective schools. To avoid this issue next year, it would be beneficial to identify a large pool of faculty who would be willing to

perform their demonstrations perhaps one or two times per semester at the various schools. With this sort of rotation in place it is possible that the clubs may not be able to hear from the entire identified faculty, which might be seen as a negative by some people, it could also be seen as a positive.

One problem that was encountered this year, with the Doherty especially was the emphasis on not repeating anything that had already been done last year. Since the club is open to freshman, sophomores, juniors, and seniors, there are many overlapping years in which students might be subjected to the same presentation repeatedly. For fear of driving students away with repeated presentations, this rotation of presentations should guarantee that no student will see a presentation more than twice assuming a four year participation in the club which is really not considered likely at this time. The Doherty club catered to freshman and sophomores, with few juniors involved last year. This year at least the freshmen were expected to return. Actually, it was an all new group except for 3 students, but in principle, repetition could be a problem and should be avoided.

The third issue also deals with the presentations, specifically the ones given by the students. During the initial planning stages of the project, many ideas floated around centering on our experiences at WPI and how we could relate what we had learned to the clubs through presentations and lecture. The club advisors as well as our own experiences showed that this was a rather ineffective way to go about determining the schedule of presentations throughout the duration of the club. It would prove more interesting for both parties if a mutual agreement were reached between the club and the WPI students with regards to the discussed topics. An agreement in which the presentations were split between topics the WPI students wished to speak about and the

topics that the club members wished to hear would simultaneously spur interest in engineering while still addressing subjects of interest. Presenters must be aware that one is not talking to people whose education is technically oriented. They are still thinking about engineering school and have not even taken advanced HS science and math classes yet. The majority of the engineering oriented subjects popular at WPI will be new and many will be overly complicated for this audience. So get feedback and keep it simple. It is recommended that a topic selection system be implemented to address the wishes of both involved parties.

The general consensus was that the field trip to WPI could have been better scheduled and tailored to the HS student's interests. The on campus Space Technology and Policy conference dealt with living and working on the Moon –and Mars given the keynote speaker. It was designed for an on campus audience. Most of the speakers were drawn from teams working on IQP's in this area.

The Student Pugwash Organizers were space buffs. Those individuals were responsible for planning on campus activities for WPI students. A few of the topics were general and basic, but some were not- and the first one that the HS students saw on Fusion reactors was particularly technical. Specifically, the high school students were a bit overwhelmed technically and the subject was not a good fit for most of them. They were not space buffs and brought little or no background to the space conference discussion. The atmosphere was rather intimidating, being seated in a large lecture hall with a video camera taping while various parties shared the results of their year long very specific research topics. These students needed a general overview or introduction by a faculty member first. This sort of setting seemed rather counterproductive; worse, the

first group did not give a practiced presentation, further increasing the stereotype that engineers are nerdy individuals who have a hard time conveying their ideas. Luckily the rest were better. WPI student classes determined the schedule rather than which talks would appeal to high school students the most. The students got more out of the general admissions tour and videotape, though the speaker that came up just as they were leaving was so good that many wanted to stay and were not allowed to hear the end, due to the bus schedule. The logistics were poorly planned for our audience. We should have planned our own events schedule, drawing on the whole campus not the one event.

For the future, we recommend that the HS students be subjected to specific Student Pugwash space or nuclear power or intellectual property or whatever conference theme presentations there are for no longer than one hour. They should just come for the keynote speaker rather than the project reports. Let the rest of the time be focused on various lab demonstrations. WPI has a lot to offer in terms of labs that can put on extremely interesting presentations that would most certainly hold the attention of the students as well as generating interest in the fields that need such facilities. Efforts were made this year to set up some lab visits, but it takes far more time and planning than expected to organize fire or computer game lab demonstrations.

Funding proved at one point to be a greater issue than was realized at the beginning of the project planning. It was originally assumed that each student would contribute \$75, totaling \$150 dollars per group that would in turn be matched by the WPI IGSD office providing a budget of \$300 dollars per group for various expenses. Due to delays and a sloppily written proposal, this was a resource that remained untapped. Despite getting the IGSD to provide money for the field trip transportation, having a

more professional proposal that better communicates the goals of the club and how the money would be used in a constructive fashion would greatly improve the chances of success receiving funding for activities. However, there is no way that WPI is going to pay for high school faculty members to advise these clubs, no matter what the union rules say. The WPS will have to deal with the staffing issue on their end. About 60% of the funding request was thus dismissed out of hand. Somehow that got approved last year when only one club was involved, but the money was never spent, so the precedent was not set.

The last issue was the time frame in which this project took place. It was scheduled for WPI's B, C, and D terms, which loosely corresponds with the academic schedule of the WPS. There might be a better turnout for club meetings if the club started earlier and was run for one half of the WPI year, such as , B and C or C and D term, which is approximately one half of the WPS school year. A case could be made for an A term start too, to get people before they become involved in other club activities.

The reason this is recommended is due to the response that was received this year. Having a predetermined meeting date of Wednesday at 2:00 p.m, it was quickly determined that the majority of school meetings and activities occurred on Wednesday at that time. Specifically the student council and math team meet then. The club advisors believed that many of the kids involved in both of those would have attended the Science and Technology club had they not already had a previous commitment. By tailoring the schedules of the WPI group around those of the WPS students, a club with better and more consistent turnout could be created. This would be mutually beneficial by

providing a more personal atmosphere between the two groups, allowing better communication as well as a better overall experience.

1.7 What We Hope to Achieve

We hope to inspire the members of our club to become interested in science and technology as a potential career path after high school. With the majority of our club members being sophomores or juniors, the thought of college looms over them. Having been in that position only a few years ago, we know that it is very intimidating knowing that a choice will have to be made shortly that can potentially dictate one's path in life. One thing that is often overlooked is the importance of opinions and information conveyed by individuals who are only a few years their senior. These are individuals who know how they are feeling and can help the club members face their fears, focus and make an educated choice. It does not have to be a final choice, and one should keep options open. It is okay to have doubts, not be sure and just try something.

One of the club advisors said that any chance her students are able to get away from the high school for a day and visit a college she feels is an extremely valuable experience. In her opinion, not enough of them entertain the thoughts of going to college, and if they do they are ill informed as to the whole process. With some of the local Worcester colleges often taking a chance on some of the graduating high school students who otherwise would not be able to financially afford college, it is important that the students realize the nature of the opportunity being offered to them.

One of the goals of the Doherty team last year was to address the gender imbalance between males and females in the science and technology disciplines. With last year's North high team not being able to gather a consistent group of students across several meetings, the team went into this year's project with little idea as to what to

expect gender wise. We hoped to create an atmosphere that is as friendly and attractive for females as much as it is males.

We also hoped to shed some light on the best way to go about communicating information regarding the future and technical careers to the students. Whereas many do not think about college and approach the process with little idea of what they want to do, others do not even entertain thoughts of college because of concerns that it is too hard to do and costs too much. By providing information early enough, or even supplemental information in the case of those members who are juniors and seniors, we hope to prepare the students to make better decisions when the time comes. This sort of information which the aspirations survey gathered on what the student concerns are, is not only useful for our purposes, but the guidance counselors at the respective high schools as well as the WPI admissions office would benefit from knowing if finances, grades or standardized test scores and the greatest looming obstacle to aspiring to college.

The main theme of last year's team that came to North High for one presentation also focused on space elevator and the "Space Race" type projects taking place at WPI. The club advisors, as well as the students experienced distaste with this sort of approach to science and technology, feeling that it was over their heads conceptually. Not wanting to eliminate any students from becoming potential members, our club, per recommendation of the advisors, next year the North High team should deal with as little space related material as possible. Judging by the amount of space related material pushed at North, there was a growing misconception amongst the North High students population that most WPI students are space buffs or we study a lot of topics related to

space. Seeking to squelch this idea, we hope that the Club meetings will be based around more practical and “down to earth” subjects for a year or two.

We also hope to provide a source of guidance for the members of our club with regards to what high school classes they should take to better prepare themselves for college. It is unrealistic to believe that the high school guidance counselors can identify and help the students that are freshman and sophomores, who haven't even thought about college yet let alone started preparing for it. Having not yet considered how taking advanced classes and developing a solid work ethic may impact their chance at a successful college career. It is our hope that we can instill a good attitude toward academics and provide good advice to those who are willing to listen. This could range from convincing them not to back down from the challenge because they heard rumors that a certain class was hard and that they won't be successful to sharing tips on how crucial it is to develop a good relationship with your instructors, we think we can make a difference. If we did it, or are doing it, engineering college can't be too intimidating.

2. Implementation

2.1 Implementation

Meeting A (Wednesday, 02/07/2007) – Advisor’s Meeting

The first time we traveled to North High School we conducted an official meeting with couple of WPI alumni: Greg Morse, a chemistry teacher, and Joseph Marzilli, a physics teacher at North High. Tri Lai, who was an alumnus of North High and a member of the team that tried to start this club last year had referred them, to us. Since Mr. Morse and Mr. Marzilli had agreed to advise last year’s club, they were more than willing to be our club’s advisors. Unfortunately, Mr. Marzilli was preoccupied as he is the advisor to the “Student Councils” and the “National Honor Society”. Therefore, Mr. Morse was chosen to be the main club’s advisor at this point. Beside Mr. Morse and Mr. Marzilli, we also met with David Elworthy who is the principal of North High School. After a brief discussion, Principal Elworthy gave us permission to develop our club after school at North High.

After establishing who would be the club’s advisor, we presented to both Mr. Morse and Mr. Marzilli the short proposal (see Appendix A), which described our club’s objective. They both seemed very excited about the idea of educating students about different majors in engineering, and encouraging students to pursue engineering/technology careers. They were also interested in the idea of a field trip to WPI. We then discussed the time and day we would be available for our weekly club meetings. We concluded that we would select Wednesday, from 2:00 p.m. to 3:00 p.m., as our meeting time with the club for the next seven or eight weeks. However, we recognized the conflicting interests of the “Students Councils” and the “Varsity Math

Team” that were also recruiting students to join their clubs. Both of those clubs also met every Wednesday. Finally, we discussed with Mr. Morse and Mr. Marzilli about how to recruit the students for the club. Mr. Marzilli recommended that we should put together a “flyer” which could raise awareness and promote our club. He also asked us to come back to North High sometimes next week to speak to some classrooms in the science department to advertise and introduce to the students our club’s objective. He said that the students had responded well to face-to-face contact on the past. Additionally, Mr. Morse promised us that he would make an announcement on the school’s telecomm, which he believed was the best way to influent our club information to the students.

Overall, this was a successful meeting. Both Mr. Morse and Mr. Marzilli were very helpful and friendly. After this meeting, we knew exactly what our next steps would be. The tentative plan for next week was to have a “flyer” ready and work on the classroom recruiting process.

Meeting B (Monday, 02/26/2007) – Classroom Recruiting

This week we were able to come to North High School to implement our classroom recruiting process. With the support of Mr. Morse, we went to total of seven different classes in the science department such as: Biology, Physic, Pre-Calculus, and Advanced Placement Chemistry. We passed out a “flyer” (see Appendix B) which we had prepared for the students and teachers that we met with. Then we introduced them to our club’s objective and some project topics that we would deal with during further club meetings. Some of the topics that we mentioned to the students included: chocolate asphalts, eggs drop, robotics demonstration, WPI field trip, party, etc... Then we took several minutes to answer the questions that students and teachers asked relating to the club.

Overall this was a successful series of meetings. Most of the teachers that we met showed interest in the club. They recommended the club to their students, and even promised to give extra bonus points on the exam for those students whose would come to the club’s first meeting. However, the reaction was mixed. Some students showed interest on the club while others seemed disinterested. One person who was definitely interested was a very nice chemistry teacher who was recruited to play the role of Mr. Marzilli, which would be the co-advisor of our club, Mrs. Holmes (Sandy). After this last meeting we concluded that our official club’s advisors would be Greg Morse and Sandy Holmes.

Meeting 1 (Wednesday, 02/28/2007) - Introduction

This was our first official meeting with the club. We both figured out that the club would turn out successfully if we could have between ten to fifteen students. Our goal for this meeting was to introduce ourselves, and point out ten different presentation topics (see Appendix E) that we currently had on-hand. Then we had the students vote for the four topics that they are most interested in. Finally, we introduced to the students the balloon vehicle game in which they have to use one balloon, straws, paper slips, and duck tape to build a device that could fly from one side of the room to another (about fifteen to twenty feet long). We decided to have the students work on this device at home and bring it back next meeting for a competition. Mr. Morse promised the students that he would award two movie tickets to the student who had the winning device. We all hoped the students would be excited to meet again next week to see who would win the competition.

We were pleasantly surprised that we had a turnout of eighteen students, which included ten males and eight females. Although most of them were freshmen and sophomores (only a couple of juniors and no seniors), they seemed to be interested in the objective of our club, especially when we introduced to them the idea of a field trip to WPI, the party, and the balloon vehicle game. Four presentation topics that the students showed strong interest in were:

1. Chocolate asphalt (presented by Orry S. Cummings)
2. Gears and Cams (presented by Timothy Souza)
3. Introduction to Engineering (presented by WPI administrations staff)

4. Lego Management (presented by Eric Deluca)

After we finished the first meeting, we figured out that the students were more interested in some sources of activity related to engineering and science rather than listening to the presentations. Therefore, we decided to create more games and activities in our future meetings in order to keep the students interested and come to our club for all seven meetings.

Here is an unofficial schedule of our club:

- Meeting 1 (today) – Introduction of the club, and game.
- Meeting 2 (03/07/07) – Gears and Cams Presentation, and game.
- Meeting 3 (03/14/07) – Introduction to Engineering Presentation.
- Meeting 4 (03/21/07) – Chocolate Asphalts Presentation and activity.
- Meeting 5 (03/28/07) – Lego Management Presentation.
- Meeting 6 (04/04/07) – A Field Trip to WPI.
- Meeting 7 (Final, 04/11/07) – Club Party.

Meeting 2 (Wednesday, 03/07/2007) – Vehicle & Boat Contest

The second meeting of our club began with the balloon vehicle contest. Since no one had taken time in between meetings to actually make their vehicle, the meeting began with a fabrication session. The students and teachers were given approximately twenty minutes to make their design, after which they had the opportunity to test them. If their design failed for some reason, the next ten minutes were allotted to fixing design flaws as well as improvement. After this ten-minute design modification, the time trials began. The test track was a piece of fishing line strung between two file cabinets, a span of approximately fifteen feet. While slightly on the shorter side, this distance ensured that most of the vehicles made it from one side to the other, a requirement for competition eligibility. Of the seven individuals whose designs met the assigned criteria, the fastest time was 1.67 seconds.

Due to difficulty obtaining the proper materials, and the lack of time remaining for the club meeting, the cams and gears presentation was postponed. We decided instead to assign them another creative thinking assignment that involved the creation of a boat, using only a piece of paper and tape. The goal of this activity was for the boat to be placed in a tub of water. Pennies would be added to the boat one by one, until the boat sank. Whichever boat held the most pennies would be declared the winner. In total, eight students put their boat to the test. Of those eight, the maximum number of pennies held by a boat was eighty-five. This competition was also well received, and the general consensus was that it was quite fun. As a small incentive, a bag of candy was offered to the winner.

According to the previously developed meeting schedule, as well as the urging of the teachers has resulted in the arranging of a WPI admissions staffer to come speak at our next club meeting about science and technology as a career, and the various applications of such a career. It was our plan for this presentation to last approximately 30-40 minutes, leaving the rest of the time to do some sort of activity. It should be kept in mind that the teachers had strongly supported both of the activities done during this meeting, revealing that it was a more effective way to communicate with our students rather than a lecture style. Taking this into account, our future meetings would attempt to integrate more hands on activities that promote creative thinking as a way to teach.

The tentative plan for next meeting was to invite our contact in the WPI admissions department to come speak on the different types of engineering.

Meeting 3 (Wednesday, 03/14/2007) – Chocolate Asphalts Activity

As we discussed last week, we planned to invite a WPI administrations staffer (Tiana D. Carrasquillo) to our club this week's meeting, and have her make the "Introduction to Engineering" presentation to our students. However, Tiana said she had another meeting on this Wednesday, and she was unavailable to come to our club. Therefore, we decided to introduce to our students another interesting activity called "Chocolate Asphalt", which was designed by Orry S. Cummings, a WPI member of the Doherty High School team. However, because his club also runs on Wednesday, he passed along the presentation about the "Chocolate Asphalt" activity to us and has us figure it out ourselves. The goal of this activity was to help the students learn about how asphalts were made. The materials and supplies for this activity included: chocolate chip, M&M, aluminum foil, microwave safe bowls, a microwave, and spoons. At first, we gave a short presentation about the history of asphalts. Then we provided each student and teacher a piece of aluminum foil that they could form in any shape they want. For the next step, we melted the chocolate chips in the microwave. We gave each of them their own melted chocolate, which symbolized the "Hot Black Asphalt" material. Then we have them mixed in the M&Ms, which symbolized the "Aggregates" (rocks, sand, small stones). These are the two ingredients in the Hot Mix Asphalt. Finally, we let them pour the mixed asphalts into the shape device that they made before using aluminum foil. Then we asked them to bring it home, put it into the freezer to make it dry and feel free to enjoy their delicious creation.

This activity was also well received by both the students and teachers. Even though only seven students showed up to this club meeting, all of them seemed very

interested in our club activities and objective. We were surprised that five out of seven students showed up to this meeting was female. It was also interesting that most of them were juniors and sophomores (four juniors, and two sophomores). Word about the club was spreading. As for next week's club meeting, we would try our best to get in contact with a WPI admissions staffer (Tiana D. Carrasquillo), and have her address the students. We both felt that this "Introduction to Engineering" presentation was important to the students, especially those who want to go to college, and we should have it done as soon as possible. Also, we decided that we would send out the WPI Field Trip permission slips to the students by next week's meeting.

Meeting 4 (Wednesday, 03/24/2007) – WPI Administrations Speaker

This week we were able to get Tiana Carrasquillo to come and speak with the students about engineering and admission to college. After handing out cube puzzles, she started the PowerPoint presentation. The first thing she spoke about was the different types of engineers. Throughout the previous weeks, it had seemed as if our students knew little about the different types of engineers, rather considered an engineer to be a rather broad title that encompassed a little bit of everything. They were surprised to find out that engineers play a role in everything from the construction of airplanes, to the chemistry behind cosmetics, and almost everything in between. Tiana then went on to speak about the curriculum at WPI, which has the students completing three qualifying projects, one of which is the IQP, our club. Of noted interest was the option of studying abroad. It seemed as if the students were not aware, or had not considered the possibility of studying in a foreign country.

The students were particularly engaged in this presentation, asking questions and answering questions asked of them. Tiana did a good job of ensuring that the students were involved, getting them to vocalize their aspirations. Since a fair majority of the club was interested in pursuing careers that are not related to science or engineering, Tiana switched modes and instead spoke about the college process. In only a few years, most of our students will be applying to college, and recalling our own experiences, it was apparent that they were not quite aware of what was involved or how to succeed in getting accepted at a college. Overall, the presentation was a success, and our group felt as if it was vital in order for the students to fully comprehend the goals of this IQP project.

Meeting 5 (Wednesday, 03/28/2007) – Building Contest

Our plan for this week was to introduce to the students the new activity called “Building Contest”. The goal of this activity was to test the students’ creativity, show them the basic idea of how to work in the team environment, and provide them with some concepts of Construction Engineering. The whole idea of this activity was to have a students build a *tower* (as high as they can) that could keep good balance in the strong wind. The materials for this activity were included: twenty cassette tapes, one large fan, and a 1.5-meter ruler.

We first gave a short introduction about the “Building Contest” activity and explained how it was related to Construction Engineering. Then we had the students divided into teams of two or three (the total was four teams). However, due to the limited number of cassette tapes, we could not have all four-team start at the same time. Therefore, we decided to have one team working at a time. We provided each team five minutes to make the plan and build their towers by using twenty cassette tapes. For the next step, we used the large fan and blew the wind into the towers for two minutes. Then we measured the height of those towers that kept good balance and did not fall down. Of the four towers that met the assigned criteria, the highest tower was 1.14 meters.

We had a turnout of eleven students that consisted of nine males and two females. Eight of them were first time students to the club. The topics were reaching different parts of the student body but continuity was going to be an issue. Also, there were approximately five students whose could not come to this meeting because they had to attend the Central Massachusetts Math League Competition today at Wachusett Regional High School. On the other hand, we ended the meeting about twenty minutes early

because our eight new students had baseball practice at 2:45 p.m. Overall the meeting went very well. The students seemed very interested in the “Building Contest” activity, and we felt that they showed full effort and creativity when they built their towers.

For next week, instead of holding the club meeting, we planned to bring the students on the field trip to Worcester Polytechnic Institute (WPI). The tentative plan was to take the maximum number of twenty selected students on the field trip.

Meeting 6 (Wednesday, 04/04/2007) – WPI Field Trip & Space Conference

This week we were able to take a total of seventeen students on a field trip to WPI. Our original goal for this field trip was to help the students learn about WPI student culture, and students' daily life at WPI. On the trip we showed them various on-hand projects that WPI students were working on. They then listened to some interesting Space presentations. We hope that the students will become more interesting in pursuing a technical career after that day's event.

The field trip was started with the "Admissions Conference" led by Tiana Carrasquillo, the admissions staff. She was a skilled presenter. She then showed a short video which basically described about the qualify projects program and students' opportunities at WPI. She also provided some helpful advice to the students on how to become more desirable candidates when applying for college.

After the "Admissions Conference", the students took a WPI Campus tour led by an Admissions tour guide. The admissions tour guide displayed very good public speaking skill and was always willing to answer any questions asked by the students. The goal of this tour was to help the students gain knowledge about WPI culture and the technical career atmosphere through visiting various academic buildings, engineering laboratories, student's dorms, etc...

Finally, the students attended the "Space Conference", which was the main object of the field trip. They had listened to several space presentations presented by WPI students. The students were expected to gain some knowledge of living, working, and profiting in space. The four presentations that the students attended were:

- 1) Fusion and Drives: The Next Generation

- 2) Lunar Agriculture: Growing Potatoes on the Moon
- 3) Gathering LOX in LEO for Profit
- 4) The Four Frontiers Vision of How to Settle Mars

The students seemed to be very interested on the Admissions Conference as well as the Campus Tour. We noted that students asked Tiana and the admissions tour guide many different questions about WPI's academic programs, student's life, sport programs, qualify projects, etc... Even though the space presentations taught some very interesting points, the highly technical nature of the topics lost many of the high school students. Overall this was a very successful field trip. We found that the students really enjoyed the trip today. We believe that a few of the students will consider WPI as a college to apply to and pursuing career goals at an engineering college were now an active possibility for them to think about. Even if they were determined not to go to college locally, some other engineering college would be considered.

Meeting 7 (Wednesday, 04/11/2007) – Club Party & Feedback Survey

This should be the final meeting of our club. Our plan for this week was to have a pizza party with the students and the teachers. Then we would pass along a brief feedback survey (see Appendix D) and had them fill it out.

We brought in ten large pizzas and some sodas to the party. The students seemed to enjoy the food and we had a lot of fun during this final meeting. Before the party ended, we had the students fill out a feedback survey. Most of them had provided us very positive feedback, which they thought the club was helpful, fun, and they would love to see the same club next academic year. Most importantly, the students expressed their appreciation for taking them on the field trip to WPI.

We also had a brief discussion with our advisor, Greg Morse, and co-advisor, Sandy Holmes, about the possibility that they would advise the club next year. They both had a good impression on what we did with the club, and Greg Morse told us that he is more than willing to advise the “Science and Technology” club next academic year. Finally, in order to show our appreciation to the advisors, we presented each of them a small gift, which included a fifty dollars Macy’s gift card, and a beautiful thank-you card.

This was another successful meeting that we had at North High. We were very sad for ending the club where we had a great time with both the students and the teachers. We were sure that we will miss them a lot. In addition, according to Mr. Morse, the students appreciated us for the time and effort we both put into the club. Mr. Morse had promised us that he would write us a short letter for the report (see Appendix G) in which he would give recommendation and feedback on the club as well as the WPI field trip.

3. Results and Conclusions

3.1 Results and Recommendations

The advisors for the club this year, Greg Morse and Sandy Holmes did an excellent job in their position and have expressed interest in helping out with the club next year. Please refer to Appendix G to see what Greg Morse has written about his experience with the club.

Little resistance was met within the local high school where we were actually setting up the club. It seemed that all the prior year problems had come from upper administration where there was hesitance to give approval because of precedents being set, encroaching on Guidance Office turf and union contracts. Once approval was given to local administration to proceed on something the teachers wanted to for no pay, everything moved through the school quickly. We received a warm reception from both the school administration and faculty. Apparently this Club, or at least one along these lines was a long standing desire within the school, because there was a lot of support from teachers within both the math and science departments.

Due to the meetings being scheduled on Wednesdays, this conflicted with previous commitments to both math team and student council. Had this not been the case we think the average meeting would have been as well attended as the first meeting and the field trip, about 18 to 20 students. On the other hand, over time we met more students than that at least once. We greatly appreciate the efforts of both the students and faculty to do their best to excuse the students early to attend our club.

The field trip overall was fairly successful in itself, with both some high points and some low points. We received feedback from the club members as to what they

wished to see and what they wished to see improved. The majority approved of the presentation by the admissions department. It was well done and presented in a manner that was attractive visually without focusing solely on a power point presentation. They also enjoyed the video, and were impressed with the facilities on campus. The tour that was given was also well received. As previously mentioned, one of the club advisors stated that any time she can get the kids out of class to visit a college then she feels it is a great opportunity for them to see what life beyond high school is like. In this respect the campus tour was good it gave the club members a good idea of what living in college is like as well as the buildings and facilities that are provided for the furthering of their education. Although none of the feedback indicated this for we did not get the opportunity to arrange it, but a lab tour would have been a great addition to the tour.

Although it was our previously stated goal that the club would provide guidance for sophomores in planning the junior year, since they are not yet receiving attention from guidance we now have a more general vision of what is needed. The first job is to start talking to freshmen and sophomores about the possibility of going to college. Guidance is loaded down with juniors needing to take tests and seniors needing to apply to college. The sophomores are a low priority unless they are in academic difficulty. With regards to potentially going to college, our goal was not to exclude anyone from this opportunity to connect planning course schedules with the college admissions process. Sophomores and Juniors headed for college must do this, Freshman should think in these terms too, but it is too late for Seniors. Throughout the course of the meetings there was representation from every single grade level, and no evident difference in how much enjoyment the students got out of the chosen activities.

Despite the focus on science and technology as further education and potential careers, the activities performed and the lessons learned throughout the club are of interest students considering many disciplines. Opening up the club to every student curious about science and technology or who wants to be technically literate regardless of their career interests seems quite possible. It really does not have to be a “Future” Scientist and Engineer Club and we think it should be a future goal to help create interest in science and technology as a whole for people curious about how things work, whether they want to be an artist, nurse or chemist.

Going into our first meeting, we felt it would be successful if we were able to attract anywhere from 5-10 students on a consistent basis. Over the course of the 7 meetings we found that we had anywhere from 10-20 students. The split between males and females tended to range anywhere from about even to female dominated. There was only one male dominated session, the one on building towers. The breakdown of gender attendance by meeting can be found in the Appendix F. In total, we saw 33 different individuals throughout the course of the club. The meeting logs, which have been elaborated upon, can be found within the implementation section of this report and give a detailed write up about the activities performed each meeting and how they were received.

As previously mentioned, the time conflict with student council and math team often impacted the number of students that were able to attend. It would be recommended that the day of the meeting be chosen as a day other than Wednesday or when there is the least amount of conflicts with other after school activities if those clubs move their meeting times. Offered to us this year, which we felt was a great opportunity

was the ability to speak to some of the science classes before the first meeting for a few minutes. This is when we won over the teachers. Since we had the chance to outline what we had to offer, we think new people kept showing up when we hit the activity they considered the most interesting. If they had to skip something else to come to it it is understandable that they came when we had something of great interest to them.

Not knowing what to expect and having been given little time to prepare as the inclement weather forced school closings, our presentations to the classes had less content than we would have liked to offer, knowing what we do now. This was also due to the fact that this sort of club had not been implemented in North before and we were unsure of what the students would take an interest to. Clearly an aspirations survey is not needed to launch a club, but we are aware that 20% of the students in the school are probably thinking about science or engineering at least as one possibility. That is about 30-40 students/ class or 120-160 students overall at North High. It would be nice to do a freshman and sophomore survey one year and a freshman survey the next 2 years running, and invite the total pool by personal invitation. If the science dept did that in required science classes guidance need not become involved.

If the same opportunity to speak in classes is extended next year we would recommend that more time is taken to prepare for this talk as well as have a tentative schedule developed that can be distributed as a template for the upcoming meetings. Also, the majority of the classes that we spoke to were upper class science classes with a few presentations being given to lower class science classes. Presumably the fact that the science teachers heard our talk and passed the word rectified this error. The attendance at most of our meetings had representation from all grade levels. Hence, it is recommended

that next year, no preference be given to class years when deciding which classes to announce the club in. On this note, it would be good if the math department were included in this as math is a large part of science and technology. Although the club focus is not on the math portion of things, it has been noted in our experiences that often those who are enrolled in higher-level math are also in the advanced placement science classes.

The presentation given by the admissions department at the school was extremely stimulating and we felt it was good, but could be better with a few additions. We felt that it was important to focus on the role of engineering in industry, particularly what separates each designation of engineer and what they all do for a job. Our members were surprised to learn that engineers aid in the manufacturing of everything from cosmetics to space shuttles.

It was also helpful to introduce the WPI mission and the three projects system, giving the students a look into what the curriculum is like. What we feel could be improved on is the addition of a section that talks about the college process in general. How to start preparing for education beyond high school as a sophomore and junior would be of particular interest to the freshman and sophomores, as they are not yet receiving much attention from the guidance counselors. Guidance was focusing on the seniors, and that is understandable.

Another thing to note may be the Worcester consortium of colleges. While the presentation focused on WPI and what it has to offer, the other colleges were not mentioned. Since it is unrealistic to believe that all of these students will be interested in attending WPI, introducing the other colleges and what they have to offer would be

beneficial. This was done in Laura Handler's FACES program 2 years ago, which was a WPI day for only the 50-60 female juniors located by the aspirations survey as interested in technical careers. Holy Cross and Clark admissions officers presented too, and they had their own ways of supporting engineering majors with 2-3 programs of various kinds. The science majors they kept on campus. With those few small additions we feel as if the admissions presentation was a valuable asset to the club.

The majority of the meetings went well, however some small changes in bringing resources and scheduling improvements could be made to guarantee that they are successful and that all of the students are engaged. Most of the activities performed this year were done so with a focus on finding something that is related to science and technology and would provide entertaining so that the members would come back to consequent meetings. They did however lack some background information that could have been provided to help the students better understand the larger significance of the activity.

This was purely an oversight on our part, as it was not realized that basic questions would be raised as to why things happened the way they did displaying confusion about concepts such as buoyancy, friction, and gravity. While it was possible to explain briefly using our background knowledge, it was hard to convey the ideas in terms that would be easily understood by the audience. Had we planned for this contingency we could have done better. Not having had thorough experience with physics, chemistry, and mathematics, a brief introduction to the topics before undertaking the activity would be beneficial.

Ideally the meeting would be broken into two halves, the first featuring an interactive semi-lecture with a power point presentation hitting the basic principles that govern the activity to follow. Brief and easy to understand is the goal with the presentation portion ending in a question and answer session. This would require extensive background research as well as complete understanding by the team members. The larger group would then be broken down into two smaller ones under the direction of each team member to perform the activity. In some instances this would help to prevent a waiting time like would be present with the larger group. It also seemed to maintain interest in helping to build a competitive atmosphere in which one group competes against the other. An arrangement similar to this one would prevent turning the club into solely lecture or activity based. However, we have been warned that competition plays better for males than females, so not to take things too far in that direction.

3.2 Conclusions

It is not only our feeling, but that of the club advisors as well, that this club was a success, has great promise to improve and should continue next year. Too often the students do not even entertain the thought of going to college believing that it is too expensive and that they are not well enough prepared. The aspirations survey data suggest that this is an even greater problem at North High than at Doherty and Burncoat High Schools while South High seems to share the problem with North. What has been accomplished this year is a giant step towards assisting the Worcester Public School system in adequately preparing the students for life after high school, whether or not their plans currently include going to college.

We encouraged technically inclined people to consider a technical program in college. Although this club is focused primarily on science and technology, the pool of students that attended the club was very diverse, in terms of race, gender, and even in their career interests. In a brief informal poll taken during one of the club meetings, only about 2 of the 12 or so students present claimed that they were sure they were interested in science and technology as a career. It was one of several interests for most. The rest just came to have fun and actually find out for themselves more about science or technology as well as related careers.

Having been in their position only a few years ago, we know that it is very confusing and overwhelming knowing that you will soon have to make a choice that could potentially dictate the rest of your life. It is too hard for the guidance counselors to put in the necessary time to ensure that their technically inclined students are adequately

informed as to what their options are and how they can go about achieving them. This is not the field the counselors decided to pursue.

A club is more effective than other options simply because of how the club members can associate with the college students better than adults who decided to become teachers can. Generally speaking peer bonding is easier to achieve than teen/adult bonding. The students better associate with individuals who are close in age. Recalling one of our first meetings, a girl expressed surprise at how young we were. By offering our services as peer advisors rather than adult advisors it appeared as if they were more willing to listen to what we had to say concerning future course load, standardized testing, and any questions regarding college in general.

The small schools system adopted is not effective in determining which high school the students choose to attend. Having little experience with how the skills they are learning can be applied in real life situations, they do not know how to decide about what small school to enroll in. The tendency is to just not decide, or decide by default, and stay with their friends who are moving from East Middle School to North High based on their quadrant in the district. Attending ETA means they need to commute across town and make new friends at Doherty. Few are willing to do that. Even then, it does not appear as if their focus is entirely dedicated to the scope of the small school they belong to, as we found out first hand here at North.

Students clearly interested in engineering by 9th grade were supposed to be part of the ETA at Doherty, but our results show that they were not willing to make this commitment. While in principle the small schools idea is a good way to prepare the students for a future career, it appears as if a lack of direction coming out of middle

school (only 20% are aware of the small school program) results in a situation in which there are students interested in science and technology present within some or all of the other small schools, and all of the major high schools. Thus, many are without any special enrichment program they could relate to at all. It makes some sense for a science oriented student at North High to take part in health career related programs but at Burncoat High, the available small school is devoted to the arts. Those students are without a support system, and the Principal knew it, enthusiastically embracing this proposal as soon as he saw it and recruiting a math teacher to advise a club within a week of being contacted.

The team this year as well as last year ran into many roadblocks along the way that threatened to impede progress. The first problem is the resistance encountered within the school system itself. Tri Lai and Jason Hwang of last year's North High team put it best when they said,

“The problems that urban education faces, as illustrated by North High, are not at the level of the school, but at the level of the central administration which denied the school access to local resources due to its larger agenda and internal power struggles. In a word, the central administration building was afraid to set a precedent without everyone being in favor of it – and so it tried to delay the project to death to avoid overtly having to say “no”, after the project was approved, because the sponsoring administrator did not have the authority to make it happen without expending too much political capital.”

With both the club advisors as well as Alan indicating that a club like this has been needed for a long time, it is hard to understand how there could be anything other than enthusiasm in central administration for a project such as this. However, this year there was a grass roots plan and no favoritism. Every high school was offered a club, and none refused the offer. This is probably due to endorsements from the Doherty High School advisor, but in any event Central Administration heard a chorus of calls to set up Clubs

and endorsed the idea rapidly. What took time was setting up the chorus. Every individual involved in the North High effort, from the club advisors, to the school principal, to the members of the club had a great time. They were also very appreciative of the fact that college students from such a prestigious institution such as WPI were taking time out of their day to set up a club for the benefit of the Worcester community. It has taken two years in the case of some schools to receive permission to run this club and to prevent its offering would be unfair to the students. It can only get better in the future and help to address some of the problems that have gone unnoticed for many years.

For these reasons, we feel as if continuing the club next year would be a step in the right direction. Although only a few of the attending members expressed sincere interest in science or technology as a future career, we believe that this is not because they are not interested, but because they are not well informed. They need a place to try the idea on for size. The concept that engineers do more than build bridges and that they are involved in bio-medical fields, as well as engineering for the environmental impact of a project has not reached these high schools. This fact alone may help to increase the number of students interesting in pursuing a career in engineering and science.

By choosing a meeting date that does not coincide with previous commitments that according to the club advisors the majority of those interested in science and technology have made, attendance in the range of 20 to 30 students each week is a possibility. Offering a greater focus on the various roles of engineering in life will put opinion leaders in the public schools who know something about engineering and science the way WPI does it. To eliminate this project and prevent this experience from being

extended next year would be a waste of a great opportunity to reach an uninformed, but certainly not uninterested audience.

It took two years but we sold North High on the idea of this kind of Club. Others have convinced the other high schools in Worcester of the same. The high schools have in turn given their praises to the central administration for this program. 10 WPI students want to do this kind of project next year. What are now needed are 3 to 5 WPI science and technology faculty advisors to take the program to the next level. They can do the demonstrations we could not and open the labs to visiting field trip groups that we failed to do this year. Technical man power, gender equity and engineering stereotype issues can still be addressed as the clubs professionalize and set up for a long-term partnership.

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Hwang, Jason, and Tri Lai. North High Coaching: Coaching Students and Analyzing Urban Education. Worcester Polytechnic Institute. Worcester, 2006.

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Appendix A

A Proposal Written to Brian Morse of North High School:

Mr. Morse,

Please allow me to introduce ourselves as the individuals assigned to your high school. Our names are Timothy Souza and Alan Ngo. You may or may not remember Alan as a graduate of North High in 2004. In any case, we are both juniors here at the Worcester Polytechnic Institute and have undertaken this project to fulfill our IQP project requirements.

Last year two students from WPI, Matthew Duncan and Brian Dorchik, ran a project at Doherty High with the goal of establishing a Future Scientists and Technologists club throughout the entire Worcester Public School system. Similarly, Jason Hwang and Tri Lai attempted to create a similar club at North High, albeit unsuccessfully. This year however we hope to change that and provide the students with the experience that the students at Doherty received last year. It is through previous correspondence with Tri Lai that you were identified as the individual most likely to be interested and willing to help such a club succeed. We understand that circumstances and opportunities change from year to year and you may no longer be available for our project. Our hope is that by writing this proposal letter, we can both gauge your interest as well as attempt to convey our intentions, so you may determine if it is a program you wish to take part in.

In the case that you are indeed interested, we look forward to meeting with you to share the results of last years Doherty project along with our team's goals and to explore the possibilities and expectations you have. Ideally, our meetings would incorporate the other teacher advisors from the various Worcester area high schools however this is not feasible at this point in time, since they are still being identified and asking to join in.

As you may or may not know last years projects were delayed because they were not approved by Albert Vasquez. He did however express interest in the idea. This aspect of the project will probably be taken care of by Kathy Kambosos of Doherty High School as she has agreed to serve as a liaison between us and Vasquez since she has wanted to do something like this for years.

Currently our team has been in constant discussions as to how we can best use WPI resources to provide the best experience possible for the high school students involved in the club. We have been in contact with professors as well as WPI students who could potentially present with respect to their disciplines. This is something that we would like to discuss with you, so scheduling a meeting to do so is crucial before we can move forward.

An excerpt from the report written by Dorchik and Duncan states:

A future scientist and engineers after school club program was designed to assist students of Doherty High School achieve their aspirations. This short pilot project version of the project established the feasibility of creating such a program and the level of interest at the school. There was a core group of about 15 students but at least another dozen attended at least one meeting and the group became increasingly female.

Several means of having a meaningful influence on the students were tested. Attention is also paid to the question of gaining access to the schools and the form this project might take in the future. The striking success of the program in attracting females who wanted to explore the possibilities in a technical career without making the commitment necessary to be part of the Engineering and Technology Academy at Doherty is noted. (ETA was about 20% female but our Club was at least 50% female.) We conclude that lack of knowledge is a barrier to the technical professions, that this project was successful in lowering that barrier, and should be continued and expanded.

Our group is composed of 10 students broken into 5 teams whose goal is similar to that of Duncan and Dorchik's. Having read about what those two accomplished last year gives us great hopes of achieving the same at North High.

At Doherty High School there is a small school called the Engineering Technology Academy, or ETA. The goal of this program is to provide a technically based education for those students interested in pursuing that career path. One of the benefits of our club is the ability to partake in engineering and technology based activities and presentations without making a commitment to such a program. An opportunity like this one allows students to explore a technically geared learning experience without shifting their academic focus. This is particularly important to the females, as surveys taken last year indicated that they were more likely to be considering alternative careers. By catering to this curiosity, we are able to provide a safe place for the students to explore their options by interacting with individuals who stood in their place only a few years ago, faced with making the same decisions.

We hope to establish a good relationship between WPI and the Worcester Public School system to identify and encourage those students interested in a science or engineering career. While it is possible that our efforts could coincide with those of the ETA, collaboration between the two groups is not necessary. We are however open to cooperation if that is the best option.

During its pilot project stages last year, the club was run as an extracurricular activity twice a week. We do not feel as if two meetings with the students per week are necessary, and have determined that it would be more advantageous to hold one meeting per week, with another meeting for the team and advisor. Our hope is that by starting as early as possible, we will be able to run the club for approximately 3 months, or 10 to 12 meetings. These 10 or so meetings would include a field trip to WPI as well as a concluding party.

Given that all of the schools are fundamentally geared towards differing interests, our club programs will vary at each. While they will vary slightly, our intent is to implement

similar ideas, sharing demonstrations and speakers. For instance, one theme we have discussed in depth is space, and the attempts of the United States to construct a lunar base by the year 2018. Nearly 10 years away, that date will place most of the individuals their age in a position to potentially be involved in such efforts. Such circumstances are reason to believe that a few club meetings dealing with space might be of interest.

The original idea was to find a professor from each department who would act as a liaison between their department and the club. This has proved to be hard to arrange as the majority of the group is majoring in either mechanical or civil engineering, meaning the majority of our contacts are in those departments. Attempts have been made though to recruit professors from other departments but those details have yet to be finalized. The team is also comprised of individuals involved in athletics and fraternities on campus, allowing them to break the stereotype of engineers and show that not all engineers are geeky and antisocial.

During the last two years, the administered aspirations survey indicated that there were some females interested in a technology oriented career. These females were bussed to WPI and given a tour of the campus, an offer not extended to their male counterparts. Though it was originally due to an overwhelmingly skewed proportion of males to females, we see no reason why the males should be excluded and believe that a field trip to WPI on Project Presentation Day would prove to be beneficial. Not only does WPI plan to accommodate extra visitors that day, it will give the students a good sense of what the different disciplines of engineering actually do.

Given that this is the first year the club would be offered at North High, we would appreciate any feedback or advice you have concerning the best way to present information in an attractive fashion. We realize that we are asking a lot of you and understand if you are not able to fulfill the outlined level of involvement. If this is not possible we appreciate any direction that you are able to provide. Our main goal is to provide the students with an experience that is irreplaceable and unique, and we would like you to be a part of that.

Thank you in advance for reading and considering this proposal.

Sincerely,

Timothy Souza (tsouza@wpi.edu)

Alan Ngo (ngotri@wpi.edu)

John Wilkes, advisor (jmwilkes@wpi.edu)

Appendix B

Science and Technology Club

Have you ever considered a technically oriented career after high school and have no idea how to go about preparing yourself? Come join the Science and Technology club,

Have you ever visited WPI? No? Good, because a day long field trip is in the works where you will get to hear guest speakers, tour the campus, and witness demonstrations at many of WPI's on campus labs.

We have various presentations planned, some of which include making chocolate asphalt, a robotics demonstration, and a general overview of the types of engineering and their function in the work place. Presentations will be given by WPI students, faculty, and staff.



Starting after February vacation, meetings will be held on Wednesdays, after school from 2 to 3 o'clock.

For more details, please contact Tim Souza (tsouza@wpi.edu), Alan Ngo (ngotri@wpi.edu), or speak with Greg Morse or Joseph Marzilli.

Appendix C

Meeting 11/15/06

1. Kathy Kambosos – Doherty Connection
 - Ask her to find contacts at each of the Worcester High Schools
 2. Worcester Public School system
 - Mostue/Vasquez
 3. Letter of Introduction
 - Attached with proposal, Wilkes no comment
 4. Proposal Draft
 - Attached
 5. Space Group Request
 - They want us to distribute surveys to get information concerning space
 6. North High Team
 - Tim Souza and Alan Ngo
- Need to develop proposal and letter of introduction for North High
 - Locate contacts and start pushing through them
 - Contact Chris to get existing proposal and letter of introduction
 - Maybe try and make contacts with professors in other departments for presentations

Meeting 11/29/06

1. More communication with professors that may be interested in giving presentations
 - Contact Mike O'Donnell about potential presentation regarding CNC machining, perhaps the fabrication of a Sterling Engine

Meeting 12/6/06

- Finalize who is going to North High and Doherty
 - We think that the cover letter was sent as well as the proposal
 - Get final copies of each document and adapt it to North High
1. Funding Issue
 - WPI wants us to contribute at least \$75, they will raise us about \$100, if we need more than we have to submit a proposal
 - We have about 18 hours of teacher time with the current budget
 - Must use some time for prep, say 6 hours for prep and 12 hours for actual time
 - We will use 10 for meetings, and 2 to talk with the kids
 - We have to turn in a proposal, must be written

- Must include a clause saying we will request the Worcester Public School system to match our contributions
- 2. Firm up faculty contacts as to what we could add to the proposal
- 3. Create a presentation that I myself could actually give

Meeting 12/13/06

1. Vocational School – need letter of introduction
 2. Ideas/Resources – WPI
 3. Space teams at WPI/Nuclear power team
 4. What we can do over break
 5. Budget Proposal
- We need to create a lengthier version of the proposal to ask for money from WPI
 - The Vocational School is in trouble and quite iffy as to what may happen, kids are on a month on month off basis
 - Burncoat is the school for Visual and Performing Arts, has a pool of people interested in computers, program was phased out
 - North High has a reputation and WPI tends to take chances on the kids, must be able to help kids create and attractive resume
 - South High is heavily ethnic, up and coming center of education, tend to have some gangs, history of gang violence
 - I volunteered myself to develop a presentation on cams, linkages, and gears, write up for after break

Meeting 1/18/07

- Weekly meetings will be held from 2-3 on Tuesdays
- Teachers at North have checked with the principal who are to be contacted by Burt Vasquez
- Buses cost \$150 per
- 1 meeting is for a party
- 1 meeting is a trip to WPI
- 8 meetings are for presentations
 1. robotics
 2. space presentation
 3. prosthetics
 4. gaming
 5. chocolate asphalt
 6. introduction to all types of engineering
- space presentation: alevy, lizv44 Tues @ 7 or 6:30
- Keithe Baggett: future careers in space

- Job for this week is to figure out what we can do for the in house presentations
 - Either develop something alone or figure something out with Alan
 - Maybe develop presentations and just rotate groups
- There is a group that has put together a role playing game that deals with the distribution of nuclear arms

Meeting 1/23/07

- Robotics demonstration didn't work out too well, the actual presentation was good but the Mass Academy kids are no good, Don't show to Faces and returnees
- Perhaps change up demonstration
- Definitely do a field trip
- Definitely do a presentation on the types of engineering, don't do it as the first presentation
- Make sure to take attendance and do so at every meeting
- Recommend using survey, however, delete some of the questions
- Make sure to bring laptop and perhaps a projector if power points are to be used
- Do a follow up survey at the end of the class to see if the presentations are good or bad
- When we meet with our advisors have an idea of what our presentations are
- The carnival ride thing is a go, just be careful how I structure it, make it flashy
- Perhaps do something on the sterling engine with step by step, give one away at the end
- Be honest with them
- Be prepared to know background on presentations and be able to answer questions

Meeting 1/25/07

- Perhaps take a trip over to the Ecotarium, see if anything is going on
- Establish contact and set up a meeting

Meeting 1/30/07

1. Contacts at the High School
 2. Proposal progress
 3. Update on Space/Management groups
 4. Fund raising
 5. Science part
 6. Quick start plan
- Call people at north and see what the deal is, when we contact have a tentative schedule, let them know that we want to discuss it but will be forced to make the decision if we cannot
 - See if club advisor has some sort of specialty and would be willing to give one of the presentations

 - Space survey group could give a presentation on the implications of a new space race
 - Management group wants to hold a big conference and if we can get the kids out of school, Pugwash will pay for buses
 - i. Could also attempt to have some space presentations given in the Ecotarium

 - 2/19 and week off in early April for the Worcester Public Schools
 - After the space presentations we can give a survey on Space, NAIC
 - Or after the space presentations we can take the kids out on a campus wide tour
 - Ideal choice is to get the space presentations done at the Ecotarium

Meeting 2/1/07

- We need permission letter to get into the school
- Must bring a 1 page proposal for discussion purposes
 - Proposal must be pre-approved on next Tuesdays meeting before we go into the school on Wednesday
 - Linkage proposal is good, just bring along physical models so they can actually see how the linkages work

Meeting 2/6/07

- Send Liz email tomorrow letting her know the results of our meeting
- Chris had developed a tentative schedule of presentations

Meeting 2/7/07 at North High

- Met Principal Elworthy as well as Mr. Morse and Mr. Marzilli; all were excited about the club
- Suggested we put together flyers advertising the club as well as come to some science classes, in the past the students had responded well to face to face contact
- Both Morse and Marzilli agreed to provide help if it was required, Morse more so than Marzilli as he is busy with Student Council
- Excited for WPI field trip

Meeting 2/13/7

- Strategy is to make sure that we do not exclude people that are not in the Student Council or Math Team
- Make things exciting for the kids during our class presentations
- Attempt to integrate math into things somehow
- Start after vacation ok, just make sure that we do not start too much later

Meeting 2/27/07

- Modify Faces permission slip to apply to our school, send to advisor and principal, ask them to ok the form and give to the students, get it signed off by the advisor, distribute next week and then collect the week after
- Day off from school on March 21st
- Once we have everything set we must get the buses, substitute teachers, chaperones
- Need head count for each school concerning the lunch for the space conference
- Need to let them know which space presentations sound the most interesting
 1. New Space Initiative – public attitude towards moon
 2. NIAC Study – forecast for future in space
 3. Atmospheric Mining Group
 4. Lunar Agriculture
 5. Drives – Solar Sail, Nuclear
 6. Moon and Mars
 7. Lunar Base – Cosmic Radiation
 8. Space Tethers/ Mass Drivers
 9. Can Space Station pay for itself
 10. Fusion/Helium 3
 11. DoSpace Initiative

Appendix D

2007 North High Science and Technology club survey

1. Did you have fun as a member of this club?
2. Would you like to see the club continue again next year?
3. What did you particularly like about the club?

4. What suggestions could you make to improve the experience during meetings?

5. Was the field trip to WPI a valuable event? Is there anything you would prefer to see on campus?

6. Comments:

Appendix E

IQP: Future Scientists and Technologists

Prospective Meetings

1. Chocolate Asphalt
 - Civil Engineering - A basic over view of road construction and different materials used in the process followed by making of asphalt from melted chocolate and other chocolate candy.
2. Lego Project Management
 - Civil Engineering and Project Management- An overview of what a project management and then a construction project with legos. Project goals would include building a tower with legos, surviving a wind test with that tower, and also keeping cost low with the amount of legos.
3. Gears, Cams, and Linkages
 - Mechanical Engineering- A look at many simple devices that are used in all types of machines.
4. Teraforming Mars
 - Biotechnology- Presentation on how different plants could be used to create oxygen on Mars.
5. Computer Science with Professor Gennert
 - Computer Science- A look into computer science from the head of the WPI department. Actual presentation focus undetermined.
6. Rehabilitation Engineering with Professor Ault
 - Rehabilitation Engineering- Look at the design process and helping people with disabilities have as much of a normal life as possible with the help of engineering. More details to be determined.
7. Robotics Demonstration with Ken Stafford
 - Robotics Engineering- A presentation using robots to show in a fun way the ability of robots.
8. Space presentation field trip at Ecoterium
 - A WPI sponsored field trip where WPI IQP presentations will be given at the Ecoterium in Worcester accompanied by a presentation by a member of the NASA Institute for Advanced Concepts.
9. Introduction to Engineering given by the WPI Admissions dept.
 - Overview of all the different typed of engineering accompanied with information about starting salary and the growing market for engineers.
10. Another Field trip to WPI
 - Field trip sponsored by WPI to give a tour of labs on campus and to give demonstrations on computer software unavailable at the Worcester Public High schools.
11. Space Survey results presentation
 - An overview of data gathered from a survey in Pennsylvania and in Worcester High Schools to show what high school students think about space.
12. Pizza Party
 - Final meeting with pizza and soda final questions from students can be answered.

Appendix F

| Attendance Sheet (Students) | | | |
|------------------------------------|------------------------------|--------------------------------|--|
| | <u>Number of Male</u> | <u>Number of Female</u> | <u>Total number of Students</u> |
| Meeting 1 (02/28/2007) | 10 | 8 | 18 |
| Meeting 2 (03/07/2007) | 6 | 4 | 10 |
| Meeting 3 (03/14/2007) | 2 | 5 | 7 |
| Meeting 4 (03/21/2007) | 6 | 6 | 12 |
| Meeting 5 (03/28/2007) | 9 | 2 | 11 |
| Meeting 6 (04/04/2007) | 10 | 8 | 18 |
| Meeting 7 (04/11/2007) | 21 | 12 | 33 |

*Note: 33 different students attended the club throughout the course of all 7 meetings

Appendix G

It is my pleasure to write a letter or recommendation for Alan Ngo and Timothy Souza with regards to their work with the Science and Engineering Club at WPI. Both Alan and Tim were very good working with the students, and provided club activities that got the students thinking about careers in science and engineering.

As a WPI graduate in 1993, I remember well my IQP. Like Tim and Alan, I chose to complete my IQP at a Worcester school. My IQP involved teaching a thematic unit dealing with alternative energy sources at Belmont Elementary School. Based up on my experiences then, and my career as a science teacher at North High School, I appreciate the effort and thoughtfulness that Tim and Alan put into the club. They were very patient with the students, and were able to answer questions in a thought provoking way. Many of the students involved in the club have expressed an interest in taking an additional science class at North High, over and above the graduation requirements.

I sincerely hope that Alan and Tim enjoyed their time at North High as much as we did, and I am happy to have had a chance to work with both of them on this club for the students.

Sincerely,

Greg Morse

Greg Morse
Science Teacher, North High School

Appendix H

Proposal Draft #1 - The Worcester Future Scientist and Engineer Clubs: A Proposal to be reviewed by ...

Last year Duncan and Dorchik (June, 2006) ran a pilot project at Doherty High School on the possibility of establishing Future Scientist and Technologist clubs in the Worcester Public Schools. This year that pilot program has been expanded into five teams of two students that will be setting up clubs at five different high schools, Doherty, Burncoat, North, South, and Worcester Technical High School. Advisors have been designated at all the schools and they will start in WPI's D Term, at the latest. This would make time for a two month long program with one meeting a week with a field trip to WPI included as one of those meetings.

Some of the meeting topics last year such as a general overview of the different areas of engineering and a robotics demonstration would be included again in our meetings. Also our group has been working with our advisor John Wilkes on many new ideas for meetings such as presentations on assistive technology, materials, space exploration, asphalt properties and mixing, and a design challenge. These proposed meetings show many different aspects of engineering and the high school club advisors have responded well to most of them. Some of the advisors like Joseph Marzilli and Brian Morse of North High are both WPI alumni and have agreed to advise the club there at North, with or without "overtime" pay. However, most of the principals are saying that no pay is available, and not all advisors can donate their time.

To fund this club each group member is going to contribute seventy five dollars over the course of our three term IQP. We would like to ask WPI to provide one hundred dollars for each group member to supplement the a donation of seventy five dollars of our own. Thus each two person team will have a "WPI" budget of three hundred and fifty dollars per term. Along with the money WPI and our group is supplying we will also ask the Worcester Public School system to match WPI's investment to the club of two hundred dollars per club. This would give us a budget of two thousand seven hundred and fifty dollars for the five clubs. This allows for over twelve hours of time with the high school advisors to the club. We would like to spend eight of those hours in the club and four for outside meetings with the advisors to organize for meetings, and go on a field trip.

The main resource requirement for the club project involves union rules for WPS teachers. They must be paid thirty dollars an hour for "overtime" – after hours teaching and advising. Last year the WPS first promised the money for two clubs and then rescinded the offer. To protect the project we plan to fund the club for a minimum "honorarium" from WPI of two hundred dollars, per advisor and still have seven hundred and fifty for busses to have a field trip to WPI. This will cover an hour a week for seven actual club meetings, and five meetings to plan, debrief, and do other things such as recruit and assess. A request will also be submitted to WPS for a two hundred dollars per club, but that will be to cover transportation for a second field trip, special events, and other expenses including a party for the last club meeting. These are things we can do without if we have to do so, though they would greatly enhance the program. Thus, if WPS again runs out of funds and cuts all the "frills", the project can go forward on a

“staff” and WPI trip only budget. If they come through each club will have an five hundred and fifty dollar budget. We expect to cost share the project with WPI, as noted above.

We believe that this project could be very important for the city of Worcester, and help WPI enhance the engineering profession. Many people would garner the benefits of these clubs. All ten of us are eager to get started. If we want these club programs to be as extensive as we explained we must know we have advisor pay and can get to WPI at least once at the time of a student Pugwash conference on space technology and the return to the moon tentatively scheduled for early April. We know we can get these clubs off the ground, if we can get the WPS faculty advisors to commit enough time without your assistance we will not be able to assure them that they will get at least token payment for their time, and get to use WPI resources at least once.

Appendix I

Proposal Draft #2 - The Worcester Future Scientist and Engineer Clubs: A Proposal to be reviewed by Richard F. Vaz

Last year Duncan and Dorchik (June, 2006) ran a pilot project at Doherty High School on the possibility of establishing Future Scientist and Technologist clubs in the Worcester Public Schools. This year that pilot program has been expanded into five teams of two students that will be setting up clubs at five different high schools, Doherty, Burncoat, North, South, and Worcester Technical High School. Last year a field trip was talked about but was never actually done this year a field trip to WPI was made possible by our IQP team. Our field trip included an admissions talk about WPI and the projects program, an admissions guided tour of campus, and the pugwash space conference. The pugwash space conference showcased many WPI IQP groups which did projects on the future of space. The presentations showed new technologies being developed now and what a future space station on the moon would look like and how it would function. The trip was set up to excite the students interest in engineering which is the clubs main goal and also to get the students interested in a career in new space opportunities as an option for their future. This field trip brought about eighty students from the Worcester high schools to WPI and further stimulated their interest in engineering. Our team thinks that this was a very valuable experience for the students and wants this type of trip to be done annually.

We are requesting that WPI reimburse our group for the busses for the trip which totaled three hundred dollars. All other expenses of the group have been covered by our group members themselves and have definitely amounted to the two hundred and twenty five dollars that each member is supposed to spend for the three term IQP. We would greatly appreciate the help of WPI in funding for the busses to lessen the strain on us for money. Without this help it would be very hard to get the clubs next year to organize and follow through with a similar trip to WPI. With the momentum we currently have with these high school clubs it would be a shame is the IQP group next year working with these clubs was not able to achieve this field trip again after the success we had this year.

Appendix J

November 5, 2006

Kathy Kambosos
Doherty H.S.
299 Highland Street
Worcester, MA 01602

Dear Mrs. Kambosos,

I am writing this letter to introduce a team of ten students that have registered for the project offered by John Wilkes and Liz Tomaszewski to expand and improve on last years high school clubs project. This project would work off of the project that Brian Dorchik and Mathew Duncan set up last year, but we will now have a larger team setting up five teams of two students to send to each major Worcester High School. We would also like to start earlier to make more meeting times possible.

Our group consists of juniors in both mechanical and civil engineering. Most of us are also football players at WPI and involved in the fraternity system. We are looking forward to working with kids in the same place we were three or four years ago thinking about what we are going to do with our lives and considering engineering as a possible career. We would all like to share what we have learned at WPI to help these students potentially interested in engineering to pursue their goals and give them a better engineering knowledge base as they move towards college. We can share about the college culture and community life as well as the academics, but will not be trying to “sell” WPI per se. Still we want to make WPI resources available to the clubs.

As we develop our proposal we will want your perspective on how things went last year at Doherty. We have read Dorchik and Duncan’s report and it made us optimistic about what can be done this year.

We also want to know what you think about the idea of approaching the other schools about similar clubs. Would you be able to provide names of people at other Worcester high schools who can advise clubs and do you think the ETA should “sponsor” the clubs at other schools as an “outreach” program? We also want to talk to you about whether running the sophomore survey was valuable enough to do again maybe in a required science class.

I hope we can meet soon to discuss the club and how it will be moving forward this year. We are really excited to get the club going and start teaching kids some basic engineering.

Sincerely,

Chris Norton, Orry Cummings, Charles Fradella, George Chyoghly, Keegan Richey,
Matt Frasier, Nick Ambrosino, Alan Ngo, and Timothy Souza
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