Development of a Capstone Grade 12 Pre-Engineering Experience in the Worcester Public Schools

An Interactive Qualifying Project Report

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Abstract

Recently, there has been a decline in interest in the fields of science, mathematics, and engineering among Massachusetts's high-school students (Kelly, 2001). The Massachusetts Education Reform Act of 1993 was, in part, designed to improve the preparation of all students in professional work by increasing the level of education in these areas in Massachusetts' public schools. Doherty High School (DHS) in Worcester, is one of the first schools in Massachusetts to target the field of engineering. Doherty is developing a program in collaboration with Worcester Polytechnic Institute that promotes education in engineering. Previous Interactive Qualifying Projects (IQP's), a graduation requirement at WPI, at DHS have developed curricula for grades 9 through 11 in the pre-engineering program. The focus of this project is to develop a curriculum for the spring semester of a grade 12 pre-engineering program.

Our goal was to develop recommendations, using a variety of data collection methods, for the second semester of the pre-engineering curriculum for Doherty High School seniors. This curriculum includes a module that sends students to either an internship or college course for a portion of the semester. It also includes suggestions for a preparation period that will provide students with the necessary background needed to successfully complete either the internship or college course. After the students have returned from their endeavors, there will be a debriefing period where they critically assess their experiences and present them to the 10^{th}, 11^{th} and 12^{th} grade pre-engineering classes.

Introduction

The number of students majoring in engineering in the nation has reached a 10-year low (Thompkins, 1998). After the 1986 peak, this number has decreased by approximately 19% (Kelly, 2001). One of the reasons identified for this drop is the "poor high school preparation in math, [and] science [and] ignorance of what engineers do" (Kelly, 2001). The Massachusetts Department of Education (DOE) has developed a system for public high schools to improve their level of education. As part of the Education Reform Act of 1993, Massachusetts provided Curriculum Frameworks, which recommend course material and a minimum level of comprehension for publicly educated students. The Massachusetts DOE has recently added frameworks that promote the education of engineering and technology in public schools. Doherty High School is collaborating with Worcester Polytechnic Institute in order to develop pre-engineering curricula for its students to meet the recommendations of the state Curriculum Frameworks. This collaboration has thus far produced modules for grades 9 - 11.

We worked with Doherty High School to develop the second semester of the grade-12 pre-engineering curriculum. This curriculum is divided into three modules:

1) a preparation period during which students are introduced to resume writing and portfolio development,
2) an internship at a local company or a class at a local college,
3) a debriefing period where students present what they have learned to DHS students in grades 10, 11, 12, and assess their own experiences critically and reflectively.

This report is divided into five chapters: Literature Review, Methodology, Data Analysis, Conclusions, and Recommendations. In our literature review, we discuss background information and a few precedents for our proposed curriculum components. Topics covered are: the declining interest in engineering, the Massachusetts Education Reform Act, Doherty High School's role in promoting engineering education on a larger scale, and current modules for high school students

taking college courses and participating in internships. Our methodology section includes a detailed description of our procedure for arranging and placing students in internships and college courses. Our data analysis section includes an exact description of all our results and its analysis. It contains the conclusions of our feasibility study, the data from the surveys we issued, and the results we obtained while setting up the college courses and internship positions. Our recommendations section acts as a guideline for the people taking over this project after we have established it. It includes the names of the people that should be contacted when preparing for next year, how to follow up with the colleges and companies in the fall to finalize the plans for the spring, strategies that worked for us when setting up the capstone experience, comments to our liaisons and the EPiC board to improve the program, and other options available when the program grows. Our conclusions include a brief description how our project affects the Engineering Pipeline Collaborative as well as the students for whom we are preparing this program.

Literature Review

There is a legitimate need to introduce more high school students to engineering. The number of engineers graduating from college has dropped in comparison to 10 years ago (Dolan et al, 2000). Several groups have addressed this topic in the past. The Massachusetts Education Reform Act of 1993 mandates that high school students be able to discuss certain topics in engineering by grade 12. There are precedents that have allowed students to broaden their horizons by participating in college courses and internships. This chapter will discuss these precedents, their importance to the broader goal of increasing engineering awareness, and ultimately, why it would be beneficial to incorporate parts of these modules in a 12^{th} grade pre-engineering curriculum at Doherty High School.

I. Background

The decline in the number of students who pursue engineering as a career can be explained by several factors. These reasons range from "the perception that engineering is not a stable profession…to poor high school preparation in math and science" (Kelly, 2001). Massachusetts is the first state in the nation to focus on the issue of increasing awareness about engineering among high school students in terms of the statewide curriculum. Doherty High School in Worcester, Mass is one high school striving to find a solution for its students.

Education Reform Act of 1993

The Massachusetts Legislature passed an act in 1993 to ensure that all students in Massachusetts' schools are given the opportunity to learn material outlined by the academic learning standards of the Massachusetts Curriculum Frameworks (Cannata et al., 2000 – 2001). This act guarantees that students have the necessary background in a variety of fields, including science and technology/engineering. The Massachusetts Education Reform Act of 1993 mandates a three-part reform process. The first part is the Common Core of Learning, which is a

set of broad educational goals constructed by Massachusetts' citizens for publicly schooled students. The second part is the Curriculum Frameworks, which set specific curriculum standards for each grade level and subject, based on the demands of the Common Core of Learning. The third part is the Massachusetts Comprehensive Assessment System (MCAS), which is the statewide assessment program based on the frameworks, to measure the performance of students and schools based on the standards set in the Curriculum Frameworks (Massachusetts Department of Education, www.doe.mass.edu).

Although the Curriculum Frameworks are only statewide recommendations, the required MCAS exams offer the state a quantitative method to assess the effectiveness of public education in Massachusetts. Since the adoption of the Education Reform Act, an additional framework approved for science and technology/engineering courses has been added. Doherty High School has adopted a program called the Engineering Pipeline Collaborative (EPiC) through which Doherty teachers realize these new engineering frameworks in day-to-day lesson plans.

The Engineering Pipeline Collaborative

The Engineering Pipeline Collaborative is a program that embraces the spirit of Massachusetts' education reform. The Worcester Public Schools sponsor the EPiC program with support from local companies and colleges, including Worcester Polytechnic Institute (WPI). One of the goals of the EPiC is to improve the level of education that high school students receive in the fields of engineering and technology (Schachterle, 2001). EPiC focuses on two main issues: 1) preparing future engineers for the difficult college curriculum that they will face in upcoming years, and 2) providing potential engineers with the opportunity to explore a field that they may be interested in pursuing as a career (Cannata et al., 2000 - 2001). Presently, Doherty High School only has modules for grades 9 - 11. This IQP helped to develop a grade-12 capstone experience at Doherty High School. The curriculum includes college course and

internship modules that will take place during the last half of Doherty's 2002-2003 academic school year. Some background and existing models for the modules that we developed will be discussed in the next two sections.

II. College Coursework for High School Students

There are several approaches for engaging students in an engineering curriculum. One approach is to enroll students in advanced coursework on a college campus. A course at a local college would allow the student to preview engineering before they actually attend college. Engineering classes would challenge the students' performance and motivation in the field they wish to study. A student who finds himself or herself comfortable with these classes is more likely to pursue an education and a career in this field. There are several ongoing programs that could aid us by serving as models for the development of our college course module. The Dual Enrollment Program and summer college engineering programs for high school students are some that we have found. These programs will be discussed in this section.

The Dual Enrollment Program

The Dual Enrollment Program (DEP), established by the Education Reform Act of 1993, allowed qualified students to earn high school credit by taking courses at Massachusetts institutions of higher learning (Massachusetts Department of Education, 1997). The DEP, which was run by the Massachusetts Department of Education (DOE), is not currently in operation due to a loss of funding, but is relevant because it may be reinstated in the future. High school juniors or seniors could apply to this program with written consent from their parents or guardian. A GPA of at least 3.0 was required and the student must have demonstrated the ability to benefit from a college level course as observed by the student's teachers, principal, or guidance counselor (DOE, 1997).

The courses in which a student may enroll through the DEP should be courses that will both aid the student in growth or progress and fulfill high school graduation requirements (DOE, 1997). The grading of these courses with regard to high school transcripts is at the discretion of the high school. For example a grade of a 'B' in the college course may be listed as an 'A' at the honors level on a high school transcript.

The Dual Enrollment Program was funded by the Commonwealth of Massachusetts; the Board of Higher Education established costs per credit for students participating in the program. These costs established for the 1997-1998 academic year were $150 for the University of Massachusetts, $100 for state colleges and $70 for community colleges (DOE, 1997). Certain fees such as lab fees, which are not covered in the per credit cost, may be waived by the higher education institution or will be the responsibility of the student. Students are required to provide their own books and transportation.

The general regulations of the Dual Enrollment program can be applied to any high school in Massachusetts that is interested in sending its students to take college courses, regardless of the type of program the high school is willing to develop. The DEP will be very helpful in the development of our module, and might still be beneficial to the students at Doherty High School if it is eventually reinstated. In addition to the exposure to college level courses, students would be adding credits toward their own high school diplomas. In the structuring of our college course module, we would have utilized the DEP as a mode of enrolling students into colleges. If the program regains funding, it would be the most appealing enrollment option to cover the cost of classes at public institutions.

Existing Modules: Summer Programs

Summer college engineering programs provide high school students with the opportunity to attend college courses. Similar to the Dual Enrollment Program, high school students take

college level introductory engineering courses at local universities. These courses familiarize students with different branches of engineering. For example, Denver University has designed a college-level engineering program called "The Making of an Engineer" (ENGR 0050). In this program, students are taught "the art and science of engineering". It is offered over the summer and all high school students interested in science and technology are recommended to take it. If successfully completed, students will earn college credit for the course (http://www.du.edu/education/ces/moe.html). "The Summer College Engineering and Computer Science Program" hosted by Syracuse University is another similar existing module (http://sumweb.syr.edu/ssr/summer/engineering.html). In these summer courses students explore the roles of creativity and problem solving in different engineering disciplines. Students also learn about basic tools and techniques employed in engineering such as using spreadsheets, estimation, data analysis, and computer aided drafting. Beyond classroom lectures, students are taken to visit power plants, manufacturing, and construction sites where engineering is practiced. The courses that are used in this program are a good model for courses that should be suggested in our module.

III. Internship as "Windows to the Future"

A college course can be a valuable asset to give students an idea of what college-level engineering will be like; however, sometimes a hands-on module would be more appropriate. Interested and qualified students participating in an internship program during their senior year in high school gain first-hand experience in the field of engineering. In college courses there are certain skills and background that students must develop to succeed, especially in mathematics. These skills may not necessarily be in our internships since the candidate may not be engaged in activities that require them, such as working with machinery or drawing.

Models for High School Internships

An increasing number of companies are starting outreach programs that aim to attract young people into the engineering field (Kazi, 1994). The reason for this is they are trying to create a future resource pool of employees for themselves (Ruber, 2000). Companies such as the Aerospace Corporation, which is a federally funded research company based in California, and the non-profit group, Making Opportunities for Upgrading Schools and Education (MOUSE), in New York City, have started programs to recruit high school students. These organizations give high school students a taste of what their companies have to offer.

The Aerospace Corporation started a program in the early nineties called the "Rebuild L.A. Program" (Kazi, 1994). The company picks students from local high schools who appear to have promising futures to intern for them over the summer. These students participate in jobs that interest them under the guidance of experienced Aerospace Corporation employees. In the program's first year of operation, it had 30 students; the next year it rose to 41 (Kazi, 1994). This program is a huge success and gives technically inclined students a view of how the high-tech field operates.

MOUSE, along with Redwood Partners' CEO Randy Shoenfield, started a program called "Interactive Internship" (Ruber, 2000). This program works with inner-city high schools to give students a chance to explore the realm of the high tech industry. While sponsor companies in this program are mainly Internet based, it can provide a valuable model for future programs or even an expansion to include engineering companies. In addition to the experience received by the students in the program, the companies obtain personnel who can be trained in the area that could most benefit from a future generation of skilled IT workers.

Internships are a valuable asset for both students and the corporations alike. While students gain experience and confidence, employers are fostering a flow into the high tech professions. Programs such as these will aid both parties in the future. The key to a successful

internship is that students must think critically and reflectively about their work experience. If the knowledge gained is lost within a month, the point has been missed. Internships for high school students allow them to excel in college and in the work force, knowing that they have already gained the necessary experience. Our project will provide Doherty students with the opportunity to do just that. Working at a local company will also open up the possibility of a future job for these students. The advantage DHS students will have is guidance from their schoolteachers, something most students in an internship do not have.

IV. A Preparation Term

The students need to be prepared in order to succeed the college course and internship modules. Preparation materials for the students must be developed from a variety of sources consisting of: information designed to assist in the selection of courses; methods to register for courses, contact information for companies and material designed to orient students with work environment in locations other than their current high school. This material must be presented in a beneficial manner so that the student will understand what will be expected of them in the future.

Instructional Objectives

In order to develop a curriculum for a high school pre-engineering course, methods for teaching the subject of engineering must be explored. Gupta (1987) suggests instructional objectives to be the most important piece of information required to properly teach any subject. He defines an objective as "an intent communicated by a statement describing a proposed change in the learner – a statement of what the learner is to be like when he has successfully completed the learning experience..." An instructional objective must indicate three points of information:

1) What the learner will be doing when demonstrating that he or she has reached the objective
2) The important conditions under which the learner will demonstrate his or her competence
3) How the learner will be evaluated, or what constitutes acceptable performance.

In the case of the DHS students, instructional objectives will not specify learning as taught in the engineering class but rather that done either in the college course or internship. Through weekly assessment journals, students will be consistently evaluating their own progress in attaining their goals. For college courses, the information that students are expected to express along with the method of evaluation is specified in the syllabus. For internships, this information is specified by the job description.

Resume Writing

For effective placement of students in either an internship or college course, it is necessary to identify their area of expertise and background. One of the best ways to accomplish this is for the students to submit resumes to the screening personnel, which will also be beneficial to them in their future job searches. A resume serves as an introduction to one's qualifications, and is used to get an interview with a company or to better market one's experiences. The Career Development Center (CDC) at WPI and the Worcester Public Schools have each prepared guides that assist students in writing resumes.

There are three common formats for professional resumes, and one specialized format for academia and research called the Curriculum Vitae. The first format is the *chronological resume*, where jobs are listed in chronological order, starting with the most recent and working back through the years. The second format is the *functional resume*, which highlights qualifications with little emphasis on specific dates. The third format is the *combinational*

format, which is similar in format to the functional resume, but also has company names and dates included in a separate section.

Since most students will not have a long list of relevant work experience, they should include other information that markets their skills and abilities. This content could include their contact information, a short objective, honors, awards, sports, hobbies, community service, course listings, skills learned in class, foreign languages, publications, and any work experience they may have. As recommended with most students, the resume should not exceed more than a full page on 8 ½ by 11 inch paper and should include only information that will help portray all that they can offer to their employers.

Student Mentoring

Student mentoring has been used in several applications. One such application was Project CIRCLE (Community of Information Resources and Collaborative Learning Environments), an implementation of computer-based tools for collaborative learning in high schools, sponsored by the University of Texas in Austin. As part of this project, high school teachers were trained to use several software packages that were intended for usage in the classroom. To complement the training, student mentors (high school students) were assigned to the teachers to assist them in the implementation of the software. Although many teachers felt that the training session they received was adequate, "they still felt insecure in taking that first step in using the technology with their class" (http://www.cica.indiana.edu/cscl95/resta.html). The student mentors were able to alleviate the teachers' anxiety by assisting them with the actual implementation. After the completion of this project many teachers not related to the program requested student mentors to assist them in the implementation of other software packages. This is just one of many examples of mentors assisting in the education of others. A similar program could greatly assist the DHS students in their endeavors during their senior year.

Methodology

A methodology is an organized, documented set of procedures and guidelines. Our methodology is divided into several major sections in which we discuss all aspects of the curriculum that we have installed. These sections are presented in the order in which they were addressed in our Interactive Qualifying Project. Our report includes a complete curriculum for the spring semester of grade 12 in the pre-engineering program at Doherty High School. The curriculum includes an option to either take college courses or participate in internship programs at several local engineering related companies, all of which will interest and motivate the students. We have included a proposed schedule of events for the students to present their experiences to their peers during the debriefing portion of the program.

I. Feasibility Study

We conducted a feasibility study before we began the development of our pre-engineering curriculum, as we had to determine whether our project would be feasible for us to complete and for Doherty students to take part in. This feasibility study identified issues such as student scheduling and availability of internships and college courses. The following sections are organized into a set of specific tasks that outline the study from an initial student schedule survey to the final feasibility report.

Time Frame

At Doherty High School the academic school year is broken into four ten-week quarters: the first quarter runs from August 27th to November 1st, the second from November 2nd to January 17th, the third from January 18th to April 4th, and the last from April 5th to June 13th. In the case of the seniors, the last quarter ends around May 26th to prepare for graduation. We proposed that our project take place during the first semester (the first 20 weeks) of the academic

school year at Doherty High School. Scheduling just after summer vacation causes a few problems because WPI courses begin in August, before DHS classes get underway. This is problematic since DHS students still have to go through a short preparation term, which means they would be starting their college courses late into the college semester. Beginning courses late into a college year would be a very ineffective learning experience for DHS students at WPI because they would need so much time to catch up to the class that they would not be able to get the full experience of a complete college course. This would also be very impractical for the DHS students at QCC since registration for a college course would still require the students to pay the full cost for the course, even if attending a few days or weeks late. Not only would students have to pay full price, but QCC strongly recommends that all students attend their courses from the beginning for the same reason that WPI does; it would be very difficult to catch up in the subject material.

Scheduling during the first 20 weeks would make this project very difficult to implement, so we had to find the best alternate time frame for this project to take place. To find the best time frame, we prepared a document comparing the pros and cons of three other options. The first option is to have the program during the second 20 weeks (middle of the school year), running through the holiday break. The second option was to have our program during the third 20 weeks (end of the school year) – the second semester beginning in January. The final option was to have the internship and the college courses run over staggered time frames. This meant that the internships would run during the second 20 weeks, while the college courses would begin during the third 20 weeks. The discussion between the three options is reported in detail in Appendix 1. Having our program during the second semester proved to be the easiest to manage and would give us a definite timeframe on which to base our feasibility study.

Task 1: Student Scheduling

This initial study gave us an idea of the average schedule for a Doherty High School senior in the pre-engineering program. First, we administered a schedule survey (Appendix 2) to the students asking them which classes they were planning to take during their senior year. We also examined the students' involvement in extracurricular activities, such as sports, jobs, honor society meetings, or other commitments that might influence their after-school availability. After we compiled our data into a spreadsheet (Appendix 3), we spoke to Mrs. Sue Michaud, a DHS guidance counselor, to determine during what periods the students' prospective classes were being offered. Unfortunately, there will not be a final list of classes and times for next year until late summer. We were advised that the classes are usually available during the same periods every year, so we based this study on continuity into the next year. We were able to use the information provided by Mrs. Michaud and our schedule survey to help us determine which days and times would be best to schedule the college courses or internships for the students. We then organized this information by day and times, so that we could observe any trends of available time during the week.

Task 2: Available Course Inventory

The initial exploration of college courses focused on Quinsigamond Community College, Worcester State College, and Worcester Polytechnic Institute. WPI and QCC are the nearest colleges in Worcester to DHS that offer engineering courses and other courses that are required for engineering majors (physics, calculus, chemistry, etc). WSC offered some of the basic sciences that could be used as background for engineering courses, but did not offer any actual engineering courses. It was for this reason, along with the fact that QCC is less expensive, that we eventually excluded Worcester State College. Since our project will take place during the

last 20 weeks of DHS's academic schedule, we examined the course catalogs for C and D terms at WPI and the Spring semester at QCC.

Task 3: Available Internship Inventory

Once the college information was gathered, we spoke to David Potter and Sheila Frias, both School To Career Coordinators from the Worcester Public Schools, who have experience with placing students in internships. They supported our initial idea of scheduling the internship at the end of the school day, and provided us with a list of companies that might be interested in participating in the program. This list included the 100 largest employers of the Worcester area and companies from the Worcester Chamber of Commerce. There are six students that are interested in participating in an internship: four in biotechnology and two in mechanical engineering. We decided to place two students per company so that students could keep themselves motivated and feel more comfortable around their peers that share the same background and experience. We are going to place the students into two biomedical companies and one mechanical engineering company based on the students' interests respectively. We also wanted to have a single backup company for each industry – one biotechnology and one engineering company – for a total of five companies. We narrowed down the list to only engineering and biotechnology companies. David Potter suggested that we should search for at least 15 to 20 potential companies in order to secure our three. With our initial research into internships complete, we were able to proceed and write the feasibility report.

Task 4: The Feasibility Study

Finally, we reported the findings of our feasibility study to our liaison and advisors. Since our project was found to be feasible, as noted in our feasibility report, we began to research and develop our final curriculum framework for the internship and college course

modules. If we had found that the project was not feasible, we would have determined what changes needed to be made, and then presented those suggestions to our liaisons. The feasibility report, found in the Data Analysis chapter, was relatively short but integral to the progress of our overall research. After determining our project's feasibility, the next logical step was to develop the screening process that individualizes the capstone experience.

II. The Screening Process

The screening process offers methods to determine what each student would like to do during the second semester of his or her senior year. We recommend methods for placing students in either a college course or an internship based on personal essays, academic performance, and recommendations. Through this process we hope to match students up with the best possible capstone experience.

Student Interest Survey

In order to determine the eligibility and interest in the grade-12 program, a screening process was completed with the current 11^{th} graders. As part of the screening process, we conducted an "interest survey" on the census of 11^{th} grade students in the pre-engineering program. "The basic idea of a survey is to measure variables by asking people questions and then to examine the relationships among the measures" (Singleton, 1998 p. 247). The purpose of this survey was to find out which academic and professional disciplines interested students most.

To introduce the possibilities our proposed colleges could offer, we provided short descriptions of several engineering and science majors and fields of study as found in the Society of Women Engineers website (http://www.swe.org/SWE/StudentServices/CareerGuidance/brochure2.html) (Appendices 4 - 5). The students ranked each interest on a scale of 1 (least interested) to 10 (most interested) to determine the degree and frequency of interest in certain

fields. From this data we determined and recorded the most popular disciplines. The interests of students in grade 11 may change each year, meaning that this survey will need to be repeated each year in order to maintain an accurate representation of the students' interests. This survey focused on students' interest therefore, questions that pertain to race, ethnicity, or gender were not addressed. The reason we decided this is because these questions are beyond the scope of our IQP. Our project focused on the development of the second semester of a grade-12 curriculum, not "Marketing Pre-Engineering Diversity" as did the previous IQP, which also dealt with the same group of students. In general, their results showed that females and minorities are more interested in a profession that helps someone, such as being a doctor. Females especially preferred medicine or biology to engineering because they did not agree with the statement that engineering betters society (Dolan et al., 2000, p. 78). Further information on the issue of women and minorities in engineering can be found in the IQP report entitled "Marketing Pre-Engineering Diversity: A Focus On Engineering Minorities" (Dolan et al., 2000).

Interviews

The last step in narrowing a specific field of interest was to conduct one-on-one interviews with the current 11th grade pre-engineering class. During these interviews we asked questions that pertained to:

- the students' preference for either an internship or college course,
- their motivations for participating in the engineering program, interests within majors,
- preferences for projects that they previously completed and whether they had any connections within local companies.

Since this class consisted of only 11 students, one-on-one interviews with all the students were feasible and relatively simple to execute. As this program expands, however, this may not be the case.

Student Placement Survey

Student placement surveys can be useful once the pre-engineering program grows to higher numbers and one-on-one interviews become unfeasible. We developed a student placement survey (Appendix 6) that addresses many of the same questions that were present in the interview guide. This survey could be distributed during one of the engineering classes and collected the next day in order to allow the students ample time to thoroughly respond. During the period in which the surveys are to be collected, time should be allotted for students to finish responding to the survey. This will increase the accuracy of their responses as it will allow for them to clarify any questions they may have regarding the survey before they hand it in. Once these surveys are collected they can be used to identify each student's preferences for their senior year. As with the interviews, this survey should be completed at the end of the students' junior year in order to allow enough time to develop internships with companies.

Teacher Recommendations

We have developed a teacher recommendation form (Appendix 7), which will assist in identifying the student's capabilities and motivations. This form is to be completed by three teachers: the students' engineering teacher, a math or science teacher, and one non-science teacher who will reveal the students' performance in an area that might be out of their interest, which would provide a better view of the student as a whole. This form will be used in conjunction with the surveys and essays that we have devised in order to assist the screening personnel. Specifically, decisions regarding which college/company a student will attend could be determined by this form, as it addresses issues such as communication skills and other non-engineering related skills.

Student Essay

In addition to the teacher recommendations, students will also have to write a two-question essay. One question focuses on their interest in pursuing an internship or taking a college course while the second asks why they think it will be a meaningful experience. The essay questions (Appendix 8) are worded in such a way that will allow the screening bodies to assess the student's motivation and goals for the internship and college course. In addition to appropriately placing students in internships and college courses, the purpose of this essay is for the students to think critically and reflectively as to what these experiences will add to their student records. This essay should be a good first-hand indicator for the screening bodies as to how the students feel towards taking a college course or participating in an internship, and will be an integral part of the screening process.

Student Screening

Portfolios including teacher recommendations and student essays will be given to the screening personnel. The screening personnel will most likely be teachers currently involved in the pre-engineering program. The list of potential companies will be narrowed down due to the interest survey, so that only companies in the industries of interest will be considered. The potential college for a particular student will be selected by a review of the students' grades and academic performance. We will screen the students this way because we do not want to place a student into an environment where he or she may fail or may not be challenged to the extent that would be beneficial.

III. The College Course

The college course module will be one of two modules that will run during the second semester in the 12^{th} grade pre-engineering program. The procedure we used to set up the

internship module will be outlined in the next section. This section is a continuation of the sub-section entitled "Available Course Inventory," under the main heading of Prescreening in this chapter. In that section we had outlined our procedure for obtaining a preliminary list of colleges and courses. After the college of interest had been identified, the next step was to identify introductory courses in several engineering fields of study along with math and science courses. We obtained the schools' catalogue and web site address. These sources will give us a general description of the courses offered at each college and their pre-requisites. The first task we needed to complete was to narrow down our course list from the one that we compiled in the feasibility study.

College Course Selection

We had compiled a preliminary list of college courses from WPI and QCC for our feasibility study. However, that list was not sufficient for our final report, as it needed to be filtered. It was therefore necessary to trim our list down to only those classes that would fit into our proposed time frame, and those that would most benefit students without overwhelming them. Primarily, we used our own experiences with classes at WPI to screen our list. We also limited our course listings to intro engineering, biology, calculus and lab science courses. For QCC, we spoke with Professor Dadbeh Bigonahy, Coordinator of Engineering and Sciences, who assisted us in narrowing down our initial list of courses.

Design of the Students' Academic Schedule

Students in the pre-engineering program will still be required to take a full schedule of high school classes while engaged in their capstone experience. Therefore, it is imperative that the pre-engineering class be scheduled during the last two periods of the day. This particular scheduling will allow students to attend their college course or internship without worrying about

returning to Doherty on time. Also, students will need to select a class that fits into their personal schedules, taking into account extracurricular activities. We included in our final class list (Appendices 9 – 14) several times that each course is offered. Hopefully this will assist the students in their course selection.

Interviews with Admissions and Other Offices

After we finalized our list of courses, we needed to decide how the students would attend the selected colleges. Due to safety and liability reasons for the colleges, the students would have to be formally matriculated into the college. However, this procedure would be different from the general school population. We met with many people at both colleges to finalize the procedures by which the students will be matriculated.

We started our inquiries at QCC by speaking with Dadbeh Bigonahy and Tara Fitzgerald, Dean of the Registrar's office. We received some information about placement tests, auditing courses, and financial assistance. We then spoke with Pamela Fitzgerald, the Dean of Instruction for Technology at QCC: she spoke with us about tuition and specific admissions procedures. After we spoke with her we had finalized the admissions procedure for QCC, which is detailed in the Data Analysis chapter. After our meetings with QCC, we contacted Professor Lance Schachterle, Assistant Provost of WPI. He provided us with all the information we needed with regards to admissions procedures and tuition arrangements for the students.

IV. Internships

In addition to the college course module, we have developed a second module in the 12th grade pre-engineering curriculum that will provide students with the opportunity to participate in an internship. As with the previous section, "Internships" is a continuation of the subsection called "Available Internship Evaluation" under the heading of *Feasibility Study*. In that section

we outlined how we obtained and narrowed down a list of companies to be used for the internships. In this section is the procedure we followed to finalize the internship module.

Determining Possible Companies

In order to determine the specifics for each internship, we needed to obtain some details of employment from each company. We spoke with Mr. David Potter and Sheila Frias, who gave us our original list of companies. Mr. Potter gave us the list of companies in the Worcester Regional Chamber of Commerce. He also gave us some helpful tips about calling our selected companies and effectively presenting our project. We also met with Dr. Gail Nigrosh, Development Specialist for Higher Education and Business Partnership. She gave us a list of contacts at UMass Medical Center, other biotechnology companies, and the Steering Committee of the Worcester Pipeline Collaborative, a Biotechnology program based in Worcester's North school district. We compiled a catalogue of approximately 50 companies from our original list that we thought would be beneficial work environments for the students (Appendix 15). We selected seven engineering companies from the catalogue to call, since we expected less than half to join our program. Our selections were based on the company's reputation, location, focus on engineering, and whether the company had been agreeable to high school internships in the past.

Contacting Companies

Using the advice Mr. Potter gave us, we drafted a script for our phone interviews. This script, found in Appendix 16, included relevant information about our project such as the length of the internship and the fact that it would be unpaid. We also drafted a one-page informational flyer advertising our program (Appendix 17). If the company was interested in our program after our telephone conversation, the flyer was emailed out immediately. We also scheduled a follow-

up call two days after the initial contact. This second call was used to address any specific questions the company had. If the company was still interested, we scheduled a meeting to discuss the details and information we needed.

Internship Meetings

If a company expressed interest after the follow-up phone call, we scheduled a meeting at the company to discuss details and any concerns that the company may have. We split up into teams of two to make our visits. This allowed us to make as many meetings as possible in the shortest amount of time. There were several details that needed to be dealt with after the company agreed to take a student intern, including

- a general job description,
- the length of employment,
- the dates that each student will be expected to start and finish the internship,
- what days and times the student will be expected to work,
- the student's position within the company,
- who will be mentoring the student,
- and any necessary forms that the student must fill out, such as nondisclosure or state forms.

While speaking with the company we also made sure that the student will not be operating any machinery, or performing any other tasks prohibited by law due to his or her age. We also needed to ensure that a student would not be given menial tasks that will not be related to his or her interest. One of the major problems that we faced was the fact that many of these companies could not give us a full job description for our students. At engineering firms especially, the specific tasks that a student would be responsible for vary by the type of project the company is working on at that time, and it is difficult for a company to predict what it will

need in the future. In these cases, we tried to determine general responsibilities for the students in order to ensure that they would, in fact, take part in engineering work regardless of the current project.

Transportation and Safety Issues

Problems could arise when students leave campus to go to their selected companies. The students do not all have a method of transportation. Arrangements need to be made so that administration, teachers and parents know that a student is leaving. These issues were cleared up fairly easily. While conducting our one-on-one interviews, we asked each student if they would have a car next year. We are also planning on sending students to the companies in pairs so even if the students don't all have cars, it won't be as much of a problem, as long as one of them does.

There is currently a program at Doherty called "Students Involved in Their Education", or SITE, that sends students to off campus internships. We have researched this program and we will use its procedures to send students off campus legitimately with the school's permission. There are permission slips that parents will sign as well as special school IDs that will allow students to leave school early. SITE's current procedural forms can be found in Appendix 18.

Evaluation of Students

Mentors at the sponsoring company will be given forms (Appendix 19) to be filled out weekly as a way for teachers to track the student's performance and grade them. Questions are related to the amount of work the student has completed, the quality of that work, and the level of motivation the student has displayed in learning or completing specified tasks. These questions have been designed to give the mentor a chance to critically assess the student's performance. The end result of the students' work is not as important as the amount of learning accomplished by the students and their effort in attaining their goals. The mentors should

complete and submit these forms to the teacher on a weekly basis in order to give the student feedback if he or she experiences a decline in performance in the internship.

V. Independent Design Project

As we mentioned in the previous section, students that choose to participate in an internship will have the option to extend the internship for an additional 10 weeks, after the evaluation following the first 10. For students or companies who feel that the experience is not enhancing their education, early termination is possible. It was therefore necessary to design a 10-week program that involves science and engineering for the students whose internships are terminated.

We have discovered small science and engineering projects that some high schools have designed for their students. Almost all involve companies or higher institutions. We cannot adopt these modules due to time constrains and the lack of corporate mentors available to run these programs. For this reason we started searching for other options that would involve activities students can complete independently. The best theme for a project that we found is one that focuses on increasing safety. This would serve as a method to familiarize students with the design process by having them design and create a new product. Currently, this project is part of the Technology Class offered in the Massachusetts Academy of Mathematics and Science in Worcester, Mass.

In order to develop a format for this project we modeled design projects from the WPI course entitled "Kinematics of Mechanisms." In this course students are required to follow the design process to develop a machine and write a professional report. In our module, students will design their own project that will be focused on the chosen theme. Students will have a total of 10 weeks to devise a project, design it and write up the report. A chapter focused on the design process was photocopied out of the textbook (Appendix 20) *Design of Machinery*

(Norton, 2001), which is used for the course *Kinematics of Mechanisms* at WPI. This section should be read by the students and used throughout the project. Project guidelines (Appendix 21) have been created in order to give the students direction so that they may successfully fulfil the requirements. Guidelines for development of the report have also been created (Appendix 22) in order to ensure conformity between reports and assist the teachers in constructing a grading standard (Appendix 23), which has also been outlined. Mr. Camoreyt and Dr Lowery, pre-engineering teachers at DHS, will assist the students with any problems they might have throughout the project, and will also grade their final reports.

This design project allows students who terminate their internship an opportunity to take part in an activity, which will greatly enhance their education in the field of engineering. The design process is one of the most important concepts in engineering, regardless of major.

VI. The Preparation Term

After developing our college course and internship modules, we needed to formulate recommendations for a preparation term to ensure that the students will excel in their off campus endeavors. This term has two major components: an introduction to the available courses or information that will be required in preparing for the internship, and the formulation of a student portfolio.

Resume Building

In order to market DHS students to companies, we requested they compose resumes. This provided us with a means to identify their strengths and weaknesses, which allowed for better placement within companies. We prepared the students to write their resumes by providing them with a resume-writing guide, obtained from the Career Development Center (CDC) at WPI. Along with this guide, we spent approximately 10 minutes answering questions

that they had with regard to writing their resumes. For future classes, one of the DHS teachers should run this informational session.

Initiation of Student Contact

Prior to the senior year, most of the groundwork for the college course and the internship modules will have been completed. However, in the months leading up to the capstone experience, certain initiatives must be made by the students to reestablish contact between the school and either the colleges or the companies. Students must contact either Mrs. Pamela Fitzgerald at QCC or Professor Lance Schachterle at WPI before November to register for classes in the spring semester. For students attending WPI, they must have a letter sent to Professor Schachterle from a high school official; this is outlined in Appendix 24. Students must contact these people to discuss details such as tuition and matriculation. The students will then be sent to the registrar to sign up for their desired classes. Students also need to make contact with their companies. We will leave a record of the contacts that we had at the company and recommend that contact be made by a certain date. A meeting might have to be arranged before the student actually begins. Forms may need to be filled out by the student before work commences.

Initiation of Mentor Contact

In order to ensure that DHS students have proper support while they are away at either the college course or internship, we set up student mentors. These student mentors are WPI students who will assist the DHS students by directing them to proper resources, tutoring, giving a campus tour or preparing them for an interview. Student mentors will be expected to work with the DHS students for approximately two hours per week, starting in January and ending in April. We spoke with Tracey Pakstis-Claiborne, the Assistant Director of Student Life at WPI to

develop the Mentors' role. During our meeting with Mrs. Pakstis-Claiborne we gave her a job description for the mentors and discussed what needed to be clarified or improved. She suggested that an initial contact between herself and one of the Doherty teachers should be made at the beginning of B-Term in order to give her ample time to recruit and train WPI students to mentor. After she has recruited students, she will contact the DHS teacher and work with him or her to match students with mentors as effectively as possible. The DHS teacher will then be given a list of mentors along with their email addresses so that the DHS students may contact them.

Developing Student Portfolios

The students will develop their student portfolios while they are either enrolled in the college course or participating in an internship. The portfolios are designed to make students think critically and reflectively about their tasks at hand and communicate their thoughts on paper. The portfolio will begin when the internship or college course commences. The students will be asked to keep a record of what they learn, problems they encountered, activities they have completed and their general thoughts of their experiences in either the college course or internship. This record will take the form of weekly assessment journals. These forms can be found in Appendices 25 and 26. We decided that these portfolios should be evaluated and assessed formally on a grade system that will consist of A, B, C, D, and failing. We did this in order to give the teachers a way to assess what the students are doing and how they are progressing in their endeavors.

VII. Debriefing

When the students have returned from either the internship or college course, there will be a period of debriefing in order to assess the student's performance. Each student will be given

an evaluation form when they return from their endeavor. For the internship, this evaluation form (Appendix 27) will be used to inform companies of the students' impressions of their internship. For the students taking the college course, course evaluations found in Appendix 28 could assist in eliminating or screening out courses that might have been beyond the high school intellectual level or adding future courses geared towards the students' interest.

A major component of the debriefing period is the student presentations. Each student will be required to give a presentation explaining his or her experience to the 9^{th}, 10^{th} and 11^{th} grade pre-engineering classes. This process will not only enable the students to evaluate their experiences but also motivate the current 9^{th}, 10^{th}, and 11^{th} grade pre-engineering class to continue with the program into their senior year. The presentations will cover the student's job/course description and an overview of the tasks that they completed or the material that was covered, along with other pertinent points. Presentation outline guides can be found in Appendix 29.

Data Analysis

Our Methodology chapter mentioned a detailed description of the tasks we completed while putting together our project. This chapter will deal with the relevant data that we received from our methodology and its analysis. The analysis will include the quantitative and qualitative data that we gathered, how we proceeded with this data, and the reasons for proceeding the way we did.

I. Feasibility Study

As stated in the methodology section, the feasibility study was used to determine whether our team was capable of completing this project with the limitations and resources at hand.

Feasibility Report

Before we began our research, it was necessary to determine if it would be feasible to continue our development of this capstone experience for Doherty High School pre-engineering seniors. There are several factors that play into the development of a curriculum that focuses on off-campus experiences. These factors include: safety, logistics, and scheduling issues. We discussed the safety and logistical issues with Mr. Camoreyt and Dayle Reynolds; however we needed to look into the scheduling issues a little further.

There are always problems, some of which can be easily resolved, when high school students are sent off campus during the school day. The safety and logistical issues that surrounded sending the engineering seniors to internships and college courses were taken care of. After we spoke to Mrs. Marion Giacomelli, coordinator of the SITE program, we were told that all we needed for the students to leave campus was to have the "Internship Contract" signed by the sponsor, the student intern, and the student's parent/guardian. Because both the parent and student consented to the terms of the contract allowing them to leave campus for their

internships, all of our logistical and safety issues were taken care of. Mrs. Marion Giacomelli also noted that we could change the internship contract to fit our specific needs for the engineering internships and college courses. The following details are covered by the internship contract: students being dismissed from classes early, the students' agreement to complete their responsibilities at their internship, the mentor's agreement to complete their responsibilities to the student, and a parent/guardian's permission to send their son/daughter to off-campus sites. We decided to use the internship contract currently used by the Worcester Public Schools School-To-Career program (Appendix 30) as it addressed all of the necessary issues.

The second issue that we needed to address while developing our program was that of transportation for the students to and from their intended destination. This was an issue because not all students own a car or other method of transportation. Students that do not have a means of transportation should be provided with one to their company or college, but this is not usually the case. Since we are placing two students per company, carpooling is a solution to this problem. One student who has a car can be partnered in the same location with a student without transportation as long as they have the same interests for their capstone experience. As for the college course, carpooling and busses provided by the Colleges of the Worcester Consortium are the solutions for transportation. The consortium bus schedule can be found in Appendix 31.

In order to allow students to leave school before the end of the school day, parents must write a letter stating that they give their son or daughter permission to leave DHS property at a specified time. This letter is separate and independent from the internship contract that the parent/guardian, student, and mentor have to sign – this letter only gives the guardian's consent to sending their student off campus and takes the liability off both DHS and the destination college or company. This letter is already a requirement for the SITE internship program at DHS, indicating a precedent for getting students off campus. After all the transportation issues were cleared up, scheduling was the only problem left to take care of.

Scheduling was the most difficult problem to solve because it was the parameter over which we had the least control. In order for our internship and college course modules to work effectively, they needed to be scheduled during the last two hours of the day. David Potter stressed that internships should be done during the last double period of the school day. He stressed this point so much because he stated that sometimes companies like students to work a few extra hours after the program's scheduled times as paid hours. Also, some students do not have the motivation to leave campus for an internship or college course that they enjoy, only to return during the middle of the school day to resume classes. Transportation and performance issues will not be problematic if the engineering class is scheduled to be during the last double period of the day, starting at 12:03pm. Unfortunately, scheduling is beyond our control because administration has the final word on the academic schedule. Administration plans to schedule AP Chemistry, AP Physics, and Pre-engineering during the same double periods: 8/9, and 10. A majority of the students presently in the 11^{th} grade engineering class have indicated to us that they want to take at least two of those classes next year. There is some discussion about ending the formal AP Physics class because all the topics covered in the class were informally addressed during the 10^{th} and 11^{th} grade pre-engineering courses. As mentioned before, most students are very interested in taking AP Chemistry and the senior Pre-engineering course. Hopefully these issues will be resolved by the time our recommendations are acted upon. The teachers at DHS understand the importance of having this course scheduled at the end of the day, and are very supportive of this, but there will be no finalized decisions until just before the next school year begins.

Given the information and forms that we gathered, we conclude that this project was feasible to continue. We have been told that, most likely, the grade-12 pre-engineering program will be at the end of the day and we are depending on this to hold true throughout next year.

Based on this assumption, many of the scheduling issues are resolved, allowing for all students to participate in this program.

II. Surveys

In order to determine student interests and prospective schedule availability we administered a few surveys. These surveys took place near the beginning of our project so that we could use the results to direct our research properly. We surveyed all the 11 students in the junior engineering class and even a junior who was enrolled in the engineering program in her sophomore year, but left the program this year.

Student Schedule Survey

As part of our feasibility study, we analyzed prospective student schedules for their senior year. To obtain this data, we administered a schedule survey. On it were questions that asked students to list the classes they planned to take along with any extracurricular activities that they planned to participate in. After we collected the results from this survey, we spoke with Mrs. Susan Michaud, a guidance counselor at DHS, who informed us of when classes were typically scheduled (Appendix 32). She stressed that the list of class times may not be accurate for next year, as the schedule will not be finalized until a few weeks before school begins. The schedule survey and the data we collected using it are found in Appendices 2 and 3, respectively.

Student Interest Survey

In order to determine what fields the 11^{th} grade pre-engineering students were interested in, we conducted an interest survey. This survey consisted of two pages, the first of which listed several majors and included their descriptions. The second page listed all of the previously

mentioned majors and asked the students to qualitatively rank their preference for each on a scale of 1 to 10; 1 being the lowest and 10 being the highest.

This survey can be found in Appendices 4 and 5. Using the results from this survey we constructed the graph pictured below:

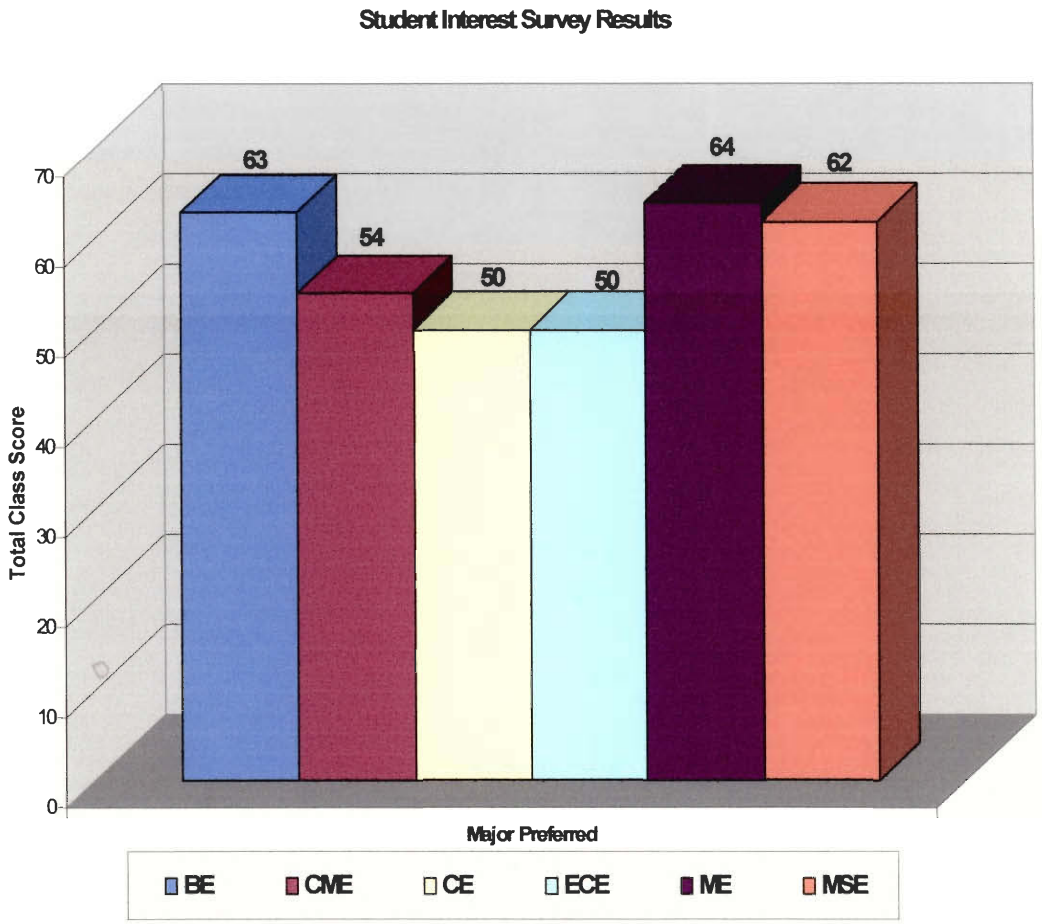

Figure 1

The vertical axis represents the sum of all of the students' rankings for a particular field of engineering. The horizontal axis represents the majors that they ranked: Biomedical Engineering, Chemical Engineering, Civil Engineering, Electrical & Computer Engineering, Mechanical Engineering, and Materials Science & Engineering, respectively. As can be shown from this graph, the three major areas of interest are mechanical engineering, biomedical engineering, and materials science and engineering, in that order. When the DHS teachers are

designing the preparation material or any other course related material they can use the results from this survey to shape the curriculum. This survey will need to be carried out every year to determine the field(s) in which there is general interest, so that appropriate companies and college courses can be targeted.

Student Interview Questionnaire

In order to narrow down the scope of the interest areas elucidated by the student interest survey, we conducted a one-on-one interview with each student in the 11^{th} grade pre-engineering class. In addition to questions that directly helped us place students for their senior year, the questions asked in these interviews varied from what their favorite class in school was to why some of their previous classmates had dropped out of the pre-engineering program. The initial questions on this interview schedule were designed to help improve the existing engineering courses in future years. If we were able to reason what students like or did not like about the courses, we might be able to make suggestions to decrease the turnover rate.

We constructed several histograms based on the results of these interviews. The first histogram presents our question of module preference: either internship or college course. The remaining histograms present the background data on the student's view of the pre-engineering program. Figure II shows the students' favorite classes. As can be seen most of the students chose engineering. However, it is not surprising that the second and third highest preferred classes are Biology and Math, respectively. The student interest survey highlighted biology as the second popular area of study. Figure III shows the reasons why students selected to take part in the engineering course the previous year. The most popular reason, affinity to math and science, which is beneficial in engineering fields, is encouraging. It is also encouraging to see that a lot of students thought that it was a good opportunity for the future.

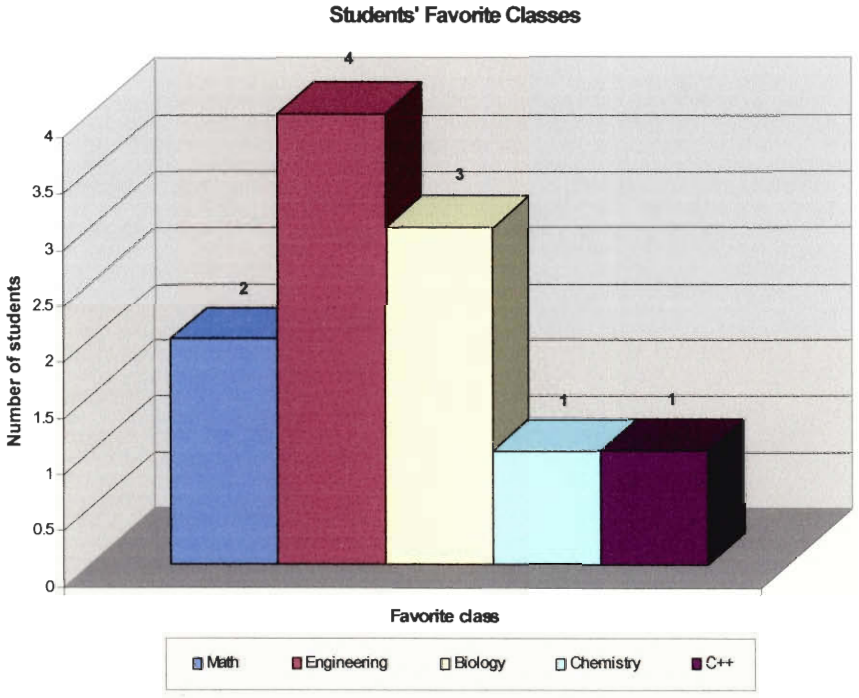

Figure II

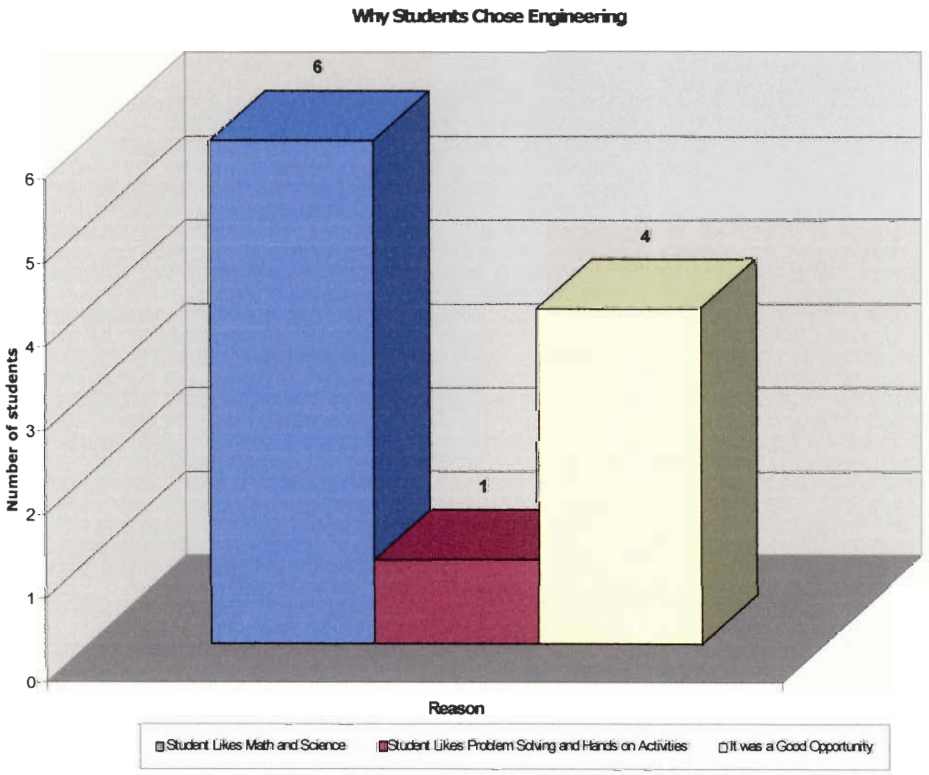

Figure III

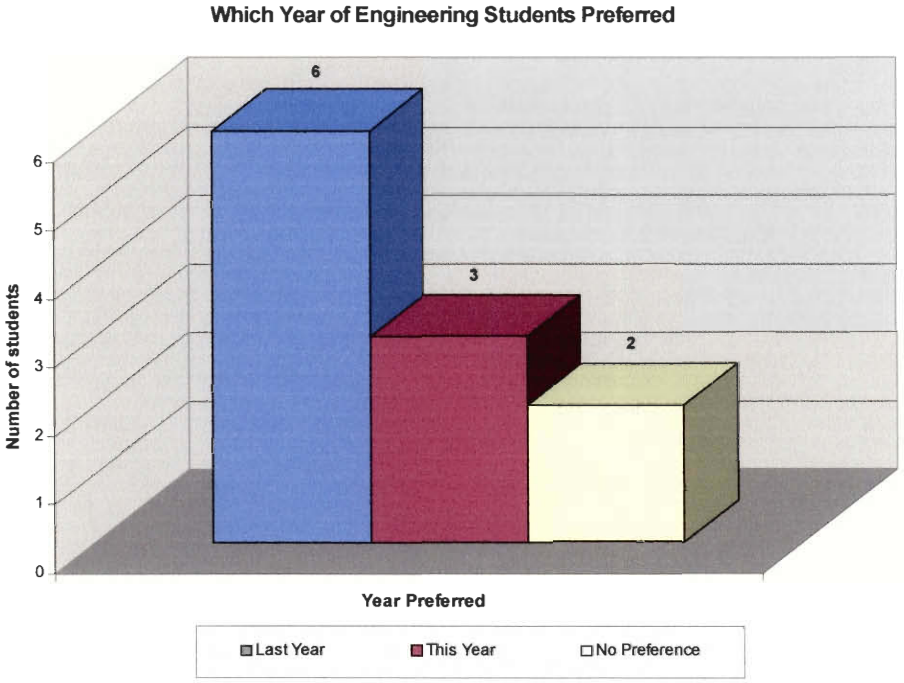

Figure IV

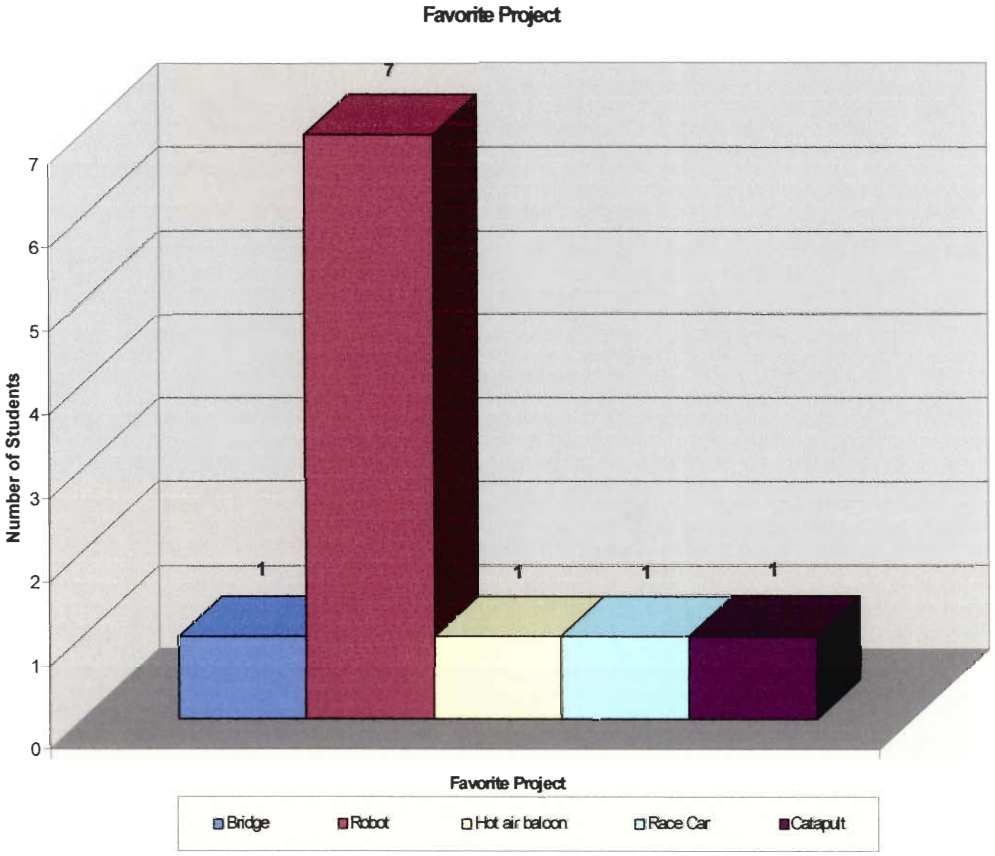

Figure V

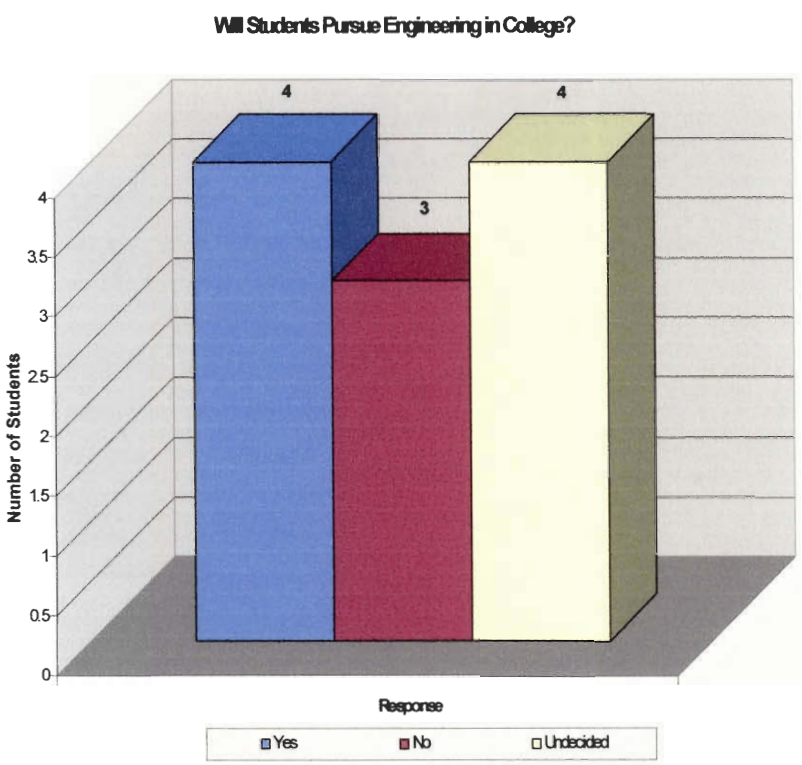

Figure VI

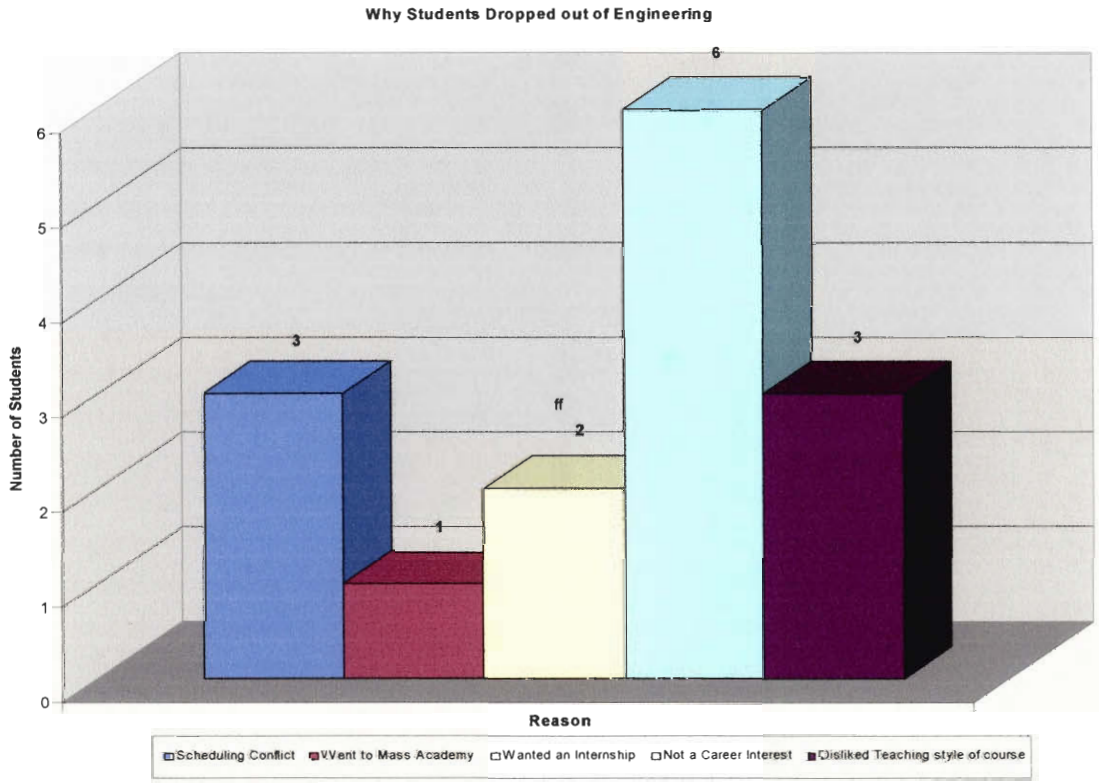

Figure VII

In figure XII we can see that most students preferred the 10th grade pre-engineering class. Those that responded that they did not like the current 11th grade explained further by telling us that this was because they did not enjoy the electrical engineering curriculum. In contrast, most students chose building the robot as their favorite project, figure XIII. The robot was a major project of the 11th grade electro-mechanical curriculum. Figures XIV and XV are more directed towards the effects of the pre-engineering curriculum on students rather than the actual curriculum. These two figures show how many students plan on pursuing engineering in college and why some students dropped the course respectively. As one can see in figure XIV, the 11th grade is fairly split with respect to their pursuing of engineering in college. It is a very good sign that seven students definitely know what they want to do. Hopefully after the installation of the module that we have designed the remaining four will be decisive as well. Figure XV shows the major reason that students' dropped the pre-engineering course before their 11th grade year was that engineering was not a career interest. Even though these students were lost, it is encouraging to know that students are aware of what they want to do so early. If a student does not really know what engineering is, and pursues engineering in college, then chances are that he or she might end up dropping out and wasting money. If they have prior knowledge of engineering before they enter college then they should know whether or not they would like to continue with it and are not in the position to waste money.

Finally the last question that we asked the students was which module they would prefer: either an internship or a college course. The majority of students said they would prefer an internship, as can be seen in figure XVI. Those that stated no preference, did not say that because they didn't know what they wanted to do, they do not have a preference because they believe they will receive a beneficial experience from either the college course or the internship.

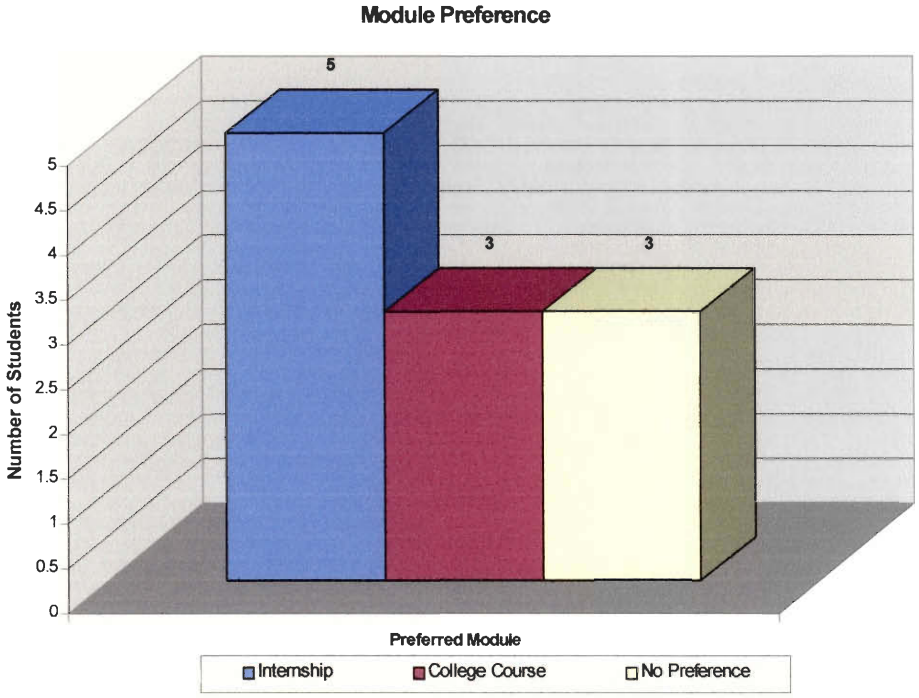

Figure VIII

III. The College Course

After we completed our feasibility study and our surveys we had enough information to start outlining a procedure for students who wish to take a college course during the second semester of their senior year. This section will be divided into two main subsections, the preparation period and the college course module. We will discuss the debriefing period in a later section.

The Preparation Period

A majority of the effort that is put into realizing a module such as this one is concentrated on preparation and not the actual module. With adequate preparation the module will almost run itself. Many things have to be in place before students can embark on a journey of higher learning. They need a method to enroll, support throughout the course, and some method of

assessment. All of these points have been factored into our procedure for college course enrollment. First we will discuss the preliminary course selection and enrollment.

The college course module preparation will start out in much the same fashion for students who desire to take a course at either QCC or WPI. The first step that must be taken is to decide what course a student wants to take. Students should be provided with the college course pamphlets that we developed (Appendices 9 – 14). These pamphlets list a variety of engineering and science courses, which were selected from the spring semesters at each college with regard to the proposed time for the pre-engineering class at Doherty as well as the level of difficulty that we felt was appropriate for Doherty students. Once a student has selected a class, he or she should obtain a course catalog or visit the college's website in order to verify the current course listing as we were not able to obtain schedules for the 2002-2003 academic years for either WPI or QCC.

Students who plan to attend Quinsigamond Community College should contact Mrs. Pamela Fitzgerald, the Dean of Instruction for Technology. She will put students in contact with Marci Skillings, Director of Tech-Prep at QCC, to facilitate enrollment by feeding them through the Tech-Prep program. Students must contact Mrs. Fitzgerald no later than November 1st to enroll for the spring semester. QCC is prepared to waive or reduce tuition for a limited number of students. If a student plans to take a math course at QCC, they will be required to complete an assessment test. This should be scheduled as early as possible so that it does not conflict with course selection. For those students, it is recommended that they contact Mrs. Fitzgerald in early October so that she may assist them in scheduling the test. Students that consider taking courses at WPI must contact Professor Lance Schachterle, also no later than November 1st. At this same time, students must ensure that a letter from a proper school official is sent to Prof. Schachterle in order to fulfill one of the enrollment procedures. The details of this letter are outlined in Appendix 24. Professor Schachterle will only be able to provide a method for matriculation. In

order to register and enroll, students will have to go to the registrar's office. WPI will also offer a reduced tuition for a few eligible students who will to be determined by the pre-engineering instructors.

High school students entering a college environment will need some type of support throughout their experience. This support will come in the form of student mentors from WPI. Tracey Pakstis-Claiborne will recruit students from WPI to help Doherty students survive their courses or internships. In order to facilitate the matching process before the spring semester begins, Ms. Pakstis-Claiborne will need to be contacted sometime before Thanksgiving, preferably at the end of October. At the time of first contact she will require the number of students in the pre-engineering program and their proposed majors. She will then recruit appropriate WPI students who are interested in acting as peer advisors have the appropriate academic background to match them up with students from DHS. First contact between students should take place shortly before the December holiday break.

The colleges begin classes in January. QCC begins around the 22nd and WPI begins around the 10th. These dates change from year to year and should be verified before the holiday break. Students should also make sure they purchase all materials they need from either the campus bookstores or an online reseller before the start of the semester. The bookstores usually open a few days before classes start and would be open anytime before the holiday break. Finally students must make sure that they will have transportation to and from the colleges. If they do not have their own, arrangements must be made.

The College Course Module

Once everything is in place, students will be ready to venture off into the world of higher learning. Aside from the grade that a student receives for the course, there will be other factors that play into the students' final grade for the module. Students will be required to keep a log of

all of their activities; students will also be required to give a presentation before their peers (more will be discussed on that in the section entitled: Debriefing).

Students will be required to keep a daily journal, called the Weekly Assessment Journal, of their experience at college. The description of what should be included in this journal can be found in Appendices 25 and 26. The main idea of this section is to have the students relate how they feel they are doing in the college course. Also, it is to brief the Doherty instructors on what is going on in the student's class. In particular students must comment on material covered, any assignments, tests, or labs, information required to complete tasks, and areas of difficulty in the course. These journal entries will give students the opportunity to express their like or dislike of the course or particularly what is difficult.

Students attending college courses will be required to meet with their teacher at Doherty, at an appointed time that fits with all of the students' schedules. The purpose of this meeting is to check and make sure that everything is going well and that there aren't any problems that are going unnoticed. In addition to this meeting, students will most likely have meetings with their WPI student mentors. These meetings will most likely run like a tutoring session, where the student will question the mentor about topics that he or she had trouble with and the mentor will do his or her best to answer. Both of these meetings will be weekly for the duration of the springs semester.

At some point around March 1st, students attending WPI will be starting their second class. Students must make sure that they have the proper materials for this second class. All will continue as in the first term. At the end of April and the beginning of May, classes will end at WPI and QCC respectively. At this point students must begin preparation for their debriefing presentations.

IV. Internships

Appendix 15 contains the current list of potential companies in the Worcester area that focus on engineering. We used this list of companies to try to set up our internships. In the list of Worcester area employers, found in Appendix 15, the companies whose information is lightened are the companies who were either not interested in participating in our program or the companies who had to wait for approval through the appropriate channels in their respective organizations. As was pointed out earlier in our report, we had to set up internships for a total of six students for next year: two are interested in mechanical engineering and four are interested in biotechnology. Since we will be pairing the students in these internships, we needed to find a total of three companies for the students. As stated, we will assume that we have a low success rate at contacting the companies, so we predicted that we would have to call about five companies in total. This section contains a detailed explanation of how we set up the contacts and internships within these companies. In this section we explain how we chose the companies we were going to call, the initial phone calls to the companies, the follow-up call, and the meeting with the company.

Choosing Initial Companies

When going through our list of companies, we decided that the five most relevant companies for the students' interests are Abbott Bioresearch Center (formerly BASF Bioresearch Corporation), Alden Research Laboratory, Inc., Babcock Borsig Power, Inc., Massachusetts Biomedical Initiatives, and UMass Medical School. Mrs. Susan Chase, our main contact with Human Resources at Abbott, is also a member of the Steering Committee of the Worcester Pipeline Collaborative, so she already has a relationship with the Worcester Public Schools. This made contacting Abbott through her a very attractive choice since the Engineering Pipeline

Collaborative is very similar to the Worcester Pipeline Collaborative except that the later is concentrated on biomedical studies. Alden Research Laboratory was also a very good choice because Alden was founded as part of the Mechanical Engineering Department of WPI. They became a private company about 15 years ago, but still have very strong ties with WPI and their students. The third company we considered was Babcock Borsig Power. We considered this company because it is approximately 3 miles away from Doherty High School. Also, out of the other mechanical engineering companies on our list, the company description that we found on the internet (www.bbpwr.com) seemed to best fit what the two students interested in mechanical engineering were interested in – design, not manufacturing. The fourth sponsor for internships that we considered was Massachusetts Biomedical Initiatives (MBI). This organization is located on Innovation Drive in Worcester, which is an area rich in biomedical companies. We chose this company because they had previous experience in hiring students to be put in internships related to biotechnology. Kevin O'Sullivan, the contact person at MBI, was also recommended by our advisors as someone that we should probably speak with. The final place that we considered was UMass Medical School, which isn't a company in the traditional sense, but a school and center for research. We strongly looked into UMass because it is the main center of education for students enrolled in the Worcester Pipeline Collaborative, so we felt it would be a good place to incorporate our students in as well. Also, Dr. James Hamos, who was one of the founders of the Engineering Pipeline Collaborative, has already had experience in helping the placement of high school students from Doherty High School into programs at UMass and we felt we could use his support to advance our project.

Initial Phone Calls

We spoke with Dr. Hamos, who was on sabbatical in Washington, about our project and our idea with the internships as a capstone experience. He felt that the program will be a great

experience for the EPiC students, but made sure to express a very relevant concern: the purpose of EPiC is to support engineering, not to do research or certain types of lab work. This point was very important and had to be taken into account, especially when dealing with internships for students interested in biology, who might be looking for a position in a lab. Dr. Hamos also advised us to call Robert Layne at UMass, who is the Program Coordinator for the Worcester Pipeline Collaborative as a good starting point for our attempt with UMass.

The script we used in our first contacts with these companies, found in Appendix 16, communicated some very important points. The first point we wanted to communicate was that this was for senior engineering high school students. We mentioned this so companies would know right away that they are dealing with some very exceptional students from Doherty High School, a local public school, that already have experience in engineering. The second point we make sure we mention is that this internship is unpaid. This is a great marketing tool because if companies feel that we are soliciting for paying jobs at their companies, they may get turned off, but if they know that the students will be working solely for experience, then they may be more likely to "hire". We also want to tell the companies that these are not full time internships, but only lasting for two to three hours for four days a week. We also make a note to the mention that this program (EPiC) has been around for a few years, but that this part of the program is a pilot venture. This may scare a few companies who are not interested in trying new things, but it could also excite companies, or companies could be indifferent to this fact. We mention those points, but also make sure to add some more detail in our informational pamphlet that we sent out.

The first organization we called was UMass Medical School and we spoke with Mr. Robert Layne. The second company we called was Alden Research Laboratory and we spoke to Mr. Ned Taft, the President. The third company we called was Abbott Bioresearch Center and spoke to Mrs. Susan Chase, the director of Human Resources. The fourth company we called

was Babcock Borsig Power and spoke to Mrs. Pat Wood, who is the head of Human Resources. These four companies were all interested in receiving additional information on our program so we e-mailed our informational pamphlet to them. The fifth company we tried to call was Massachusetts Biomedical Initiatives, and we spoke to Mr. Kevin O'Sullivan. He told us that he was very interested in our project but was unable to assist us in supplying internships. He explained that MBI was not a biomedical "company" in the traditional sense, but was an incubator for new and growing biomedical companies. He did not have any positions that would be relevant to our project at his company, but he wanted an informational pamphlet e-mailed to him so that he could forward it to all the incubator companies that MBI was developing in case they were interested in the program. As part of our initial call, we set up a second follow-up call so that we could follow up with the companies and make sure they are interested in our program and are able to participate. After that, we will set up meetings to get to know the companies more and see what available positions would best be filled by the students in our program.

Follow-Up Call

The follow-up calls are usually scheduled two days after the first call. When we followed up with Babcock Borsig Power, Pat Wood was not available, so we didn't get a chance to talk to her again. Every time that we called after that, she was also unavailable. After about two weeks of trying, we finally concluded that they were interested in our program and didn't wish to pursue this topic any further. We did not follow up with MBI, because they had already told us that they could not continue with our program. Kevin O'Sullivan did e-mail us to tell us that he had forwarded the information to the appropriate people at MBI's "child" companies.

The second call to Abbott was not as successful as we had hoped. Abbott is a very large company, and definite decisions within the company cannot be made immediately. Susan Chase told us that she had forwarded this information to the management she reports to when making

decisions like this one. A similar situation happened when we followed up with UMass; Robert Layne had to consult with his boss Dr. Harmon Hines. As a result, Harmon Hines had to consult with the Superintendent of Worcester public schools, Dr. James Caradonio. UMass had already made a commitment with school in the North school district with the Worcester Pipeline Collaborative, and he did not want to mix school districts by including students from the Engineering Pipeline Collaborative, which is based in the Doherty school district. We could not get a definite answer on UMass' participation in the program immediately because the issue of conflicting school districts had to be resolved by Superintendent Caradonio and Dr. Hines. Unlike Umass Medical School, there was an eventual response from Abbott Bioresearch Center showing interest in taking part in our project. Tentatively, Susan Chase and Abbot have agreed to take part in our program and provide 2-4 biotechnology internships as long as they can identify engineering mentors for the students.

The results of our second call with Alden Research Labs were more fruitful than the rest. We spoke with Ned Taft, and he was very excited about joining the program. His company has been growing rapidly over the previous year and he is constantly looking for excellent people to join. We set up a meeting to meet with two of our team members in person so that we could give them the resumes of the students who were interested in mechanical engineering as well as discuss any questions or concerns that he may have.

Visit With the Company

Two members of our team met with Alden Research Labs to square away any of the final details. We wanted to meet with Ned Taft in person so that we could build a personal relationship with the company. We felt this would be very important because we wanted to make sure that the Worcester Public Schools maintain a strong relationship with the corporations. We also wanted to make sure that the relationship that Alden Research had with

Doherty High School and the Engineering Pipeline Collaborative would be one that will remain strong for the years to come – we want this connection with internships to remain open next year, and not have this experience only happen once.

We met with Ned Taft and two other engineers, Dean White, Project Engineer, and Andrew Johansson, Hydraulic Engineer, to discuss the details of our project and Alden's role with it. They were impressed with the experience that the students had on their resumes, especially with CAD and with building a robot in their engineering class that would react to outside stimuli. An example of this project is a robot would detect obstacle, and could turn to avoid hitting it. The two engineers who we met with were the ones that would be mentoring the students during the internship in Alden. Ned Taft explained that much of the jobs' skills would be learned by doing the work, and not by studying any books. This company deals with mechanical engineering, but specifically, flow engineering – analyzing fluid flow through a system, designing more efficient system, and manufacturing the design. We were assured that the students would be assigned mentors to assist on a project, and may not be let alone to do totally independent work, but will always have a specific project to work on. Ned Taft wanted to meet the two students interested in mechanical engineering to discuss some possible project options and finalize any paperwork, but this meeting would be scheduled some time next year.

Other Attempts

Because of our low success rate with the first few companies, we needed to call other companies that would be interested in hearing about our program. We contacted Advanced Cell Technology, who is known for their innovations in cloning, to try to place students in internships. They felt it would be unfeasible to hire our students for their company because of training issues. By the time students were fully trained to work at the company, it would already be time for them to end their internships. Advanced Cell Technology could not spend so much

time on something that would not yield rewards for their company. We also tried contacting Primedica in Worcester, who was recently purchased by Charles River Labs in Boston, Mass. Because of the new merger, people looking for employment in the Worcester facilities had to apply trough Human Resources in Boston. This made the application process for students unfeasible because they could not go to Boston, which entails an hour commute, to meet the hiring staff at the company. Another company that we called was Path Lab Inc., formerly CliniTech Services, Inc., is now centered at Medical City in Worcester, Mass. They explained that it would not be possible to host student internships because of the strict state regulations on certified staff. This company dealt with handling and analyzing blood samples. Not only did the regulations not allow the students to work because of their age, but the people working in the labs (including people shadowing or observing the engineers) have to be trained and certified, or else they are not allowed to set foot into the lab. We made about 6 additional calls to similar companies with very similar results – no available internships for the pre-engineering students. This experience allowed our team to learn how to communicate with large corporations and gave us experience on how to accept and recognize rejection. Although these attempts with new companies were unsuccessful, we did have success with placing students in Alden Research Labs, and later, with Abbott Bioresearch Center.

We have gone through the entire process of finding internships for these engineering students. Some attempts were successful, some were not, but now we have a blueprint that will act as the standard to contact other new companies and renew the commitments made by companies that have already joined our program.

Conclusions

During the past few years, the trend of students focusing on engineering as their career path has decreased. As a result, Doherty High School is working with WPI to improve engineering education in Massachusetts. By using methods detailed earlier in this report, we were able to develop a one-semester curriculum in which students have the option to participate in either an engineering related internship at a local company or a college course at either QCC or WPI. This option was prefaced with a preparation period, which we devised in order to provide these students with the information and skills they will need to be successful in their endeavors. After the students return, there will be a debriefing period where they critically assess what they have learned and present it to the class. The schedule diagram for this program identifies the different parts of the capstone experience and is shown below in Figure IX.

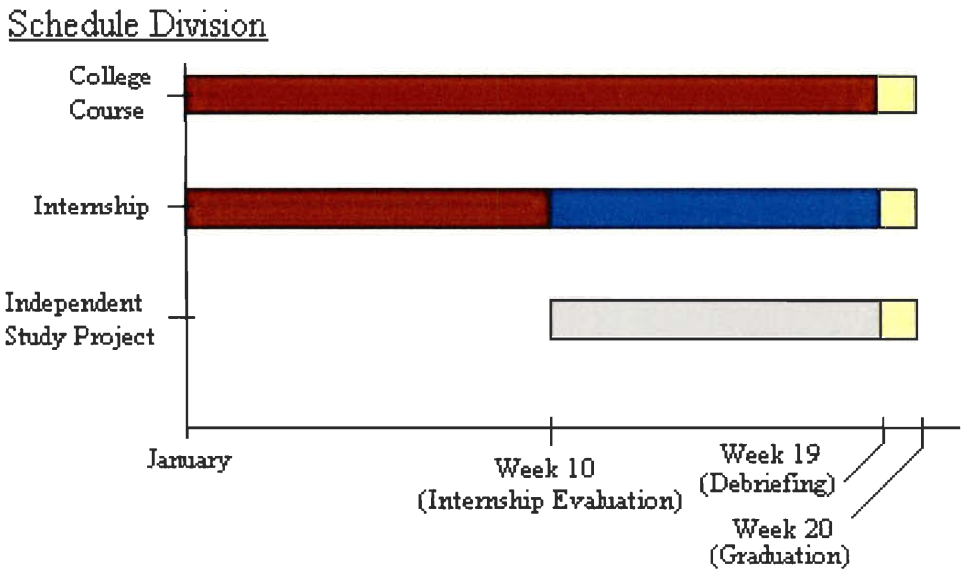

Figure IX – *Module Schedule Division*

This project expands the engineering program already established at Doherty High School, the Engineering Pipeline Collaborative. EPiC has two main focuses. The first goal is to prepare future engineers for the difficult college curriculum that they will face in the upcoming years. The second goal is to provide potential engineers with the opportunity to explore a field

that they may be interested in pursuing as a career. During the college course or internship, students will have a very clear idea as to whether or not they enjoy the field of interest they explored. As a result of our project, the students taking part in our designed module will explicitly achieve both goals of the Engineering Pipeline Collaborative rendering them more prepared to embark upon their engineering careers of the future.

During debriefing, students in grades 9, 10, and 11 will have a chance to listen to the presentations given by the senior students. Seeing what the seniors have accomplished, this final project should act as a motivating tool to keep students enrolled in the engineering course in the upcoming year(s). Even if students finally decide they do not want to continue to major in engineering through college, the increased number in the engineering program and the successful retention of the engineering students will introduce better problem solvers into all majors and fields of industry, technical or not.

Recommendations

Following our basic outline as presented in the respective module timelines (Appendices 33 and 34), this capstone experience should be fairly easy to reproduce. We have some further recommendations that we hope will aid in the replication of the 12th grade capstone experience. In this section we will discuss some recommendations that we have for both the teachers that will be implementing the program as well as for the members of the EPiC Board. Our recommendations for the teachers will be ways to explore new options for the internships and our recommendations for the EPiC board will be to expand their board diversity.

I. Teachers

With the plan that we have laid out, the teachers that will take over after we have finished will be able to continue our work without much difficulty. We have a few recommendations for our successors that will aid them in the evolution of the final curriculum.

During our time at Doherty High School, we did not have great initial success in securing companies for the internship module. We were under the impression that we would be able to utilize the companies represented on the EPiC board to place the Doherty students. However, due to the results from the interest survey, we weren't able to use these companies; the foci of these companies did not match up with the students' interests.

We recommend that the teachers who will be responsible for the 12th grade pre-engineering capstone experience, currently Mr. Anthony Camoreyt and Dr. Derrick Lowery, to attempt to contact more companies and make them aware of the program. If this task is not appropriate for teachers to do, then we recommend using the assistance of a third party, such as Mr. David Potter, who aided us in contacting companies, would provide the necessary help. His experience in the process of placing students in internships will be very useful in the future when the program grows. The companies that are being contacted should be informed about the

program, given the informational pamphlet, and given a follow-up phone call a few days later. During the follow-up they should be asked if they want to be considered for future years in the program. Even if a company is not interested in joining the program, or if students are not interested in the company's specific field in a certain year, as long as the company is contacted about the program and keeps our pamphlet on file for future reference, we can try them again in later years. For example, Coughlin Companies can be contacted and informed about the program, even though they are an electrical engineering company and will not take part in the program this year. This contacting system will help to narrow down companies and avoid futile phone calls and delayed communication in the future.

To finalize the placement of the students already set up in internships and college courses, some phone calls need to be made in the next academic school year. This process is outlined in the appropriate timelines, but is noted here for convenience. In the month of November in the next school year, it is necessary for the 12th grade pre-engineering DHS teachers to contact the colleges and companies that have already agreed to accept the students. The process for students taking courses at WPI is straightforward: speak with Professor Lance Schachterle and fill out the appropriate forms, then register for classes. Students taking courses at QCC should get in contact with Mrs. Pamela Fitzgerald to take care of tuition issues, contact Ms. Marci Skillings to be enrolled through the Tech-Prep program, and sign up for classes. The contact person at the companies should also be contacted. This phone call should include scheduling a meeting with the students. Since an important part of this project is to build strong relationships between local companies and the Worcester Public Schools, we feel that if students meet with their sponsors before hand, it could accelerate the initiation of the relationship. The mentors will then have an idea of what the students who he or she will be working with are like before the internships even begin. At the same time, formal registration with the company and

the completion of the proper forms should be done. Once these details are completed, the students will be able to begin their capstone experiences in January without any drawbacks.

The student questionnaire may reveal that a majority of students want internships in a specific field while not enough internships can be procured. In this case, we recommend that the teachers select companies that they believe will offer experiences that will be beneficial to students and place students in them according to their individual strengths. If a student is interested in tissue engineering, but is assigned to an internship at a mechanical engineering company, then this may spark a new interest in mechanical engineering or may cause interest in pursuing mechanical engineering in tissue engineering. If at all possible students should be placed in internships in their area of interest. This will increase the possibility of a successful internship experience.

This portion of the senior engineering course should be graded in adherence to the outline that we have created and reported below in Figure X. There are three paths a student may take in the 12^{th} grade experience. We did not have a previous standard for assigning these percentages, but assigned them by the amount of work we feel each separate part will demand for each different module. For the college course, the weekly assessment journals will comprise of 20% of the final grade. Students will include class notes and reflections on the topics covered in class in their journals. We felt that the grade provided by the college instructor should weigh the most on the final grade for this portion of the 12^{th} grade engineering class, which is why we assigned it 70%. Because we felt the college students would only be able to present a small part of what they actually learned, whether it be a specific topic or project, we assigned the presentation 10%. For the internships, we assigned the weekly assessment journals the same weight as the journals for the students taking a college course. We also felt that mentor evaluations of the student's fulfillment of duties and tasks on site should also hold the most weight towards the final grade. We did not have mentor evaluations count as much as the course instructor's grade, because the

assessment given by the mentor may not be as structured as a professor's. Unlike the grading for the college course, the final presentation will hold a weight of 20%, which is twice as much as that of the college course. We felt this would be fair because the students completing an internship will have more to present. Internship students will have o present everything that they did over the internship. Asking the same amount of content to be presented by college course students would be far too much, especially if a student takes two courses at WPI. For the internship/design project, we assigned 20% for the weekly journals. This amount was assigned because the students will have a lot to write about during their internships in regards to their experiences, but once that is over, they will use their weekly assessment journals as a research journal for their design project. In their journal, they should mention and date everything they have done in their project including brainstorming, research, and design. Because the internship/design students will only be spending half as much time on site as compared to the students who will be spending the entire class duration with their company, the internship evaluation will only count as 25%. We assigned this number because they do not spend as much time on site, and the mentor evaluations may be low, which is why the internship is discontinuing. Most of the grade, 35%, will be based on the final project, which will detail the engineering design process. The final presentation will be worth 20% because the students will be presenting two different things: what they learned from their internship experiences, and the final design from the design project. The values shown are recommendations that are unsupported by teaching experience, and can be changed to reflect a better grading scheme by the appropriate teachers at DHS.

	College Course	Internship	Internship & Design Project
Weekly Assessment Journal	20%	20%	20%
College Grade / Mentor Evaluation	70%	60%	25%
Project	-	-	35%
Presentation	10%	20%	20%
Totals	100%	100%	100%

Figure X – Module Grading Recommendation

Teachers should remind their students at the end of their 11th grade year that this capstone experience is not to be taken lightly. It should not be passed off as a means to get out of school. This program is designed to advance the students' education in the area of engineering through advanced course work or hands on experience. The material dealt with in this capstone will be difficult and serious and should be treated appropriately.

II. Engineering Pipeline Collaborative

Based on our project and the process that we have designed in setting up our college course and internship modules, we have come up with some recommendations that we offer the Engineering Pipeline Collaborative. We noticed that the people involved with EPiC in local colleges were very helpful with our project. These people included Lance Schachterle from WPI, Dadbeh Bigonahy from QCC, and Pamela Fitzgerald from QCC. They were all very cooperative and influential on helping us put together the college course module. The involvement of the Worcester Public Schools, the local colleges, and the teachers at Doherty High School was reliable, and we have no specific recommendations for this aspect of the EPiC committee.

The aid in setting up internships that the EPiC committee provided was not as helpful as we had anticipated. From all the companies that we were able to compile into our list, only three of them were on the EPiC board: Intel, Verizon, and Manufacturing Assistance Center. We were not able to use Intel or Verizon for our internships because the students were not interested in Electrical Engineering. Although the students did have theoretical experience with basic electrical engineering through their engineering class and hands-on experience with the design of their robots, students may not know what other things electrical engineers actually do. One recommendation we can give the companies on the EPiC board is to volunteer to give engineering students tours of their company sites. For instance, if the students were to take a field-trip to Hudson, Mass, to take a tour of the local Intel facilities, then the students might be exposed to a part of electrical engineering that they are not familiar with, such as signal processing, embedded system, microelectronics, or control systems. If the students know about these field within electrical engineering, then they may be more interested in an internship with an electrical engineering company than they were before. As was shown earlier, no students were interested in pursuing electrical engineering, but we feel that this type of first-hand exposure to the field is more influential and is more informative than only reading the paragraphs from the major descriptions form

A second recommendation that we have has to do with the members of the EPiC committee. We recommend that the companies that are already involved with the Engineering Pipeline volunteer internships. Even if the fields that the companies work with are not the fields of interest that the students want to follow, having many possibilities is useful. We can use this as a marketing tool for the companies that are intimidated or uninterested in pilot programs to get them excited about joining an established program. This would also be useful because an internship in an unrelated field could spark a liking in something new. We also recommend that the members of the EPiC board make an effort to get more companies involved in the program.

Not only would this make the task of finding contacts at companies for internships easier, but will also work as another marketing utility by informing people and companies about EPiC and how they can become involved. Not only do we think the EPiC board should try to make contacts at companies, but work to get more companies actively involved in the EPiC program as a whole. As of now, there are only 7 companies on the EPiC Board of Directors, and a small fraction of them that volunteered to be actively involved in our internship module. The EPiC committee should work to add more companies to the list of seven. Perhaps not all over them should be on the Board of Directors for EPiC, but should remain active by attending the scheduled board meetings. David Potter has a great deal of experience in placing students in internships, and was very helpful in our project, so he could serve as a very helpful resource. We believe EPiC should be involved with as many companies as possible, but to increase the number of companies on the Board of Directors, the current board could invite the companies that show fervor and commitment to EPiC's goals to join. An example of a great potential company would be Alden Research Laboratories, Inc. They were very excited in joining the program and were glad to be able to include students in a program that would impact both their company and the education of the student.

Perhaps the low attendance of corporate sponsors at the board meetings could be caused by lack of communication to board members. To improve the channels of communication, we recommend that a contact list or mailing list including telephone numbers, e-mail addresses, and other relevant information of all the members of the EPiC committee. When there is something that should be discussed by the entire group, whether it be a new company joining EPiC or a reminder of a scheduled board meeting, there will a structured method of contacting all the people and companies that should be contacted.

As was shown with our research, many of the students were interested in pursuing biomedical engineering and biotechnology. Not only do we recommend that more companies

join in the EPiC program in general, but we also recommend a more diverse listing of companies that work to form the EPiC committee. The companies involved with EPiC should not be solely mechanical or electrical engineering, but should aim to encompass fields such as biomedical engineering, civil engineering, and instrumentation. This may prove to be a challenge because of the conflicts between the Worcester Pipeline Collaborative in the North school quadrant that specializes in biotechnology and the Engineering Pipeline collaborative in the Doherty quadrant that specializes in engineering.

Our final recommendation to the EPiC board is that they communicate with the steering committee of the Worcester Pipeline Collaborative to get some of the quadrant issues resolved. Although both programs are designed to address different sciences, some resources, such as the University of Massachusetts Medical School, could be shared between both groups, but currently this is not allowed. Although this is an issue with the infrastructure of the Worcester Public Schools, if an internal discussion between both groups and the superintendent of Worcester schools, then a resolution where both groups can mutually benefit by exclusive resources can be reached.

At the moment, the number of active companies on the EPiC board if fine because there are only 6 students in the current course that are interested in internships. Since the efforts of the Engineering Pipeline Collaborative will begin starting at an earlier age, expanding down to the middle school (and eventually elementary school) grade levels, a much greater number of students will be enrolled in the engineering programs. Since the program will eventually grow, we have to make sure that the college and internship modules that we have designed will be scalable enough to expand in relation to the increasing number of students. We also have to make sure that the people who are taking over this project have enough resources to make the new contacts at companies and place the students in college courses or internships. As mentioned before, handing this task to a few teachers at Doherty High School may sound

feasible for the time being, but it will be almost impossible for the teachers to place hundreds of students in relevant internship positions. This is also another reason why we believe the EPiC board should become actively involved in the placement of students. If we include resources such as placement specialists like David Potter on the EPiC committee, then placing students will be easier in the future.

The recommendations we have proposed will serve as ideas that will strengthen the modules we have already developed for the college courses and internships. We have described how our successors will be able to complete our modules when we are no longer involved in designing it. We have also discussed how the EPiC board can help our module as the program expands through lower grades and grows in numbers. If these recommendations are considered, then the entire Engineering Pipeline Collaborative, including our project, will continue to be successful in future years.

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Appendix 1

Middle 10 - 20 Weeks:

Disadvantages

- Spanning internship over the middle 10 - 20 weeks would fit into the B and C terms at WPI; however, it would conflict with the semester system at QCC.
- Students taking college course would have to attend WPI. Tuition for two classes even after 50% discount is $2062.00 not including books and fees if applicable.
- There are scheduling conflicts. Weeks when Doherty is in school and WPI isn't and vice-versa, i.e. Christmas break.
- If the internship/ college course modules are in the middle 10 - 20 weeks, the preparation term and the engineering competition would be restricted to 1 quarter each.
- Students will go on Christmas vacation for about 2 weeks in the middle of their internships. This may not bode well with the host companies.
- Students will be traveling to and from Doherty in inclement weather.

Advantages

- Allows for both a preparation term and the engineering competition without being hindered with the stereotypical "senior slide."
- Gives students time to apply to other colleges, if they change their mind after or during their experience.
- Satisfies the original proposal's suggestion of the second 10- 20 weeks.

Final 10 – 20 Weeks:

Disadvantages

- The internship/ college course modules will be at the very end of the year. Most likely the students will not be as motivated due to the stereotypical "senior slide"
- Conflicts with initial proposal suggestion of the middle 10 – 20 weeks.
- Scheduling conflicts regarding April vacation.
- WPI and QCC do not commence classes at the same time.

Advantages

- Students would be given the choice to attend WPI or QCC
- Students would have the opportunity to change their major before they attended their prospective college.

- The addition of QCC would also expand the amount of available courses and times for the students to take.
- This would make the college course financially feasible for almost everyone since the costs will be far less (for QCC).
- Would allow for greater flexibility in scheduling both the preparation term and the engineering competition.
- Engineering competition would directly follow the preparation term.
- Students would be traveling in less inclement weather.

Staggering the Internship and College Course (internship – middle 10 – 20 weeks, college course - final 10 – 20 weeks)

Disadvantages

- The students would be leaving for the internships and college courses at completely different times.
- The teacher would almost constantly have a classroom of students, which would not allow for them to visit the students in an internship.
- There would need to be two preparation terms, one for each group of students.
- Students attending the college course and internship would not have the same experience in class.
- No time for Engineering competition unless it is at the very beginning of the year, which would limit the preparation term leading into our project.
- Debriefing period will be different for both groups of students.

Advantages

- This would not alter the internship time frame
- Fewer students would be off campus at the same time, allowing the teachers to focus more of their available time on individual students.
- Teachers will always have something to do in the classroom.

Appendix 2

Schedule Survey

Name:

1.) Please list the courses (ex. Pre-Calculus) you plan on taking next year as a senior.

2.) Please list any extracurricular activities that you plan on participating in next year, and if you know what times they are going to be held, please specify.

Appendix 3

Schedule Spreadsheet

Student:	Au, Cathy		Cote, Diane		Fife, Diane		Malatesta, Nathan	
Classes:	AP Calculus	10:47 - 11:33	AP Calculus	10:47 - 11:33	AP Physics	12:03 - 1:43	AP Calculus	10:47 - 11:33
	AP Physics	12:03 - 1:43	AP History	7:20-8:12/9:06-9:52	English 4	Any Period	AP History	7:20-8:12/9:06-9:52
	AP History	7:20-8:12/9:06-9:52	AP English	7:20-8:12/8:16-9:02	Gym	All Periods	AP English	7:20-8:12/8:16-9:02
	AP English	7:20-8:12/8:16-9:02	AP Chemistry	12:03 - 1:43	Psychology	Any Period	AP Physics	12:03 - 1:43
	Engineering	12:03 - 1:43	Engineering	12:03 - 1:43	Prob & Stats	Any Period	Engineering	12:03 - 1:43
					Engineering	12:03 - 1:43		
Extracurricular:	S.A.V.E		Field Hockey (f)		V Soccer (f)		YMCA Leaders	
	Fine Arts Club		Softball (s)		V Lacrosse (s)		V Soccer	
	DHS Pride Club		Model Congress		NHS		V I&O Soccer	
	Yearbook Comm				Prom Comm (ws)		NHS	
	YMCA Leaders				Yearbook (ws)		Recreational Soccer	
	NHS						Teach Relig. Ed.	
							Catholic Youth Council	
							Boy Scouts	
							FIRST @ WPI	
Student:	Kermani, Esther		Khalaf, Alia		Le, Quy		Markopoulos, Chris	
Classes:	AP Chemistry	12:03 - 1:43	AP Physics	12:03 - 1:43	Chemistry	Any Period	AP Physics	12:03 - 1:43
	AP Physics	12:03 - 1:43	Law	8:16-9:02/9:56-10:42/ 11:12-11:58	Algebra	Any Period	Law	8:16-9:02/9:56-10:42/ 11:12-11:58
	AP English	7:20-8:12/8:16-9:02	Psychology	Any Period	English 3	Any Period	Psychology	Any Period
	Gym	All Periods	AP English	7:20-8:12/8:16-9:02	ESL Advanced	Any Period	English	Any Period
	Pre-Calculus	Any Period	Prob & Stats	Any Period	Physics	Any Period	AP Prob & Stats	Any Period
	Engineering	12:03 - 1:43	Engineering	12:03 - 1:43	Engineering	12:03 - 1:43	Engineering	12:03 - 1:43
Extracurricular:	NHS		Literary Club		Club Sport		NHS	
			NHS		ESL English			
			YMCA Leaders					
	O'Connor, Candace		Petsas, Ted		Tumuna, Alphonce		**KEY**	
	Honors Physics	Any Period	AP Chemistry	12:03 - 1:43	Pre-Calculus	Any Period	S.A.V.E - Students Against Violence Everywhere	
	AP English	7:20-8:12/8:16-9:02	Pre-Calculus	Any Period	AP Physics	12:03 - 1:43	NHS - National Honor Society	
	AP History	7:20-8:12/9:06-9:52	US History	Any Period	English	Any Period	(s) - Spring	
	Honors Psychology	Any Period	AP English	7:20-8:12/8:16-9:02	Engineering	12:03 - 1:43	(f) - Fall	
	Honors Law	8:16-9:02/9:06-9:52/ 11:12-11:58	Engineering	12:03 - 1:43			V - Varsity	
	Engineering	12:03 - 1:43					(ws) - Winter-Spring	
							I&O - Indoor and Outdoor	
	FIRST		FIRST		Soccer (f)		Ed. - Education	
	S.A.V.E						S.A.D.D. - Students Against Drunk Driving	
	DHS Pride Club							
	S.A.D.D							
	Yearbook Comm						Course Schedules for 2001-2002 Academic Year	
	V Volleyball						Obtained from: Sue Michaud	
	YMCA Leaders							

Appendix 4

Student Interest Survey - Major Descriptions

(taken from http://www.swe.org/SWE/StudentServices/CareerGuidance/brochure2.html)

BIOMEDICAL ENGINEERING

Engineers are trained to apply techniques of mathematics and science to solving problems in medicine and biology. Engineers investigate genetic engineering, tumor biology, cellular processes, design and materials of prosthetic devices, new ways of taking images of the human body, and a wide range of other aspects of both biology and other engineering disciplines.

CHEMICAL ENGINEERING

These engineers must apply the principles of both mathematics and chemistry to solve problems, create materials, and design complex chemical systems. Chemical engineers create drug delivery systems, numerical models for atmospheric pollution problems, as well as magnetic and electronic materials. Not only do chemical and petroleum manufacturers employ them, but chemical engineers also find work in firms that produce drugs, plastics, paints, magnetic tapes, and synthetic fuels.

CIVIL ENGINEERING

The roads, dams, bridges, water treatment plants and all other public projects that affect society's daily life are developed by civil engineers. Civil engineers also perform the structural design and analysis of buildings, such as skyscrapers. Other areas of civil engineering include construction project management, construction automation, environmental engineering, traffic analysis, and mechanics of materials.

ELECTRICAL AND COMPUTER ENGINEERING

Electrical engineers explore electrical phenomena, such as determining the best methods of getting information from one place to another, and building robots that can electronically sense their surroundings. Computer engineers are involved with digital technologies like computer hardware and the development of more efficient circuitry on silicon computer chips.

MECHANICAL ENGINEERING

Mechanical engineers work with about anything that has integrated, moveable parts. They draw on knowledge from every other branch of engineering and work on a variety of projects: automobile transmissions, oil pipelines, solar heating systems, factory assembly lines, designing prosthetic devices, as well as manufacturing techniques and quality control, just to name a few.

MATERIALS SCIENCE AND ENGINEERING

Engineers in this field develop new ways to produce and process materials such as metals, ceramics, glasses, polymers, and semiconductors. They study how materials react under various conditions and contribute to the development of innovative products like ceramic parts for automobile engines, heat shields on space vehicles, and medical prosthetic devices.

Appendix 5

Student Interest Survey - Rankings

The descriptions of several engineering majors are listed on the following sheet. Please read the descriptions and then rank your interest/preference for each of them on a scale of one to ten: 1 – lowest, 10 - highest. Rankings do not have to be different between majors.

BIOMEDICAL ENGINEERING

1 2 3 4 5 6 7 8 9 10

CHEMICAL ENGINEERING

1 2 3 4 5 6 7 8 9 10

CIVIL ENGINEERING

1 2 3 4 5 6 7 8 9 10

ELECTRICAL AND COMPUTER ENGINEERING

1 2 3 4 5 6 7 8 9 10

MECHANICAL ENGINEERING

1 2 3 4 5 6 7 8 9 10

MATERIALS SCIENCE AND ENGINEERING

1 2 3 4 5 6 7 8 9 10

Appendix 6

Student Placement Survey

Name: _____

Year: _____

This survey will assist in placing you in either an internship or college course for next year. Please respond honestly and candidly as the accuracy of your response determines the accuracy of your placement.

1. What is your favorite science/engineering related class?

2. What math/science classes are you currently enrolled in?

3. What math/science classes will you be taking during your senior year?

4. What math/science courses have you already taken?

5. Which engineering courses have you taken?

6. Which projects/material did you enjoy most in previous engineering classes?

7. Do you have a preference between the college course or internship?

8. Do you have a preference for any specific companies/classes?

9. Do you have any connections with companies that would assist you in acquiring an internship?

Appendix 7

Teacher Recommendation

This student has applied for placement in the Grade-12 Engineering class. The placement in a college course or internship is highly individualized and involves project work as well as course work. Characteristics necessary for success are academic strength, creativity, motivation, and the ability to self-initiate. Please comment candidly, illustrating by example the candidate's suitability for an individualized program of study. We encourage you to share your thoughts with the applicant and thus enabling you and the student to make a mutually fitting selection. Please use the reverse side of this form for your comments. If you have a previously written recommendation, feel free to attach it to this form.

Applicant's Information

LAST FIRST M.I.

PREFERENCE: ❒ Internship ❒ College Course ❒ No Preference ❒ Other

Teacher Information

NAME

SUBJECT TAUGHT

LENGTH OF ACQUAINTANCE

E-MAIL ADDRESS OFFICE

RATINGS:

Compared with Other students in his or her class, how do you rate this student in terms of

No Basis		Below Average	Average	Good (above average)	Very Good (well above average)	Excellent (top 10 %)
❒	Creative, original thought	❒	❒	❒	❒	❒
❒	Motivation	❒	❒	❒	❒	❒
❒	Self-confidence	❒	❒	❒	❒	❒
❒	Independence, initiative	❒	❒	❒	❒	❒
❒	Intellectual ability	❒	❒	❒	❒	❒
❒	Academic achievement	❒	❒	❒	❒	❒
❒	Written expression of ideas	❒	❒	❒	❒	❒
❒	Effective class discussion	❒	❒	❒	❒	❒
❒	Disciplined work habits	❒	❒	❒	❒	❒
❒	Potential for growth	❒	❒	❒	❒	❒

SIGNATURE DATE

Adapted from http://www.wpi.edu/Admin/AO/recommendation.pdf

Appendix 8

Name:

Preference: ❒ College Course ❒ Internship ❒ Other

Please type your essays and attach them to this sheet.

In 500 words or less, please explain why you chose the program you did. If you chose *internship*, please include an explanation of why you didn't choose the college course. If you chose *college course*, please include an explanation of why you didn't chose the internship. If you chose *other*, please include an explanation of why you didn't choose either the college course or internship.

In 500 words or less, please explain why you feel this experience is going to be meaningful to you as the end of the engineering program?

Appendix 9

Quinsigamond Community Course Description and Schedules Spring 2001

For current course listings visit:
http://www.qcc.mass.edu/registrar/Default.htm

(Course descriptions obtained from Quinsigamond Community College Schedule Booklet for Credit Courses)

BIOLOGY

BIO 101. GENERAL BIOLOGY I: CORE CONCEPTS
This is an introductory course designed for both science and non-science majors. The student will examine core concepts in biology, including chemistry, cell structure and function, cell division, basic genetics, molecular genetics, and evolution. The laboratory will provide the student with basic techniques in observation, analysis, and interpretation of data relating to the topics discussed in lecture. At the conclusion of this course, the successful student should have a comprehensive knowledge of the following topics: scientific method, basic chemistry (for the understanding of biological concepts), cells and cell membranes (structure and function), mitosis and meiosis, Mendelian genetics, molecular genetics (DNA) and the basic principles of evolution. Three hours lecture, three hours laboratory. **Co-requisite: ENG101**

BIO 102. GENERAL BIOLOGY II: INTRODUCTION TO ORGAN SYSTEMS
Designed for both science and non-science majors, this course introduces the student to animal form. It considers the basic pattern of animal tissues and organ system, as well the biochemical physiological basis of organ system function. These concepts will be considered in the light of evolution of animal adaptations. The laboratory is designed to provide the student with basic techniques in observation, analysis, and interpretation of data as related to the topics discussed in lecture. Animal structure will be studied using the fetal pig as model. At the conclusion of the knowledge of mammalian form and function, including a consideration of such organ systems as digestive, circulatory, excretory, hormonal, reproductive, nervous, and sensory. **Pre-requisite Bio 101**

BIO 111. ANATOMY AND PHYSIOLOGY I
This course studies the concepts of cell structure and genetic regulation, chemical composition of the body, mechanisms of biochemical reactions, membrane transport and membrane transport and membrane potential, homeostasis and cybernetic mechanism, and the integumentary skeletal, muscular systems, and neuronal histology and physiology under normal and some pathological states. The student will gain the appreciation o, and lay the proper foundation for, a study in human anatomy and physiology; understand that the basic unit of structure and function in the human body is the cell; discuss major physiological and biochemical process occurring in the body; describe several methods of transporting materials can result in a potential difference across the cell plasma membrane; describe how the nervous and endocrine systems play a vital role in the regulatory mechanisms maintaining the homeostasis of individual; understand that the skin and its associated epidermal structures constitute the integumentary system; understand the

organization, functions and development of the human skeletal system, including body joints and movement; describe in detail structures and functions of muscles on the microscopic and macroscopic levels; and complete a study of the histology of nervous tissue and physiology of the neuron.
Pre-requisite: HS chemistry or CHM 090 or CHM 101, or CHM 103; Co-requisite ENG 101

BIO 112. ANATOMY AND PHYSIOLOGY II
This course is a sequel to BIO 111, stressing concepts of the nervous, cardiovascular, lymphatic, respiratory, digestive, and urinary systems under normal and some pathological states. The student will relate the anatomy of the brain, spinal cord, and the peripheral nervous system with their functions; know the components of the cardiovascular lymphatic systems, and relate the nature and composition of blood and lymph along with the cardiovascular physiology and the basic concepts involved in immunity; associate the organs of respiration with physiology of inspiration and expiration and the biochemistry of blood gases; understand the architecture of the digestive organs with reference to completion of chemical digestion and absorption of foodstuffs; relate how the kidney accomplishes the functions of filtration, reabsorption, and excretion of blood components and controls electrolyte, water and acid/base balance; associate the structure and physiology of male and female reproductive systems, and know the development of fertilized ovum through embryological and fetal development, including birth. **Pre-requisite: BIO 111**

CHEMISTRY

CHM 090. INTRODUCTION TO CHEMISTRY
This course provides an introduction to chemical principles for the student anticipating enrollment in BIO 101, as well as CHM 103. The student will manipulate significant figures and scientific notation; understand density, energy, and their calculations; understand basic atomic structure and the periodic table; write formulas, equations, and solve related problems; understand gasses, chemical bonding, equilibrium, redox reactions, and rate chemistry as well as solve related problems; and demonstrate knowledge of solutions, acid-base chemistry, and related calculations. **Pre-requisite: MAT 095 or MAT 096**

CHM 101. INTRODUCTION TO CHEMISTRY OF LIVING SYSTEMS
A laboratory science course in chemistry that focuses on those chemicals and processes that operate in living systems. This course should appeal to students seeking careers in the health sciences and the natural sciences (biology and chemistry). The course covers the fundamentals of inorganic, organic and biological chemistry and emphasizes the way in which chemicals are used in living systems. The applications of these chemical principles are demonstrated in the laboratory. **Pre-requisite: MAT 095 or MAT 096; CHM 090 or one year of HS chemistry**

CHM 103. PRINCIPLES OF CHEMISTRY I
This is a first-semester course of a two-semester laboratory experience. The course is appropriate for the student in engineering or for the student requiring a sound knowledge of chemical principles. The student will demonstrate by oral and/or written manner, chemical principles covering atomic structure, stoichiometry, thermochemistry, gasses, quantum theory,

chemical bonding, intermolecular forces and solutions. The topics are coordinated with laboratory experiments. **Co-requisite: MAT 123**

CHM 104. PRINCIPLES OF CHEMISTRY II
This is the second-semester course of a two-semester sequence including laboratory experience. This course is suitable for the student in engineering or for the student requiring a sound knowledge of chemical principles. The student will demonstrate by oral and/or written manner, the principles involved with chemical kinetics, chemical principles involved with chemical kinetics, chemical equilibrium, acid-base, solubility, electro-chemistry, coordination compounds, and organic chemistry. **Pre-requisite: CHM 103**

COMPUTER INFORMATION SYSTEMS

CIS 105. INTRODUCTION TO COMPUTERS AND SOFTWARE SUPPORT IN BUSINESS
This course is an introduction to the concepts of information technology as it applies to the business environment. This course will include the history of information technology, including hardware, software, and systems concepts. There will be exposure to and use of existing software and how the software is used in the application of information technology for problem solving. Review of case studies will be used to demonstrate principles, pitfalls and opportunities in the information technology field. Upon successful completion of this course the student will be aware of the hardware components of a computer system, the functions of an operating system, and the interaction of the hardware, software and operating systems.

CIS 111. INTRO TO MICROCOMPUTER APPLICATIONS IN BUSINESS
This course will introduce the student to various microcomputer concepts and provide hands-on experience in spreadsheet, word processing, and various other business related software. The student will gain a basic working knowledge of Windows, Microsoft Word, Excel, and Access software.

CIS 112. ADVANCED MICROCOMPUTER APPLICATIONS FOR BUSINESS
This course is a continuation of CIS 111. Using a hands-on approach, the student will learn how microcomputers can be used in the business environment. Three main topics are covered in the course. The first two, advanced database processing and advanced spreadsheet processing, will expand on the students knowledge of these two areas. The third area will involve graphics applications. The student will receive experience using graphics software to create documents combining text and graphics to generate professional-looking documents.
Pre-requisite: CIS 111

CIS 115. INTRODUCTION TO COMPUTER APPLICATIONS IN TELECOMMUNICATIONS
This course is an introductory course in basic computer orientation to hardware and implementation of software applications in telecommunications. The student will use various software packages to create documents, spreadsheets, graphs, databases, and presentations. The student will utilize this knowledge to solve problems and transfer information via electronic medium. Lectures, interactive learning, and demonstrations will be employed. Laboratory exercises will be required. The objective of this course is to introduce the student to a computer,

its components, and various applications. At the completion of the course, the student should be able to demonstrate familiarity with DOS and a working knowledge of the Windows environment; demonstrate the use of integrated software packages for word processing, database management, spreadsheets, and telecommunications; construct reports, documents, and presentations; and import and export documents from other formats between different software applications.

CIS 121. INTRODUCTION TO PROGRAMMING WITH C++

This course will introduce the student to the concept of solving problems through the design and implementation of algorithmic solutions. Solutions will be implemented using the C++ programming language. Topics of discussion will include then programming process, structured programming techniques, and basic logic formations. Business applications will be stressed throughout the course. Upon successfully completing this course, the student will grasp the basic concepts of programming, utilize them to create executable code, and understand how to use these skills to solve business problems. **Pre-requisite: CIS 111**

CIS 134. WEB PAGE DEVELOPMENT

This course teaches the student how to create dynamic Web sites using basic web authoring tools, as well as the newer, more complex, web enhancement software. The student will create Web pages using HTML, Active X, CGI, JavaScript, and other cutting-edge web development products. **Pre-requisite: CIS 111**

CIS 141. INTRO TO DATA COMMUNICATION & NETWORKS

This course will introduce the student to business data communications. Fundamental communication concepts, communication networks, and communications hardware and software will be discussed. This course presents the information in a non-technical format and is designed to give the student an understanding of data communication systems needed in today's business environment. **Pre-requisite: CIS 111**

CIS 223. VISUAL BASIC I

This course will introduce the student to Microsoft Visual BASIC for Windows. Fundamental Windows programming concepts will be discussed. The student will design and build Windows-based application using Microsoft Visual Basic for Windows. Upon successfully completing this course, the student will be able to create Windows applications programs to solve business problems. **Pre-requisite: CIS 111 and CIS 121**

CIS 226. INTRODUCTION TO JAVA

This course will cover the fundamentals the fundamentals of visual object-oriented programming using the Java language. Java is becoming the language of choice for portable, flexible an modular programs. Through lectures and hands-on programming assignments and projects, the student will learn how to design, write and compile Java programs. The concept of solving problems through algorithmic analysis will be emphasized throughout the course. Topics covered will include Control structures, Methods and Classes, Arrays, Searches, and Fundamental data types. An introduction to Java Applications and Java Applets will be included. Upon successful completion of this course, the student will be able to create executable code to solve problems using the Java programming language.

Pre-requisite: CIS 121

ELECTROMECHANICAL TECHNOLOGY

ELM 257. INTRODUCTION TO PROGRAMMABLE LOGIC OF CONTROLLERS

This course focuses on the principles and application of programmable logic controllers in the role of controlling manufacturing processes. The student is introduced to and learns the fundamental parts of PLC and the role each plays in providing an effective system of control. Development of PLC logic is learned, and methods of interfacing the PLC with external input and output devices are studied.

ELECTRONICS

ELT 103. 01 ELECTRONICS I

This is the beginning course in the study of electronics for all electronic majors. The topic will include the study of resistances, capacitances and inductances with DC and AC excitations, circuit theorems, use of meters, oscilloscopes and other test equipment, series and parallel resonance, and troubleshooting of electrical circuits and components. The student will breadboard series, parallel, and combinational circuits using resistors, capacitors, and inductors; troubleshoot such circuits to find malfunctioning components; use a variety of test equipment, such as analog and digital meters, oscilloscopes, and function generators; and analyze a variety of circuit configurations using experimental and mathematical and mathematical techniques. **Co-requisite: MAT 100**

ELT 105 CAD FOR TECHNICIANS

This introductory course provides necessary skills in a number of areas, the primary of which in an introduction to computer-aided design (CAD) using CADKEY. The course will also cover laboratory safety techniques, schematic symbols and cover laboratory safety techniques, and, as an introduction to the use of computers, Microsoft "Windows" will be introduced.

ELT 121. DIGITAL COMPUTER CIRCUITS

This course provides a study of digital computer fundamentals, including number systems, digital code, logic gates, Boolean algebra, combinational logic, and flip-flops. Troubleshooting techniques are taught and used throughout the course. Explained are the functions of the basic computer circuits used in the operation of all computer systems. The student will interpret the operation of a digital electronic circuit; troubleshoot to the failing component of a digital electronic circuit; demonstrate an understanding of the binary, octal, and hexadecimal number systems; and demonstrate an understanding of Boolean rules and laws used to express gate networks. **Pre-requisite: MAT 095**

ENGINEERING

ERG 101 ENGINEERING GRAPHICS

This is a beginning course in engineering drawing, utilizing computer assisted drawing technique. It provides the student with an introductory treatment of descriptive geometry, which is the basis theory of orthographic projection. The course covers orthographic, sectional,

isometric, and sectional views; assembly drawings and dimensioning using the CADKEY software. **Pre-requisite: 099**

ENVIRONMENTAL HEALTH & SAFETY

EHS 105 FUNDAMENTALS OF INDUSTRIAL HYGIENE

This introductory course studies the role of industrial hygiene in the recognition, evaluation, and control of occupational health hazards. The student will demonstrate his/her knowledge of the principles of industrial toxicology, chemical and physical hazards in the workplace, and methods used to evaluate and control such hazards. This course will provide the student with safety responsibilities and a practical knowledge of industrial hygiene.

EHS 115 HAZARDOUS MATERIALS & HAZARDOUS WASTE MANAGEMENT

The student will be able to demonstrate his/her understanding of the concepts related to applications of chemical properties of hazardous waste and hazardous materials in business and industry. He/she will discuss and make suggestions for dealing with the health hazards associated with storing, handing, and transporting hazardous waste and hazardous materials as well as demonstrate awareness of the laws, regulations, and standards necessary for emergency response personnel. The student will discuss how to react, plan, and make decisions related to extreme hazard areas.

MANUFACTURING TECHNOLOGY

MNT 101. MECHANICAL CAD I

This course of study is an introduction to the AutoCAD software. Students will explore all the necessary commands needed to produce a two-dimensional drawing. Topics include drawing setup, geometry creation, editing functions, layer setups, basic dimensioning, viewpoints, model and paper space, titleblock creation, along with the completion of this course the student will be proficient in the operation of a PC based CAD system and have a Drafting techniques. **Pre-requisite: CIS 115 or equivalent**

MATHEMATICS

MAT 100 COLLEGE ALGEBRA

The successful student will understand solving equations with fractions, arithmetic of rational expressions, simplifying complex fractions, factoring (grouping and sum/difference of two cubes), simplifying exponential expressions, roots, radicals and exponents, solving systems of linear equations (2x2 and 3x3; by elimination, substitution, and determinants), midpoint and distance formulas, binomial expansion, one-variable inequalities (linear, nonlinear, and absolute value), radical equations, absolute value equations and complex numbers, Any repeated objectives from intermediate algebra will involve a more advanced treatment of the topic. Mathematical modeling, collaborative learning and the application of technology are integral components of this course.
Pre-requisite: MAT 099 or appropr place score

MAT 121. TOPICS IN MATHEMATICS
This course consists of two components: a core and a supplement. Upon completion of the core components, the successful student will graph functions; perform scientific calculator computations involving trigonometric, exponential, and logarithmic functions; and employ algebraic and transcendental functions to model phenomena from such diverse fields as natural science, electronics, and finance. The topics comprising the supplementary component differ from one section of the course to another. Information regarding this component will be provided by the instructor at the beginning of the course. The student will understand the main transcendent functions and how they are used to model many common natural phenomena; graph such functions, and perform computations involving these functions on a scientific calculator. Further desired outcomes are dependent upon the specific supplementary topics selected for inclusion in the course. **Pre-requisite: MAT 099**

MAT 122 STATISTICS
The student will understand the difference between descriptive and inferential statistics; construct pictures of data (charts and graphs) such as histograms, frequency polygons, ogives and pie charts; compute measures of central tendency, such as the arithmetic mean, median, mode, mid-range, variance, and weight means; compute measures of dispersion such as range, variance, and standard deviation; understand the concept of discrete and continuos random variables; compute the mean and variance for a discrete probability distribution and the application in binomial experiments; understand the properties of standard and non-standard normal distribution; understand and make use of the Central Limit Theorem; perform one sample hypotheses test for the mean (large and small sample), proportions and variances; compute confidence intervals from means, proportions and variance; and understand the concepts of linear correlation and regression. **Pre-requisite: MAT 099**

MAT 123 COLLEGE MATHEMATICS I
The student will expand a binomial using the binomial theorem, writhe any term in an expansion, use Pascal's triangle, and understand factorial notations; solve linear, nonlinear, and absolute value inequalities graphing the solution using open, closed, half-open, and infinite interval notations; work in the rectangular coordinate system, knowing the distance and mid-point formulas, equations of a linear function (point-slope, slope-intercept, and the standard form); graph an equation using symmetry and domain; explain the meaning of functions in terms of domain, range, and one-to-one relation; recognize the identity function, constant functions, even and odd functions, and increasing and decreasing functions; know how to shift a graph horizontally and vertically and to reflect and/or stretch a graph; recognize the equation of a circle, locating coordinates of the center and determining the radius; sketch the graphs of and work with piecewise functions; execute the arithmetic operation (additions, subtraction, multiplication, and division) on two functions; determine the composition of two given functions, whether the a function is one-to-one, and the inverse maximums or minimums; sketch rational, exponential, and logarithmic functions; and know the major properties of logarithms and exponents. Additional topics selected at the instructor's discretion may be presented if time permits. **Pre-requisite: MAT 099**

MAT 124 COLLEGE MATHEMATICS II: TRIGONOMETY
The student will solve right and oblique triangles and related word problems; perform vector computations and use vector concepts to solve word problems; determine the values of trigonometric ratios of angles and the value of inverse trigonometric of real numbers; work with angles measured in degrees-minute-seconds or radians; solve uniform circular motion problems; know the traditional trigonometric identities and use them to prove other identities; sketch the graphs of variations of the six basic trigonometric functions; write equations to describe specific instances of harmonic motion; and solve trigonometric equations. **Pre-requisite: MAT 123**

MAT 233. CALCULUS I
This course begins with a review of the basic concepts of functions and function notation. Once the limit and continuity theorems are introduced on an intuitive basis, differentiation begins. The typical derivative formulae are applied to polynomial, rational, trigonometric, inverse trigonometric, implicit, exponential, and logarithmic functions. The application topics include extreme, related rates, curve sketching, compound interest, growth and decays, velocities, and accelerations. An introduction to integration as an anti-derivative follows, and eventually integration rules and substitution are discussed as a technique of integration. Areas of closed regions are used to introduce Riemann sums, and the Fundamental Theorem of Calculus. **Pre-requisite: MAT 124**

MAT 243 LINEAR ALGEBRA
The topics covered in this course are as follows: systems of linear equations and matrices; determinants; vectors in 2-space and 3-space; vector spaces; Euclidean n-space; subspaces; inner product spaces; eigenvalues; eigenvectors; Gaussian eliminations; linear transformations; least-squares approximations; numerical methods of linear algebra; stability of differential equations; and complex vector spaces together with applications.

PHYSICS

PHY 102 PHYSICS II
This course is the continuation of Physics I. Selected topics from the areas of properties of materials, thermodynamics, waves, and vibrations, optics and electromagnetism are studied. Problem-solving techniques are emphasized. Related laboratory experiments are performed. The student will state and explain related problems; perform related laboratory report; and appreciate the relationship of physics to the natural world.
Pre-requisite: PHY 101

Appendix 10

QCC Course Schedules for Spring 2002

For current course listings visit:

http://www.qcc.mass.edu/registrar/Default.htm

COURSE	LECTURE	LABORATORY
BIO 101 02	T-R 8:15a 9:15a	
BIO 101 03	M-W-F- 1:00p 1:50p	
BIO 101 04	M-W-- 2:00p 3:15p	
BIO 102 01	M-W-F- 9:00a 9:50a	M-- 11:01a 1:50p
BIO 102 02	T-R-- 9:30a 10:45a	T-- 2:00p 4:50p
BIO 102 50	R-- 7:35p 10:00p	
BIO 102 50	R-- 5:00p 7:30p	
BIO 111 01	M-W-F 8:00a-8:50a	W--- 2:00p 4:50p
BIO 111 02	M-W-F 8:00a-8:50a	R-- 2:00p 4:50p
BIO 111 50	F-- 5:00p 7:30p	W--- 11:00a 1:50p
BIO 111 80	S-- 10:31a 1:00p	
BIO 111 80	S-- 8:00a 10:30a	
BIO 111 50	F- 7:31p 10:00p	
BIO 112 01	M-W-F- 8:00a 8:50a	M----- 2:00p 4:50p
BIO 112 02	T-R-- 8:00a 9:15a	T---- 11:00a 1:50p
BIO 112 50	T---- 5:00p 7:30p	W--- 9:00a 11:50a
BIO 112 50	T---- 7:35p 10:00p	F- 12:00p 2:50p
BIO 112 51	W--- 5:00p 7:30p	
BIO 112 51	W--- 7:35p 10:00p	
BIO 112 52	F- 7:35p 10:00p	
BIO 112 52	F- 5:00p 7:30p	
BIO 112 80	S 10:35a 12:55p	
BIO 112 80	S 8:00a 10:30a	
CHM 090 01	M-W-F- 1:00p 1:50p	
CHM 090 40	R-- 4:00p 6:55p	
CHM 090 41	T--- 4:00p 6:55p	
CHM 101 51	R --5:00p 7:30p	R-- 7:35p 10:00p
CHM 103 01	M-W-F- 12:00p 12:50p	R-- 9:30a 12:15p
CHM 103 02	F- 1:00p 2:55p	F-- 3:00p 5:55p
CHM 103 EM	F- 1:00p 2:55p	F- 3:00p 5:55p
CHM 104 01	M-W-F- 10:00a 10:50a	R-- 12:30p 2:50p 4.00
CHM 104 50	M-- 5:00p 7:30p	M-- 7:35p 10:00p 4.00

QCC Course Schedules for Spring 2002

For current course listings visit:

http://www.qcc.mass.edu/registrar/Default.htm

COURSE	LECTURE	LABORATORY
CIS 105 01	T-R 11:00a 12:15p	
CIS 105 02	M-W-F 1:00p 1:15p	
CIS 105 03	F--1:00p 3:45p	
CIS 105 39	W-- 6:30p 9:30p	
CIS 105 70	M -- 7:00p 9:55p	
CIS 111 01	M-W-F- 8:00a 8:50a	
CIS 111 02	M-W-F- 11:00a 11:50a	
CIS 111 03	T-R- 11:00a 11:50a	
CIS 111 04	W- 1:00p 3:45p	
CIS 111 05	T-R- 8:00a 9:15a	
CIS 111 06	M-W-F 12:00p 12:50 p	
CIS 111 07	T-R- 2:00p 3:15p	
CIS 111 08	M----- 1:00p 3:45p	
CIS 111 09	M----- 1:00p 3:45p	
CIS 111 10	T-R-- 9:30a 10:45a	
CIS 111 11	M-W-F-- 10:00a 10:50p	
CIS 111 12	M-W-F—9:00a 9:50a	
CIS 111 13	M-W-F—12:00p 12:50p	
CIS 111 14	T-R—6:40a 7:45a	
CIS 111 40	M----- 4:00p 6:55p	
CIS 111 41	T--- 4:00p 6:55p	
CIS 111 42	R-- 4:00p 6:55p	
CIS 111 43	W---- 4:00p 6:55p	
CIS 111 61	F- 6:00p 8:55p	
CIS 111 70	W--- 7:00p 9:55p	
CIS 111 71	R--- 7:00p 9:55p	
CIS 111 72	T-- 7:00p 9:55p	
CIS 111 73	M----- 7:00p 9:55p	
CIS 111 80	U-- 12:00p 12:55p	
CIS 111 90	S 12:30p 3:25p	
CIS 111 91	S 9:00a 11:55a	
CIS 112 01	T-R-- 12:30p 1:45p	
CIS 112 02	M-W-F- 12:00p 12:50p	
CIS 112 61	F- 6:00p 8:55p	
CIS 115 01	M-W-F-- 9:00a 9:50a	
CIS 115 02	M-W-F—10:00a 10:50a	
CIS 115 61	F-- 6:00p 8:55p	

QCC Course Schedules for Spring 2002

For current course listings visit:

http://www.qcc.mass.edu/registrar/Default.htm

COURSE	LECTURE	LABORATORY
CIS 121 01	W-- 1:00p 3:45p	
CIS 121 02	T-R-- 8:00a 9:15a	
CIS 121 03	M-W-F-- 12:00p 12:50p	
CIS 121 40	T- 4:00p 6:55p	
CIS 121 70	R-- 7:00p 9:55p	
CIS 134 01	M-W-F-- 11:00p 11:50p	
CIS 134 02	T-R-- 11:30a 12:15p	
CIS 134 40	M---- 4:00p 7:00p	
CIS 134 70	W-- 7:00p 9:55p	
CIS 141 01	M----- 1:00p 3:45p	
CIS 141 02	M-W-F- 11:00a 11:50a	
CIS 141 40	M----- 4:00p 6:55p	
CIS 141 70	M----- 7:00p 9:55p	
CIS 223 70	T- 7:00p 9:55p	
CIS 226 40	W-- 4:00p 6:55p	
ELM 257 01	M-W-F- 8:00a 8:50a	T---- 2:00p 4:45p
ELT 103 01	T-R-- 2:00p 3:50p	R-- 8:00a 10:45a
ELT 105 01	F- 1:00p 3:45p	
ELT 121 01	M-W-F- 11:00a 11:50a	T---- 8:00a 10:45a M---- 2:00p 4:45p
ERG 101 01 ERG 101 60	M-W-F- 9:00a 9:50a M----- 6:00p 8:55p	
EHS 105 70	M-- 7:00p 9:55p	
EHS 115 70	T-- 7:00p 9:55p	
MNT 101 70	M----- 7:00p 10:00p	

QCC Course Schedules for Spring 2002

For current course listings visit:

http://www.qcc.mass.edu/registrar/Default.htm

COURSE	LECTURE	LABORATORY
MAT 100 01	M-W-F- 8:00a 8:50a	
MAT 100 02	M-W-F- 11:00a 11:50a	
MAT 100 03	T-R-- 8:00a 9:15a	
MAT 100 04	M-W-F- 1:00p 1:50p	
MAT 100 05	T-R-- 11:00a 12:15p	
MAT 100 70	T-- 7:00p 9:55p	
MAT 100 71	R-- 7:00p 9:55p	
MAT 121 01	M-W-F- 1:00p 1:50p	
MAT 121 40	T---- 4:00p 6:55p	
MAT 122 01	M-W--- 2:30p 3:45p	
MAT 122 02	T-R-- 9:30a 10:45a	
MAT 122 03	T-R-- 11:00a 12:15p	
MAT 122 04	T-R-- 12:30p 1:45p	
MAT 122 40	W--- 4:00p 6:55p	
MAT 122 70	W--- 7:00p 9:55p	
MAT 123 01	M-W-F- 9:00a 9:50a	
MAT 123 02	M-W-F- 12:00p 12:50p	
MAT 123 03	T-R-- 8:00a 9:15a	
MAT 123 04	T-R-- 12:30p 1:45p	
MAT 123 40	R-- 4:00p 6:55p	
MAT 123 70	M----- 7:00p 9:55p	
MAT 123 90	S 12:30p 3:25p	
MAT 124 01	M-W-F- 8:00a 8:50a	
MAT 124 02	M-W-F- 11:00a 11:50a	
MAT 124 40	M--- 4:00p 6:55p	
MAT 124 70	M--- 7:00p 9:55p	
MAT 124 80	U--- 12:00p 2:55p	
MAT 233 61	M-T-W-T-F- 8:00a 8:50a	
MAT 243 01	M-W-F- 3:00p 3:50p	
PHY 102 01	M-W--- 11:00a 12:15p	T---- 8:00a 10:59a
PHY 102 70	M----- 7:00p 9:55p	W--- 7:00p 9:55p

Appendix 11

QUINSIGAMOND COMMUNITY COLLEGE ONLINE COURSE OFFERINGS

SPRING 2002

For updated online course listings visit:
http://www.qcc.mass.edu/qcconline/credit.htm

CIS 105 Introduction to Computers and Software Support in Business 3 cr.
This course is an introduction to the concepts of information technology as it applies to the business environment. This course will include the history of information technology, including hardware, software, and systems concepts. There will be a brief induction to programming. There will also be exposure to and use of existing software and how the software is used in the application of information technology for problem solving. Review of case studies will be used to demonstrate principles, pitfalls, and opportunities in the information technology field. Upon successful completion of this course the student will be aware of the hardware components of a computer system, the functions of an operating system, and the interaction of the hardware, software and operating system. F/S. (Note: This course replaces former CIS 104 and CIS 124.) (BE)

CIS 105 on-line Note
Both the Midterm and the Final Exams will be administered on campus in the Individualized Learning Center (ILC). Students will need to 'drop in' to the ILC during the week of March 4, 2002 and March 10, 2002 for the Midterm Exam and the week of May 6, 2002 to May 12, 2002 for the Final Exam.

CIS 111 Introduction to Microcomputer Applications in Business (CS 161) 3 cr.
This course will introduce the student to various microcomputer concepts and provide hands-on experience in spreadsheet, word processing, and other business related software. The student will gain a basic working knowledge of Windows, Microsoft Word, Excel, and Access software. F/S/SU. (BE)

CIS 111 on-line Note
Students will have interaction with other students through discussion groups. These discussions will be communicated through the Intralearn software. There will be as needed communication between students and faculty at times convenient to both. This communication may be in person (if needed), via telephone, or the preferred method, e-mail. Students will read and complete assignments, and as needed they will enter discussion groups to offer and receive assistance on the material being covered. The instructor will monitor these discussions and offer suggestions as needed.

CIS 112 Advanced Microcomputer Applications (CS 162) 3 cr.
This course is a continuation of CIS 111. Using a hands-on approach, the student will learn how microcomputers can be used in the business environment. Three main topics are covered in the

course. The first two, advanced database processing and advanced spreadsheet processing, will expand on the student's knowledge of these two areas. The third area will involve graphics applications. The student will receive experience using graphics software to create documents combining text and graphics to generate professional-looking documents. **Prerequisite**: CIS 111. F/S. (BE) CIS 112

CIS 112 on-line Note

Students will have interaction with other students through discussion groups. These discussions will be communicated through the Intralearn software. There will be as needed communication between students and faculty at times convenient to both. This communication may be in person (if needed), via telephone, or the preferred method, e-mail. Students will read and complete assignments, and as needed they will enter discussion groups to offer and receive assistance on the material being covered. The instructor will monitor these discussions and offer suggestions as needed.

CIS 115 Introduction to Computer Applications in Telecommunications (CS 150) 3 cr.

This course is an introductory course in basic computer orientation to hardware and implementation of software applications in telecommunications. The student will use various software packages to create documents, spreadsheets, graphs, databases, and presentations. The student will utilize this knowledge to solve problems and transfer information via electronic medium. Lectures, interactive learning, and demonstrations will be employed. Laboratory exercises will be required. The objective of this course is to introduce the student to a computer, its components, and various applications. At the completion of the course, the student should be able to demonstrate familiarity with DOS and a working knowledge of the Windows environment; demonstrate the use of integrated software packages for word processing, database management, spreadsheets, and telecommunications; construct reports, documents, and presentations; and import and export documents from other formats between different software applications. (Equivalent to CIS 156). F/S. (BE)

CIS 115 on-line Note

Students will be required to meet with the instructor at the beginning of the semester for an introduction, and at the end of the semester to hand in their Power Point Slide Presentation and to take an in class written final exam. Use of the discussion board for each lesson is required. In person meetings with instructor/student are available by appointment.
Labs will be posted assigned on a weekly basis.

CIS 121 Introduction to Programming With C++ (CS 153) 3 cr.

This course will introduce the student to the concept of solving problems through the design and implementation of algorithmic solutions. Solutions will be implemented using the C++ programming language. Topics of discussion will include the programming process, structured programming techniques, and basic logic formations. Business applications will be stressed throughout the course. Upon successfully completing this course, the student will grasp the basic concepts of programming, utilize them to create executable code, and understand how to use these skills to solve business problems. **Prerequisite**: CIS 111 or equivalent PC skills. F/S. (BE)

CIS 121 on-line Note

This course will require a considerable amount of time programming in either a Lab setting or on

your own system at home, as well as participation in electronic discussion groups and connecting every day to the course site. A maximum of two weekend meetings will be scheduled in advance and published on the course site at the beginning of the semester.

CIS 223 Visual Basic I (CS 269) 3 cr.
This course will introduce the student to Microsoft Visual BASIC for Windows. Fundamental Windows programming concepts will be discussed. The student will design and build Windows-based applications using Microsoft Visual BASIC for Windows. Upon successfully completing this course, the student will be able to create Windows applications programs to solve business problems. **Prerequisites**: CIS 111, CIS 121. F. (BE)
CIS 223 on-line Note
Students will be required to come to the Harrington Lab (room 379A), located in the Administration Building on the Quinsigamond Community College campus, twice during the semester to take the midterm and final exams.

CIS 226 Introduction to Java 3 cr.
This course will cover the fundamentals of visual object-oriented programming using the Java language. Java is becoming the language of choice for portable, flexible and modular programs. Through lectures and hands-on programming assignments and projects, the student will learn how to design, write and compile Java programs. The concept of solving problems through algorithmic analysis will be emphasized throughout the course. Topics covered will include Control structures, Methods and Classes, Arrays, Searches and Fundamental data types. An introduction to Java Applications and Java Applets will be included. Upon successful completion of this course, the student will be able to create executable code to solve problems using the Java programming language. **Prerequisites**: CIS 121. F, 2001. (BE)
CIS 226 On-line Section Note
This course will require a considerable amount of time programming in either a Lab setting or on your own system at home, as well as participation in electronic discussion groups and connecting every day to the course site. A maximum of two weekend meetings will be scheduled in advance and published on the course site at the beginning of the semester.

MAT 124 College Mathematics II: Trigonometry (MA 152) 3 cr.
The student will solve right and oblique triangles and related word problems; perform vector computations and use vector concepts to solve word problems; determine the values of trigonometric ratios of angles and the values of inverse trigonometric ratios of real numbers; work with angles measured in degrees-minutes-seconds or radians; solve uniform circular motion problems; know the traditional trigonometric identities and use them to prove other identities; sketch the graphs of variations of the six basic trigonometric functions; write equations to describe specific instances of harmonic motion; and solve trigonometric equations.
Prerequisite: MAT 123. F/S/SU. (LA)
MAT 124 on-line Note
Students will be required to take a mid-term exam and a final exam on campus. One hour approximately every three weeks, the instructor will be available for personal tutoring. The

specific schedule will be posted before the beginning of the semester. There will be an additional four (4) on-line exams given during the course.

MAT 123 College Mathematics I: Pre-calculus (MA 151) 3 cr.

The student will expand a binomial using the binomial theorem, write any term in an expansion, use Pascal's triangle, and understand factorial notations; solve linear, nonlinear, and absolute value inequalities graphing the solutions using open, closed, half-open, and infinite interval notation; work in the rectangular coordinate system, knowing the distance and mid-point formulas, equations of a linear function (point-slope, slope-intercept, and the standard form); graph an equation using symmetry and domain; explain the meaning of function in terms of domain, range, and one-to-one relation; recognize the identity function, constant function, even and odd functions, and increasing and decreasing functions; know how to shift a graph horizontally and vertically and to reflect and/or stretch a graph; recognize the equation of a circle, locating coordinates of the center and determining the radius; sketch the graphs of and work with piecewise functions; execute the arithmetic operations (addition, subtraction, multiplication, and division) on two functions; determine the composition of two given functions, whether a function is one-to-one, and the inverse of a one-to-one function; graph quadratic functions locating maximums or minimums; sketch rational, exponential, and logarithmic functions; and know the major properties of logarithms and exponents. Additional topics selected at the instructor's discretion may be presented if time permits. **Prerequisite**: MAT 099. F/S/SU. (LA)

MAT 123 on-line Note

The student will purchase a multimedia package which will include a text, a number of CD's, and an online location for a good, endless supply of step-by-step drill and practice exercises. In addition to this package, the student will follow the instructor's outline which will include PowerPoint presentations, worksheets, instructor-made videos, and interactive pretests and worksheets.

The student will need access to WORD and the latest free download version of Real Player and/or Windows Media Player. The student will also need to borrow from the instructor a CD for which the student will use to download a program onto his/her computer.

Finally, there are two on-campus meetings at which the student will complete a midterm or final exam. The two Saturday afternoon meetings are scheduled for March 9 and May 4.

Appendix 12

WPI Course Descriptions

Online Application URL:
http://www.wpi.edu/Pubs/Catalogs/Ugrad/Current/courses.html

BIOLOGY AND BIOTECHNOLOGY

BB 1001. INTRODUCTION TO BIOLOGY.
Cat. I
This course consists of an overview of the major concepts of Biology, including: cell theory, bioenergetics, molecular biology, reproduction, nutrition, growth, development, homeostatic controls, and ecological issues. This course is intended for students seeking a broad overview of contemporary Biology with emphasis on human issues and current topics.
Lecture and conference. Recommended background: high school or introductory college level chemistry.

BB 1002. ENVIRONMENTAL BIOLOGY.
Cat. I
This course provides an introduction to natural ecosystems, population growth, and the interaction between human populations and our environment. Major areas of discussion include Ecosystems, Populations, Biodiversity, Pollution, and Environmental Economics. This course is designed for students seeking a broad overview of ecological systems and the effect of humans on the ecosystems.
Recommended background: High School biology.

BB 1030. INTRODUCTION TO BIOLOGICAL MACROMOLECULES.
Cat I.
This course is an introductory biology course for Biology and Biotechnology and health science pre-professional majors. The four classes of biologically important macromolecules (lipids, nucleic acids, proteins, and carbohydrates) will be studied, with particular reference to how their structure is appropriate to their function in cell metabolism and reproduction. Current topics in cell and molecular biology will be used as the basis for small group problem solving.
Recommended background: High School Biology, CH 1010 (concurrent).

BB 1040. PLANT DIVERSITY.
Cat. I

An introductory course stressing general concepts related to the vast array of plant species, taxonomic links, and uses of major plant phyla in both society and industry. Some emphasis will be given to economically important species chosen from agronomic and non-agronomic situations.
Recommended background: high school biology or equivalent.
Students may not receive credit for both BB 2030 and BB 1040.

BE 1001. INTRODUCTION TO BIOMEDICAL ENGINEERING.
Cat. I
Lectures, demonstrations, hands-on experimentation, and scientific literature readings in the major branches of biomedical engineering. A series of laboratory demonstration/experiments are utilized to complement key concepts covered in various lectures. Students will be expected to read and prepare reviews of critical papers from several branches of biomedical engineering.

BIOMEDICAL ENGINEERING

BE 2300. BIOMEDICAL ENGINEERING DESIGN.
Cat. I
Students are guided through the open-ended, real-world, design process starting with the project definition, specification development, management, team interactions and communication, failure and safety criteria, progress reporting, marketing concepts, documentation and technical presentation of the final project outcome. The course will include a significant writing component, will make use of computers, and hands-on design explorations.

CHEMISTRY and BIOCHEMISTRY

CH 1010. MOLECULARITY.
Cat. I
The theme of CH 1010 is the idea of molecularity: that all matter in the universe is composed of atoms bonded together in a limited number of ways. Molecularity is one of a small number of fundamental themes of chemistry (and of all science); it is important for us to address it immediately because it permeates all of chemistry.
Specific concepts that we will discuss are presented below.
Introduction to the Molecular View
The Quantum Structure of the Atom
Structures of Simple Molecules
Molecular Shape (Stereochemistry)
Types of Compounds: The Periodic Table

CH 1020. FORCES AND BONDING.
Cat. I
The theme of CH 1020 is forces and bonding. We will examine the origin and strength of electrical forces within molecules (covalent bonds), between positive and negative ions in a lattice (ionic bonds), and between atoms or molecules of a pure substance (intermolecular forces). Energy changes accompanying the rupture or formation of such bonds will be discussed.
Specific concepts that we will discuss are presented below.
Gases
Solids
Intra-and Intermolecular Forces
Liquids
Energy (First Law of Thermodynamics)
Solutions

CH 1030. EQUILIBRIUM.
Cat. I
The theme of CH 1030 is equilibrium. We will examine the nature of dynamic equilibrium at the molecular level, and will develop an understanding of the mathematical aspects of equilibrium. Phase equilibrium, further aspects of thermodynamics (entropy, free energy), equilibrium of chemical reactions in the gas phase, and equilibrium of chemical reactions in solution will be discussed.
Specific concepts that we will discuss are presented below.
Phase Equilibrium
Chemical Equilibrium of Gas Phase Reactions
Chemical Equilibrium of Reactions in Solution
Entropy and Free Energy

CH 1040. DYNAMICS.
Cat. I
The theme of CH 1040 is dynamics. We will examine the nature of molecular motions and their interaction with light, which provides us with all of our structural information about molecules. Various types of molecular spectroscopy will be discussed. Then we will turn to the dynamics of interactions between molecules, examining the rates of chemical reactions, and discussing the detailed molecular pathways by which they occur.
Specific concepts that we will discuss are presented below.
NMR Spectroscopy

Vibrational Spectroscopy
Electronic Spectroscopy
Dynamics of Physical Processes (Diffusion, phase changes, phase distribution)
Dynamics of Chemical Processes

CIVIL and ENVIRONMENTAL ENGINEERING

CE 1030. CIVIL ENGINEERING AND COMPUTER FUNDAMENTALS.
Cat. I
This course introduces students to basic fundamentals of civil engineering, group dynamics, oral presentation skills, engineering report writing techniques, and uses of the computer. Basics of structural engineering, geotechnical engineering, environmental engineering, surveying, materials, and construction engineering and management are presented in this course through a collaborative group teaching approach. Background is provided to gain competence in operating systems, editors, and spreadsheets. Student groups complete weekly computer laboratory projects and develop oral presentations and written reports.
No previous computer use skills are required or assumed. This course is recommended for freshman or sophomore students.

CE 2000. ANALYTICAL MECHANICS I.
Cat. I
This fundamental civil engineering course provides an introduction to the analysis of structures in static equilibrium. The focus of this course is a classical analysis of concurrent and non-concurrent equilibrium. A variety of engineering problems including trusses, machines, beams, rigid frames, and hydraulic structures involving concentrated and distributed loading systems are analyzed for external reactions and internal forces.

CE 2020. SURVEYING.
Cat. I
This course develops understanding and fundamental skills in the theoretical and practical aspects of plane surveying through the use and care of modern instruments and the associated computations. Topics include the classification of errors incurred in observed field data and necessary correction applications, the use and care of surveying equipment, traversing, differential leveling, stadia and mapping, and electronic data transfer. Computer applications are used where appropriate.

CE 3023. ARCHITECTURAL ENGINEERING SYSTEMS.
Cat I
This course introduces the fundamental concepts associated with the design and construction of a building. Major building components, such as foundations, structures, envelopes and environmental systems are presented as subsystems to be integrated. The systems approach is utilized to describe the functional interdependence of building components and the interdisciplinary nature of the design of contemporary buildings. Building components are analyzed in terms of design details and constructability implications. AutoCAD representation and building design exercises as well as case studies are used to illustrate the topic.

CE 3070. URBAN AND ENVIRONMENTAL PLANNING.
Cat. I
This course introduces to the student the social, economic, political, and environmental factors that affect the population growth and distribution patterns, and the impact of such patterns to the natural environment. By using the principles and procedures of planning, the optimal growth pattern may be examined, and the infrastructure (roads, water supply systems, waste-water treatment systems, shopping malls, etc.) necessary to support present and future growth patterns may be determined.
The information necessary in planning, which involves conscious procedures of analysis, formulation of alternative solutions, rational assessment and deliberate choice in accordance with evaluation criteria, is obtained through extensive reading. As such the course introduces a variety of topics of concern to engineers and environmentalists. The course is intended not only for civil engineering majors, but also for students preparing for an IQP in areas of urban or environmental concerns.

COMPUTER SCIENCE

CS 1001. INTRODUCTION TO COMPUTERS.
Cat. II

This course introduces computer systems to students who may need to write or use computer programs in their undergraduate engineering, science, or management courses.
Topics include problem-solving and algorithm development, the program development cycle, structured programming design, coding, debugging and documentation.
Students will be expected to implement a variety of programs using the FORTRAN programming language.
Intended audience: noncomputer science majors desiring a practical introduction to programming. This course is not sufficient background for MQPs or IQPs involving extensive programming or most advanced computer science or computer engineering courses. Such background may be obtained by taking CS 1005 or CS 1006 followed by CS 2005.
Recommended background: none.
This course will be offered in 2002-03 and in alternating years thereafter.

CS 1005. INTRODUCTION TO PROGRAMMING.
Cat. I
This course introduces structured programming with emphasis on modular design and functional decomposition.
Topics include problem solving and algorithm development, the syntax and semantics of sequential, iterative, and conditional control structures, functions, arrays, pointers, and simple I/O.
Students will be expected to design and implement programs in C++.
Intended audience: computer science and computer engineering students and those students desiring a background in computer programming.
Recommended background: none.

CS 1006. OBJECT-ORIENTED INTRODUCTION TO PROGRAMMING.
Cat. I
This course introduces computer programming, with emphasis on object-oriented programs.
Topics include: Problem solving, algorithm development, and debugging; the syntax and semantics of sequential, iterative, conditional, and recursive control structures; primitive and complex data types; and simple I/O.
Outcomes: Students will be expected to design and implement programs as applications and applets in an object-oriented programming language, such as Java.
Intended audience: All students with little or no programming experience who desire to learn an object-oriented programming language.
Recommended background: None.
Note: Either CS 1005 or CS 1006 will provide sufficient background for further study in Computer Science, including CS 2005 Techniques of Programming.

CS 2022/MA 2201. DISCRETE MATHEMATICS.
Cat. I
This course serves as an introduction to some of the more important concepts, techniques, and structures of discrete mathematics, providing a bridge between computer science and mathematics.
Topics include functions and relations, sets, countability, groups, graphs, propositional and predicate calculus, and permutations and combinations.
Students will be expected to develop simple proofs for problems drawn primarily from computer science and applied mathematics.
Intended audience: computer science and mathematical sciences majors.
Undergraduate credit may not be earned both for this course and for CS 501.
Recommended background: none.

CS 3041. HUMAN-COMPUTER INTERACTION.
Cat. I
This course develops in the student an understanding of the nature and importance of problems concerning the efficiency and effectiveness of human interaction with computer-based systems.
Topics include the design and evaluation of interactive computer systems, basic psychological considerations of interaction, interactive language design, interactive hardware design, and special input/output techniques.
Students will be expected to complete two projects. A project might be a software evaluation, interface development, or an experiment.
Intended audience: computer science majors, especially juniors.

Recommended background: CS 2005.

CS 3043. SOCIAL IMPLICATIONS OF INFORMATION PROCESSING.

Cat. I

This course makes the student aware of the social, moral, ethical, and philosophical impact of computers and computer-based systems on society, both now and in the future.

Topics include major computer-based applications and their impact, human-machine relationships, and the major problems of controlling the use of computers.

Students will be expected to contribute to classroom discussions and to complete a number of writing assignments.

Intended audience: students interested in the impact of a computer-oriented technology on his or her future way of life and well-being. This course is highly recommended for juniors.

Undergraduate credit may not be earned both for this course and for CS 505.

Recommended background: a general knowledge of computers and computer systems.

ELECTRICAL ENGINEERING

EE 2011. INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING.

Cat. I

The objective of this course is to expose new electrical engineering students (including first year students) to the broad field of electrical engineering, introducing basic concepts of circuits and systems and their applications. Experiments based on practical devices are used to reinforce basic concepts and develop laboratory skills, as well as to provide system-level understanding. The use of circuit simulation tools for analysis and design is introduced.

Topics: Basic concepts of electrical circuits, linear circuit analysis, op-amp circuits, simple transients, phasor analysis, amplifiers, frequency response, filters.

Recommended background: high school physics.

EE 2022. INTRODUCTION TO DIGITAL CIRCUITS AND COMPUTER ENGINEERING.

Cat. I

The objective of this course is to expose students (including first year students) to basic concepts that underlie computer engineering while continuing an introduction to basic concepts of circuits and systems in a hands-on environment. Experiments representing practical devices introduce basic electrical engineering concepts and skills which typify the study and practice of electrical and computer engineering. In the laboratory, the students construct, troubleshoot, and test analog and digital circuits that they have designed. They will also be introduced to the nature of the interface between hardware and software in a typical microprocessor based computer.

Topics: Boolean algebra, digital switching logic, the transistor as amplifier and switch, circuit design of logic gates, design of combinational logic circuits, software and hardware interfacing including analog/digital and digital/analog conversion.

Recommended background: EE 2011, MA 1022.

ENGINEERING SCIENCE INTERDISCIPLINARY

ES 1020. INTRODUCTION TO ENGINEERING.

Cat. I

Students gain actual engineering experience by working on an engineering problem which has been selected from a professional work experience. Student teams are formed and are assigned the entire problem or a segment of the problem.

Students are taught a general problem solving methodology and techniques of library research and creative thinking. They gain experience in planning, questioning, decision making and produce written and oral reports.

The course is primarily for first-year students

ES 1310. INTRODUCTION TO COMPUTER AIDED DESIGN.

Cat.I

This basic course in engineering graphical communications provides a background for all engineering disciplines. The ability to create and interpret standard, well-integrated detail and assembly drawings is a necessity for engineers

to communicate ideas. Computer Aided Design software will be used as a tool for creating these engineering design drawings. Multiview and pictorial graphics techniques are integrated with standards for dimensioning, sectioning, and generating detailed engineering drawings. Emphasis is placed on relating drawings to the required manufacturing processes. The design process and aids to creativity are combined with graphics procedures to incorporate functional design requirements in the geometric model.
No prior engineering graphics or software knowledge is assumed

GEOSCIENCES

GE 2341. GEOLOGY.
Cat. I
Students of this course will examine the fundamental principles of physical geology including the materials, structures, and surface features of the earth and the processes which produced them. Emphasis will be placed on the interrelationship of people and environment and applications to various fields of technology. The course includes field trips and a significant laboratory component

MATHEMATICAL SCIENCES

MA 1020. CALCULUS I WITH PRELIMINARY TOPICS.
Cat. I (14-week course)
This course includes the topics of MA 1021 and also presents selected topics from algebra, trigonometry, and analytic geometry.
This course, which extends for 14 weeks and offers 1/3 unit of credit, is designed for students whose precalculus mathematics is not adequate for MA 1021.
Although the course will make use of computers, no programming experience is assumed.
MA 1021. CALCULUS I.
Cat. I
This course provides an introduction to differentiation and its applications.
Topics covered include: functions and their graphs, limits, continuity, differentiation, linear approximation, chain rule, min/max problems, and applications of derivatives.
Recommended background: Algebra, trigonometry and analytic geometry.
Although the course will make use of computers, no programming experience is assumed.
MA 1022. CALCULUS II.
Cat. I
This course provides an introduction to integration and its applications.
Topics covered include: inverse trigonometric functions, Riemann sums, fundamental theorem of calculus, basic techniques of integration, volumes of revolution, arc length, exponential and logarithmic functions, and applications.
Recommended background: MA 1021. Although the course will make use of computers, no programming experience is assumed.
MA 1023. CALCULUS III.
Cat. I
This course provides an introduction to series, parametric curves and vector algebra.
Topics covered include: numerical methods, indeterminate forms, improper integrals, sequences, Taylor's theorem with remainder, convergence of series and power series, polar coordinates, parametric curves and vector algebra.
Recommended background: MA 1022. Although the course will make use of computers, no programming experience is assumed.

MA 2071. MATRICES AND LINEAR ALGEBRA I.
Cat. I
This course provides a study of computational techniques of matrix algebra and an introduction to vector spaces.
Topics covered include: matrix algebra, systems of linear equations, eigenvalues and eigenvectors, least squares, vector spaces, inner products, and introduction to numerical techniques, and applications of linear algebra.
Recommended background: MA 1022.

MA 2271. GRAPH THEORY.
Cat. II
This course introduces the concepts and techniques of graph theory‹a part of mathematics finding increasing application to diverse areas such as management, computer science and electrical engineering. Topics covered include: graphs and digraphs, paths and circuits, graph and digraph algorithms, trees, cliques, planarity, duality and colorability.
This course is designed primarily for Mathematical Science majors and those interested in the deeper mathematical issues underlying graph theory.
Undergraduate credit may not be earned both for this course and for MA 3271.
Recommended background: MA 2071. This course will be offered in 2002-03 and in alternate years thereafter.

MA 2201/CS 2022. DISCRETE MATHEMATICS.
Cat I.
This course serves as an introduction to some of the more important concepts, techniques, and structures of discrete mathematics providing a bridge between computer science and mathematics.
Topics include functions and relations, sets, countability, groups, graphs, propositional and predicate calculus, and permutations and combinations.
Students will be expected to develop simple proofs for problems drawn primarily from computer science and applied mathematics.
Intended audience: computer science and mathematical sciences majors.
Recommended background: None.

MA 2273. COMBINATORICS.
Cat. II
This course introduces the concepts and techniques of combinatorics‹ a part of mathematics with applications in computer science and in the social, biological, and physical sciences. Emphasis will be given to problem solving.
Topics will be selected from: basic counting methods, inclusion-exclusion principle, generating functions, recurrence relations, systems of distinct representatives, combinatorial designs, combinatorial algorithms and applications of combinatorics.
This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying combinatorics.
Undergraduate credit may not be earned both for this course and for MA 3273.
Recommended background: MA 2071. This course will be offered in 2001-02 and in alternate years thereafter.

MA 2611. APPLIED STATISTICS I.
Cat. I
This course is designed to introduce the student to data analytic and applied statistical methods commonly used in industrial and scientific applications as well as in course and project work at WPI. Emphasis will be on the practical aspects of statistics with students analyzing real data sets on an interactive computer package.
Topics covered include analytic and graphical representation of data, exploratory data analysis, basic issues in the design and conduct of experimental and observational studies, discrete and continuous probability models, the central limit theorem, and one and two sample point and interval estimation.
Recommended background: MA 1022.

MECHANICAL ENGINEERING

ME 1520. THE TECHNOLOGY OF ALPINE SKIING.
Cat. II
This course explores science and engineering issues associated with equipment and technique for alpine skiing, particularly racing. A diverse group of technical subjects related to engineering mechanics are discussed: tribology, beams, rigid body motion, material science, machining and biomechanics. Specifically we will examine: ski-snow interactions, technique for gliding, turning and stepping, selection of line in racing; equipment design, testing and performance; and ski injuries. We will also address issues in the epidemiology of skiing injuries, the calculation of the cost of ski injuries to society, the impact of ski equipment technology on litigation and the impact of litigation on equipment and trail design.

This course will be offered in 2001-02, and in alternating years thereafter.

ME 1800. MATERIALS SELECTION AND MANUFACTURING PROCESSES.
Cat. I
This course is designed to introduce the student to the engineering fundamentals of the most commonly encountered manufacturing processes. A thorough treatment of sketching, casting, welding, machining, and material properties are developed through a combination of class work and machine shop experience. Each student is required to sketch and fabricate his/her own prototype part. Experience is also provided in the area of automated process parameter selection through the use of microcomputers.
This course is recommended for all majors, for students who plan to utilize the machine shop facilities as part of their MQP work, or for those students who wish a fundamental background in materials processing.

ME 2820. MATERIALS PROCESSING.
Cat. I
An introduction to material processing in manufacturing. This course provides important background for anyone interested in manufacturing, design engineering design, sales, or management.
Processing of polymers, ceramics, metals and composites is discussed. Processes covered include: rolling, injection molding, forging, powder metallurgy, joining and machining. The relationships between materials, processes, processing parameters and the properties of manufactured parts are developed. During the course the students should develop the ability to choose materials, processes, and processing parameters for designing manufacturing procedures to take a prototype part to production.

PHYSICS

PH 1110. GENERAL PHYSICS - MECHANICS.
Cat. I
Introductory course in Newtonian mechanics.
Topics include: kinematics of motion, vectors, Newton's laws, friction, work-energy, impulse-momentum, for both translational and rotational motion.
Recommended background: concurrent study of MA 1021.

PH 1120. GENERAL PHYSICS‹ELECTRICITY AND MAGNETISM.
Cat. I
An introduction to the theory of electricity and magnetism.
Topics include: Coulomb's law, electric and magnetic fields, capacitance, electrical current and resistance, and electromagnetic induction.
Recommended background: working knowledge of the material presented in PH 1110 orPH 1111 and concurrent study of MA 1022.

Appendix 13

WPI Course schedules for C 2001-2002 Term.

For current course listings visit:

http://www.wpi.edu/Admin/Registrar/Rainbow/

COURSE	LECTURE	CONFERENCE	LABORATORY
BB1050	MTRF 3:00- 3:50		
CE 3030	TW-F 11:00a 12:50a TW-F 1:00p 2:50p		
CH1010	MTRF 8:00a 8:50a		W 8:00a 10:50a T 2:00p 4:50p T 11:00a 1:50p
	MTRF 11:00a 11:50a		M 8:00a 10:50a R 8:00a 10:50a T 8:00a 10:50a
CH 1030	MTRF 8:00a 8:50a		W 11:00a 1:50p W 2:00p 4:50p T 2:00p 4:50p
	MTRF 11:00a 11:50a		W 11:00- 1:50 W 2:00- 4:50 T 8:00- 10:50
CS 1005	MTRF 1:00p 2:00p		W 8:00a 9:00a W 9a:00a 10:00a W 4:00p 5:00p
	MTRF 11:00a 12:00p		W 10:00a 11:00a W 11:00a 12:00p W 12:00p 1:00p
CS 1006	MTRF 2:00p 3:00p		W 1:00p 2:00p W 2:00p 3:00p W 3:00p 4:00p
CS 2022/MA 2201	MTRF 8:00a 9:00a	M 11:00a 12:00p M 12:00p 1:00p M 1:00 p 2:00p	
EE2011	MTRF 12:00p 12:50p		W 2:00p 4:50p W 11:00a 1:50p W 8:00a 10:50a T 2:00p 4:50p

WPI Course schedules for C 2001-2002 Term.

For current course listings visit:

http://www.wpi.edu/Admin/Registrar/Rainbow/

COURSE	LECTURE	CONFERENCE	LABORATORY
ES2001	MT-RF 9:00a 9:50a	W 9:00a 9:50a W 10:00a 10:50a W 11:00a 11:50a	
MA 1021	MT-RF 2:00p 3:00p		W 2:00p 2:50p
MA 1022	MT-RF 1:00p 1:50p	T 9:00a 9:50a T 10:00a 10:50a T 11:00a 11:50a T 12:00p 12:50p T 3:00p 3:50p	M 9:00a 9:50a M 10:00a 10:50a M 11:00a 11:50a M 12:00p 12:50p M 3:00p 3:50p
MA 2071	MT-RF 12:00p 12:50p	W 12:00p 12:50a	
MA 2611	MT-RF 11:00a 12:00p		W 8:00a 10:00a W 10:00a 12:00p W 1:00p 3:00p W 3:00p 5:00p
ME 1520	MT-RF 12:00p 1:00p	W 12:00p 2:00p	
ME 1800	T-R- 12:00p 12:50p	F 12:00p 12:50p	T-R 9:00p 10:50p M-W 12:00p 1:50p T-R 1:00p 2:50p
PH 1110	M-W-F 10:00a 10:50a	T-R 10:00a 10:50a T-R 9:00a 9:50a T-R 12:00p 12:50p T-R 1:00p 1:50p T-R 2:00p 2:50p T-R 10:00a 10:50a	M 11:00a 11:50a M 9:00a 9:50a M 12:00p 12:50p W 1:00p 1:50p W 9:00a 9:50a W 9:00a 9:50a

Appendix 14

WPI Course Schedules for D 2001-2002 Term.

For current course listings visit:

http://www.wpi.edu/Admin/Registrar/Rainbow/

COURSE	LECTURE	CONFERENCE	LABORATORY
BB1001	M-T-R-F 12:00p 12:50p		
BB1002	M-T-R-F 3:00p 3:50p		
BE1001	M-T-R-F 11:00a 11:50a		
CE1030	MT-WF 12:00p 12:50p		R- 12:00p 1:50p
CE2020	M-T-R 8:00a 8:50a M-T-R 8:00a 8:50a		M- 2:00p 4:50p T- 2:00p 4:50p
CE3023	MT-W-RF 12:00p 12:50p		
CE3030	M-W-F 1:00p 2:50p		
CH1020	MT-RF 11:00a 11:50a		M- 8:00a 10:50a W- 2:00p 4:50p W- 11:00a 1:50p
CH1040	MT-RF 8:00a 8:50a		W- 8:00a 10:50a W- 2:00p 4:50p W- 11:00a 1:50p
CS3041	MT-RF 3:00p 3:50p		
CS3043	M-R 10:00a 11:50p M-R 3:00p 4:50p		
EE2011	MT-RF 10:00a 10:50a		W- 2:00p 4:50p R- 2:00p 4:50p
EE2022	MT-RF 12:00p 12:50p		W- 11:00a 1:50p T- 2:00p 4:50p W- 8:00a 10:50a
ES1310	MT-F 12:00p 12:50p		W- 12:00p 1:50p W- 10:00p 11:50p
ES 2001	MT-RF 8:00a 8:50a	W- 8:00a 8:50a	

M=Monday T=Tuesday W=Wednesday R=Thrusday F=Friday S=Saturday U=Sunday

WPI Course Schedules for D 2001-2002 Term.

For current course listings visit:

http://www.wpi.edu/Admin/Registrar/Rainbow/

COURSE	LECTURE	CONFERENCE	LABORATORY
GE2341	T-RF 10:00a 10:50a		W- 9:00a 10:50a W- 12:00p 1:50p
MA1022	MT-RF 2:00p 2:50p	M- 8:00a 8:50a M- 3:00p 3:50p	T- 8:00a 8:50a T- 3:00p 3:50p
MA1023	MT-R- 9:00a 9:50a	W-F 10:00a 10:50a W-F 11:00a 11:50a W-F 12:00p 12:50p W-F 1:00p 1:50p	M- 10:00a 10:50a M- 11:00a 11:50a M- 12:00p 12:50p M- 1:00p 1:50p
MA2071	MT-RF 8:00a 8:50a	W 3:00p 3:50p W 1:00p 1:50p W 12:00p 12:50p W 11:00a 11:50a W 8:00a 8:50a	
MA2273	MT-RF 1:00p 1:50p		
MA2611	MT-RF 1:00p 1:50p		W- 8:00a 9:50a W- 12:00p 1:50p T- 2:00p 3:50p R- 3:00p 4:50p W- 2:00p 3:50p W- 10:00a 11:50a
ME1800	T-R- 11:00a 11:50a	F 11:00a 11:50a	M-W 12:00p 1:50p M-W 9:00a 10:50a T-R 9:00a 10:50a T-R 1:00p 2:50p
PH1120	M-W-F 10:00a 10:50a	T-R 10:00a 10:50a T-R 9:00a 9:50a T-R 12:00p 12:50p T-R 1:00p 1:50p T-R 9:00a 9:50a M-W 2:00p 2:50p	M- 11:00a 11:50a M- 9:00a 9:50a M- 12:00p 12:50p W- 1:00p 1:50p W- 9:00a 9:50a W- 9:00a 9:50a

M=Monday T=Tuesday W=Wednesday R=Thrusday F=Friday S=Saturday U=Sunday

Appendix 15

WORCESTER AREA EMPLOYERS

Abbott Bioresearch Center
BASF Bioresearch Corporation
Research
Robert Kamen, President
Mark Ferigno, HR
Susan Chase, HR*
100 Research Drive
Worcester, MA 01605
508.849.2500

Advanced Cell Technology
One Innovation Drive
Biotech Three
Worcester, MA 01605
Mrs. Milano
508.756.1212

Alden Research Laboratory, Inc. **#7**
Hydraulic Engineering Lab
Environmental Engineering
George E. Hecker, President
Ned Taft*, x410
30 Shrewsbury Street
Holden, MA 01520
508.829.6000

Allegro MicroSystems, Inc. **#6**
Mfg. – Electronic Components
Dennis H. Fitzgerald, President & CEO
Marybeth Perry, VP Human Resources *
115 Northeast Cutoff
Worcester, MA 01615
508.853.5000
Do not mention Potter, mention Krikorian

Allison Engineering Associates, Inc
Engineering, Consult, & Tests
Allison Snyder, Financial Officer
6 Summer Street
Millbury, MA 01527-6000
508.581.9100

Alpha-Beta Technology, Inc.
Pharmaceutical
Spiros Jamas, SC. D., President
One Innovative Drive
Worcester, MA 01605
508.798.6900

Athena Diagnostics, Inc.
Neurological Diagnostic Testing
Joyce Jardin, Human Resources
377 Plantation St.
Worcester, MA 01605
800.394.4493 x3011

Babcock Borsig Power, Inc.
John Halloran, President
P.O. Box 15040
Worcester, MA 01615-0040
5 Neponset Street
Worcester, MA 01606
508.854.4088
508.852.7100
Mrs. Pat Wood
508.854.3973

Clini Tech Services, Inc.
Path Lab, Inc.
Diagnostic Lab
Virginia Lichlyter, Chief Operating Officer
100 Barber Avenue
Worcester, MA 01606
508.852.7630

C.K. Smith & Company, Inc.
Judith I. Smith, President
99 Crescent Street
Worcester, MA 01605
508.753.1475

Coghlin Electrical Contractors, Inc. #3
Electrical Contractors
Edwin B. Coghlin, Jr., President
100 Prescott Street
Worcester, MA 01605
508.793.0300

Columbia Tech
Electrical Engineering
17 Briden St.
Worcester, MA 01605
John Sillup, HR Manager
508.753.2354

Dixon Salo Architects, Inc.
Architects
Wayne O. Salo, Principal
50 Franklin Street, Suite 230
Worcester, MA 01608-1914
508.755.0533

Expressive Constructs, Inc.
Service Based Biotechnology Company
Elisabeth Sanders, Vice President
One Dix Street
Worcester, MA 01609
508.754.2209

Fleet Electrical Service, Inc.
Automotive/Electrical Parts
Gary P. Ford, President
P.O.BOX 886
Worcester, MA 01613
508.755.8666

Honematic Machine Corporation
Component Design
Joseph Cusimano, President
P.O. Box 1100
222 Shrewsbury Street
Boylston, MA 01505
508.869.2131

Gregory J. O'Connor Associates, Inc.
Architects
Greg J. O'connor, President
339 Main Street #510
Worcester, MA 01608
508-757-1377

GZA GeoEnvironmental, Inc.
Consulting Engineers
Lawrence Feldman, Senior Principal
33 Waldo Street
Worcester, MA 01610
508.755.1700

Harvey & Tracy Associates
Engineers-Consulting
Francis S. Harvey, President & Treasurers
143 Dewey Street, 01610
508.757.1354

International Ceramic Engineering Corp.
Manufacturing
Merrill W. Higgins, President
235 Brooks Street
Worcester, MA 01606-3307
508.791.4171

Jamesbury, Inc.
Manufacturers – Valves & Actuators
Jon Quinlivan, President
640 Lincoln Street/P.O. Box 15004
Worcester, MA 01615-0004
508.852.0200

Ken-Weld Co., Inc
68 Albany St.
Worcester, MA 01615
508.798.8756

Lake View Laboratories
Medical/Export
Patrick M. Palermo, CEO
108 Locust Avenue
Worcester, MA 01604
508.795.0878

Lindemberg Heat Treating Company
Metal Specialties
Dennis M. Smith, Division Manager
284 Grove Street
Worcester, MA 01605
508.754.1724

Lowell Corporation
Manufacturing
Davis Cummings, CEO
P.O.BOX158
Worcester, MA 01613-0158
508.853.2900

Manufacturing Assistance Center #4
Technical Training Manager
Jack Healy
60 Prescott Street
Worcester, MA 01605
508.831.7020

Massachusetts Biomedical Initiatives
Kevin O'Sullivan
One Innovation Drive
Worcester, MA 01605
508.797.4200

MidMass Construction Group
Manufacturing
George J. Giansanti, President/CEO
324 Clark Street
Worcester, MA 01606
508.852.5400

Morgan Construction Company
Manufacturers – Machinery
Paul S. Morgan, Chairman
Philip R. Morgan, President
15 Belmont Street
Worcester, MA 01605
508.755.6111

New England Knife Company Group
Steel Processing & Distributors
Lorna C. Forget-Cormier, Vice President
6 Burton Street
Worcester, MA 01607
508.753.2895

New Method Plating Co., Inc.
Manufacturers-Plating
Ralph J. Capalbo, President
43 Hammond Street
Worcester, MA 01610
508.754.2671

Norton S. Remmer, Consulting Engineers
Consulting Engineers
Norton S. Remmer, Principal
18 John Street Place
Worcester, MA 01609
508.756.2777

Oxford Machinery Sales Corp.
Machinery & Fabricating
Kenneth J. Ward , President
92 Gardner Street
Worcester, MA 01610
508.755.4423

PresMet Corporation
Manufacturer-Machinery
Julia E. Gwinn, President
112 Harding Street
Worcester, MA 01604
508.792.6400

Charles River Labs
Primedica Corporation
Biotechnology
Michael S. Wyand, Vice President
51 Union Street
Worcester, MA 01757
508.890.0100

Ramco Manufacturing
Manufacturing
Michael Raiero, President
32 Cambridge Street
Worcester, MA 01501
508.755.6235

Reinforced Structures for Electronics, Inc.
Manufacturing
James Romeo, Treasurer
50 Suffolk Street
Worcester, MA 01604
508.365.4585

Reney Brothers, Inc
Engineers-Civil
Winifred M. Reney, President
P.O.BOX 434/33 Burncoat St
Worcester, MA 01613
508.852.5203

Saint-Gobain Abrasives, Inc. **#8**
Norton Company
Abrasive & Industrial Ceramics
Mark Stacey, Human Resources Manager
One New Bond Street
Worcester, MA 01606
508.795.5000

Salitsky Alloys, Inc.
(Nonferrous) Scrap Metals
Andrew Salitsky, President
65 Gardner Street
Worcester, MA 01610
508.791.2444

Shepherd Engineering, Inc.
Electrical Engineering
Robert S. Sheperd, President
1308 Grafton Street
Worcester, MA 01604
508.757.7793

T.M. Elecronics, Inc.
Electronic Manufacturing
Richard C. Small, President
330 Tacoma Street
Worcester, MA 01605
508.835.3447

UMass Medical School **#1**
Education-Medical Center
Aaron Lazare, Dean/Chancellor
Thomas D. Manning, Chief operating Officer
508.856.0011
Jim Hamos, Ph.D.
Robert Layne*
55 Lake Avenue, North
Worcester, MA 01655

Vellmoid, Inc.
Manufacturers-Gaskets
Paresgh Parseghian, President
54 Rockdale Street
Worcester, MA 01606
508.853.2500

Wachusett Marking Company
Manufacturing
Alfred Bavosi, Executive
38 Harlow Street
Worcester, MA 01605
508.756.4581

Wadsworth & Associates, Inc.
Architects
John Wadsworth, President
11 Pleasant Street
Worcester, MA 01609
508.753.4800

Wirefab, Inc.
Manufacturer-Wire Products
James J. Samsel, President
919 Millbury Street
Worcester, MA 01607
508.754.5359

WORCESTER PIPELINE COLLABORATIVE

Abbott Bioresearch Center
Susan A. Chase, M.Ed.
HR Representative
508.849.2648
susan.chase@abbott.com

Assumption College
Dr. Charles Estus
Director of University Transport Center
508.767.7000

Dr. Brian Niece
Assistant Professor of Chemistry
508.767.7209

University of Massachusetts Medical School
Dr. Robert Furse
Acting Director, Office of Science Education
Currently doing Jim Hamos' job
508.856.6506
robert.furse@umassmed.edu

Dr. James Hamos
Director, Office of Science Education
508.856.3323
james.hamos@umassmed.edu
703.292.4687
jhamos@nsf.gov

Dr. Deborah Harmon Hines

Dr. Thomas Honeyman
Friend of Gale Nigrosh

Robert Layne
Program Coordinator of WPC
508.856.4559
robert.layne@umassmed.edu

Dr. Amit Roy
Tissue Engineering
508.856.8434
amit.roy@umassmed.edu

Mike Smith
Administrative Assistant to Jim Hamos
508.856.5541

Worcester Public Schools
Dr. James Caradonio
Superintendent of Schools

Dr. Gale Nigrosh
Development Specialist for Higher Education and Business Partnerships
508.799.3082
nigrosh@worc.k12.ma.us

Appendix 16

Internship Script

Hi (*their name*)_____, my name is (*own name*)_____. I am a student from WPI working on a project with Doherty High School. We saw a description of your company and thought that you might be interested in participating in a pilot program that we are developing. **[[***I was referred to you by Mr. David Potter from the Worcester Public Schools, who suggested that you might be interested in participating in a pilot program that we are developing.***]]** As part of the Engineering Pipeline Collaborative, we are developing the second semester of the 12th grade pre-engineering curriculum. In this program, the students will be participating in a 20-week, **unpaid** internship in the field of engineering. This will only be for about two hours a day, 4 days a week starting in January. We have a few students who have been in a rigorous engineering program since the 10th grade and are very interested in (*major*)_____, which led us to *consider* your company.

We would like to send you a one-page informational pamphlet that describes our project and the type of students that you *would* be dealing with in this unpaid internship. Once you have had a chance to look over the pamphlet, we would like to give you another call to see if you have any questions, comments or details on how we should proceed. How does (*day*)_____, in the afternoon sound? The only thing we need from you right now is your e-mail address so that we can send you our pamphlet. If you know anyone else in your company that would be interested in receiving information on our program, their names and contact information would also be appreciated, or if it is easier, you could even forward it to them yourself.

We are *very* excited in making this program a success, and look forward to speaking with you again on (*day*)_____. This is usually easier after you look over our brochure, but do you have any questions that you would like to ask me right now?

Thank you for your time, (*their name*)_____. Have a nice day. Bye.

Appendix 17

Engineering Pipeline Collaborative (EPiC)

- Connects mathematics, science and technology to innovative solutions for our lives.
- Links colleges, universities and businesses to the, teachers and students of the Worcester Public Schools.
- Promotes higher level critical thinking and inquiry skills by using the engineering "design process."
- Provides exciting learning opportunities for students through field trips, internships, mentoring, competitions and connections to engineering schools and companies.
- Addresses the critical need for engineers on the local, regional, state, national and international levels.

Our Plan

- Pilot capstone experience for high school seniors at a local college or local company.
- 20-week unpaid internship for high school credit starting in January: After the first 10-weeks, the student is evaluated and both the company and students are given the opportunity to extend the internship for another 10-weeks.
- Students attend internship from Monday to Thursday, at the end of the school day from about 12:30-2pm (flexible ending time).
- Mentors complete weekly evaluation forms to track students' performance.
- Internship provides engineering experience, which enhances the students' education.
- Students provide their own transportation.

Steven McFarland - 603.275.0280
Eduardo J. Paredes - 508.410.9761
WPI IQP Group
McFarlandS@worc.k12.ma.us

Students involved in the Engineering Pipeline are motivated, college-bound honors students from Doherty High School who have expressed interest in a technical field and have years of engineering education.

Appendix 18

WORCESTER
PUBLIC SCHOOLS **DOHERTY MEMORIAL HIGH SCHOOL**

Cynthia M. McMullen, Ed.D.
Principal

299 Highland Street
Worcester, MA 01602-2193
508-799-3270
508-799-3276 Fax

2002-2003 S.I.T.E. APPLICATION AND INTERNSHIP SURVEY

THIS APPLICATION MUST BE RETURNED TO MRS. GIACOMELLI (ROOM 408) OR TO HER MAILBOX IN THE MAIN OFFICE AS SOON AS POSSIBLE, **BUT NO LATER THAN THURSDAY, JANUARY 31, 2002.**

YOU WILL BE EVALUATED BY THE DOHERTY FACULTY, STAFF, AND ADMINISTRATION ON THE FOLLOWING CRITERIA: ACADEMIC ACHIEVEMENT, ATTENDANCE, CONDUCT, SELF-MOTIVATION, MATURITY, PUNCTUALITY AND RESPONSIBILITY.

PLEASE PRINT OR TYPE.

NAME _____ PRESENT GRADE ____

1ST PERIOD _____ 1ST PERIOD TEACHER _____

ADDRESS _____ ZIP _____

DATE OF BIRTH _____

1. LIST COURSES SELECTED FOR GRADE 12

_____ _____

_____ _____

_____ _____

2. WHAT ARE YOUR POTENTIAL INTERNSHIP INTERESTS?

3. LIST YOUR PAST AND/OR PRESENT ACTIVITIES EITHER IN OR OUT OF SCHOOL (PAID JOBS, VOLUNTEER WORK, CLUBS, ORGANIZATIONS, SPORTS, TRAVEL, HOBBIES, ETC.)

4. HAVE YOU EVER BEEN SUSPENDED FROM SCHOOL? STATE REASON.

Appendix 19

Internship Evaluation - Supervisor

Name, Title and Agency: _____

Address _____ Phone _____

_____ Email _____

Name of Intern: _____

Evaluation of Internship

1. Description of Intern's Assignment and Activities. Did the Intern attend staff meetings, observe your preparation of the budget, or work with the public? _____

   _____

   _____

   _____

2. What were your objectives in supervising the intern? _____

   _____

3. Did the intern's performance meet the objectives? _____
4. Was the intern academically prepared for the assignment? Were there particular courses, books, reports and skills that would have better prepared the intern for the assignment? _____

   _____

   _____

5. Please circle a rating for each skill. (5 is the highest rating)

Knowledge	1	2	3	4	5
Analytical Skills	1	2	3	4	5
Writing Skills	1	2	3	4	5
Verbal Skills	1	2	3	4	5
Interpersonal Skills	1	2	3	4	5

6. Would you hire this particular intern for a position in your agency based on the intern's performance and capabilities? _____
7. What changes would you recommend in the Internship program? _____

   _____

8. Will you participate in the Internship program in the future? Yes _____ No _____
9. Did you discuss this evaluation with the intern? If not, may the school share this evaluation with the student?

   _____

Signature _____ Date _____

Please place any additional comments on the other side of this page:

(Adapted from http://www.evans.washington.edu/students/career/pdf/SupervisorEval.pdf)

Appendix 21

Design Project Guidelines

The goal of this project is to create a design that will increase safety in some area of daily life. In order to complete this project you must first devise a plan of what you will attempt to design. To do this, you will need to complete extensive background research to determine existing products and patents. A good place to start is the web site www.uspto.gov. There you will find information on awarded patents as well as patent grants. You may also want to conduct research to determine exactly where the need to increase safety exists, along with reviewing some of your mathematics and science courses to assist you in analyzing your design. Throughout this project you should follow the design process as highlighted in the handout you will receive (Chapter 1 from *Design of Machinery* by Robert L. Norton). Also make sure to read the Design Project Report Specifications, as they are the framework for your final report. In this project, the process you follow to obtain a result is more important than your final result. It is required that you produce at least three designs before you select one to develop. You must take your design through at least six iterations before you use it as your final product. Designing is very difficult and requires a large amount of time. Do not attempt to complete this project the week before it is due as you will not be able to produce acceptable results. This type of problem requires incubation periods where you work on it until you are stumped, put it aside and work on something else, then return to the problem after your subconscious has had time to work on it. You'll be surprised how effective this "time sharing" of your tasks can be. A project of this magnitude must begin as soon as possible so that you can allot yourself enough time to develop your design along with writing up your report. It is a good idea to plan to have all design work completed at least one week before it is due so that you have ample time to write your report. This report is not an afterthought of you work, but rather a representation of it. Good luck.

Portions of this guideline were adapted from materials used in Kinematics of Mechanisms (ME3310) at WPI by Professor Robert L. Norton

Appendix 22

Design Project Report Specifications

General Information

The purpose of this document is to specify what is expected from you in your design project reports. Your report should, in general, follow the Design Process as described in Chapter 1 of the text *Design Of Machinery*[1] in terms of content, order, and format. The purpose of this report is to communicate the methodology that you used to complete your project. Specifically, how and why you did what you did. In other words, this report should convey the process that you followed in order to arrive at a solution.

Another important part of this report is the background research portion. Since the problem statement was fairly unstructured, you should have completed a great deal of background research in order to determine a more tightly constrained problem statement and a set of task specifications. If this project involves the development of a computer solution or program, then the "data description" should discuss the assumptions made, the limitations of the algorithm used, the data structure used and the design of the program.

The report format should be rigidly constrained to the following specifications, so **be sure to read them**. Reports not meeting those specifications will be downgraded.

Order of Contents in the Report

1) **Title Page:** The first page must be a title page, containing the title of your project, your name and date submitted. The rest of the page must be blank for the purpose of comments and grade.
2) **Abstract:** Although this appears first in the report, it must be written last, as its purpose is to summarize the results of the project. It must be clear and concise (1/2 page to 1 page maximum) and convey what you set out to do and what you did. It is not just a restatement of the problem; it is a summary of your results and accomplishments.
3) **Table of Contents:** Indicate where sections are located by their page number.
4) **Introduction:** This serves to define the original problem statement as given and sets the scene for what follows.
5) **Background Research:** This section should be a thorough and extensive discussion of all you have learned with regards to the background of the problem. This may include discussion of existing designs and their limitations, results of surveys, limited calculations to investigate feasibility, patent searches, literature searches, references etc. In short, you will report what you have learned about the relevant topics of concern.
6) **Goal Statement:** This is a clear, concise restatement of the problem in the light of things learned during the background research phase.
7) **Task Specifications:** This is a clearly stated list of performance specifications, which, in your judgement, are both necessary and possible in order to achieve the stated goal.
8) **Design Description:** This will be an extensive section of the report that describes your progress and activities in arriving at and rejecting possible solutions. It will, in short, be a record of your iteration through steps 5, 6 and 7 of the design process. This section should be liberally illustrated with figures and tables to graphically document your designs and analyses. Short mathematical exercises may be included within this section, but lengthy derivations or other exercises should be placed in the appendix.
9) **Results:** This section should clearly describe your final results, design or other accomplishments. It should also contain illustrations documented and discussed as described in your Design Description. This section deals with step 8 of the design process.
10) **Conclusions:** Here you will describe what you learned in this project, what pitfalls you encountered and what gains or insights you made. This is a valuable aid to us in planning future projects to improve the educational experience. Tell us if this exercise was of value to you or not, and how it could be improved.
11) **Bibliography:** Contains all references used in the report listed by author, title and publisher.
12) **Appendices:** An appendix means "add-on". This is the repository for all data or information, which are useful but would otherwise interrupt the flow of the report if included in its body. Examples of items belonging to the appendix are: computer programs or extensive printouts, catalog information, mathematical proofs or derivations, extensive test data, etc.

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[1] Revision C 9/7/00 R.L. Norton
Form adapted from the Project Report Specifications, constructed by Professor Robert L. Norton, used in ME3310, ME3311 and ME3320 at WPI.

Appendix 23

Design Project Grade Distribution

Listed below is the grade distribution for the Design Project. Each component must satisfy the requirements set forth by the Design Project Report Specifications distributed at the beginning of this project.

Component	Percentage
Title Page	1
Abstract	5
Table of Contents	1
Introduction	5
Background Research	10
Goal Statement	5
Task Specifications	10
Design Description	25
Results	25
Conclusions	10
Bibliography	1
Appendices	2
Total:	100

Appendix 24

Assistant Provost Office
100 Institute Road • Worcester, MA 01609-2280
Phone 508-831-5514 • Fax 508-831-5774 • http://www.wpi.edu/

HIGH SCHOOL STUDENT TUITION APPROVAL FORM

Academic Year _____ Term _____

_____ from _____ High School
(please print) (please print)

has met the requirements of the WPI tuition policy for high school students (on a space available basis) to obtain college credit at a fee of one half the current rate for a single WPI undergraduate course.

School College Collaborative

Authorized Signature _____

3/98

Appendix 25

Weekly Assessment Journal (ongoing throughout the college course)

The purpose of this weekly assessment journal is to keep your teacher informed of your progress in the college course. This assignment will help your teacher evaluate your performance. To accomplish this task you must comment on:

- The material that was covered.
- Assignments, tests or labs you completed.

Journal entries will include:

- Descriptions of the assignments, tests or labs you completed,
- Information required to complete these tasks (ie: solving simultaneous algebraic equations…), and
- Areas of difficulty in the course.

These entries will provide you with an opportunity to comment on areas of strength or weakness in your prior engineering experiences relative to this course. If you have experienced difficulty completing any assignments comment on why and how you can rectify these problems.

Evaluation: The Weekly Assessment Journal

This assignment comprises 20% of your grade and will be evaluated based upon how well you answer the questions above as well as thoughtfulness, quality of writing, and insight.

(Adapted from the ID 2050 Social Science for the Worcester IQP Research Journal form)

Appendix 26

Weekly Assessment Journal (ongoing throughout the internship)

The purpose of this weekly assessment journal is to keep your teacher informed of your progress in the internship. If you are working with another student, you will be expected to comment on a personal level as well as evaluate your peer. This assignment will help your teacher evaluate your performance. To accomplish this task:

- Each team member must maintain a journal of their team's activities (meetings, activities, progress)
- Your process for completing assigned tasks
- Personal reflections on the process.

Journal entries will include:

- Descriptions of the tasks you complete including your time spent on these tasks,
- Your contacts with your team member (if applicable), and
- Thoughts on your and the team's performance.

This last type of entry will give you the opportunity to reflect on your own performance along with the performance of your peer (if applicable). Did you accomplish the tasks you were responsible for? If not, why? How might you operate more efficiently?

Please provide an honest assessment of your efforts as well as the efforts of your peer (if applicable) and your mentor. This assignment is not about "telling tales out of school." Under most circumstances you should be able to discuss anything you write in your journal with your colleague. These journals, however, will be kept confidential.

Evaluation: The Weekly Assessment Journal

This assignment comprises 20% of your grade and will be evaluated based upon how well you answer the questions above as well as thoughtfulness, quality of writing, and insight.

(Adapted from the ID 2050 Social Science for the Worcester IQP Research Journal form)

Appendix 27

Internship Evaluation - Student

Name _____ Email Address_____

Internship agency name _____

Department _____

Agency Address _____

Name of Supervisor _____ Title_____

Phone # of Supervisor _____

Dates of Internship _____ Total Work Hours _____

Work Schedule _____ Rate of Pay (if applicable) _____

Attach a job description (REQUIRED)

Description of Internship

Please answer the following questions on a separate sheet of paper (computer word processing preferred). Please note that your evaluation will be made available to students seeking internships next year.

1. Description of assignment and activities. Was the work challenging?
2. How did you meet your goals?
3. Were you satisfied with the directions received from your site supervisor? Did you feel part of the team or an outsider? Were you given on-the-job training or instruction? Please describe the training.
4. Were you academically prepared for your placement? Which courses were most relevant to your internship? What courses not currently offered would you find valuable for this work experience? What other skills would you have found helpful?
5. Would you recommend this internship to another student? Why or why not? In what ways did this assignment contribute to your professional development? As a result of your experiences, have you changed your ideas of engineering?
6. If offered a position would you like to continue with this agency?
7. Did you discuss the evaluation with your site supervisor? Can the school share this evaluation with your site supervisor?

(Adapted from http:// www.evans.washington.edu/students/career/pdf/newInternEval.PDF)

Appendix 28

College Course Evaluation - Student

Name _____

College Course _____

Institution _____

Name of Instructor _____

Attach a course description (REQUIRED)

Description of College Course

Please answer the following questions on a separate sheet of paper (computer word processing preferred).

Please note that your evaluation will be made available to students seeking college courses next year.

1. Description of assignments and laboratory work. Was the work challenging?
2. How did you meet your goals?
3. Were you satisfied with the lectures received from your instructor? Did you feel like you were part of the classroom or an outsider?
4. Were you academically prepared for your placement? Which previous classes were most relevant to your college course? What courses not currently offered would you find valuable for this college experience? What other skills would you have found helpful?
5. Would you recommend this college course to another student? Why or why not? In what ways did this assignment contribute to your professional development? As a result of your experiences, have you changed your ideas of engineering?
6. Did you discuss the evaluation with your instructor? Can the school share this evaluation with your instructor?

Adapted from http:// www.evans.washington.edu/students/career/pdf/newInternEval.PDF

Appendix 29

Presentation Outline

For your final presentation, please give an overview of your experience at either the internship or college course. Some specific topics to include are:

- Your job/course description
- An overview of the tasks you completed or material that was covered
- Problems that you encountered
- Your resolutions to those problems
- What you have gained from this experience

This presentation should last approximately 10 minutes (5-7 for your presentation and 3-5 for questions) using PowerPoint or any other necessary visual aids. This presentation is an important part of your experience and your chance to explain what it is that you have learned.

If you have participated in an internship for 10 weeks and completed the design project for the second 10, your presentation should cover the following topics:

- Why your internship did not suit you
- What can be done to improve it
- An overview of your design project detailing what you have designed, why you chose your specific topic and how you reached your results.
- What you have gained from this experience

Evaluation:

This presentation will comprise 20% of your grade, unless you have taken a college course, in which case it will count for 10%.

Appendix 30

AGREEMENT

WORCESTER PUBLIC SCHOOLS
SCHOOL-TO-CAREER

STUDENT INFORMATION

NAME: _____ BIRTHDATE: ____/____/____

HOME ADDRESS: _____ PHONE: _____

SCHOOL: _____

SCHOOL TO CAREER ADVISOR: _____ PHONE: _____

PARENT/GUARDIAN NAME: _____

ADDRESS: _____ DAYTIME PHONE: _____

ADDITIONAL PERSON TO CONTACT IN CASE OF EMERGENCY:

NAME: _____ PHONE: _____

INTERNSHIP SITE INFORMATION

NAME _____

ADDRESS: _____

PHONE(S): _____

SUPERVISOR: _____ PHONE: _____

PROPOSED DATES: From: _____ To _____

DAYS OF THE WEEK: _____

TIME OF DAY: From _____ To _____

DEPARTMENT: _____

Person for student to notify of illness or other emergency that causes absence from work:

_____ Phone: _____ Call before: _____

Brief description of the work to be done: _____

_____

_____

STUDENT RESPONSIBILITIES

- Adhere to agreed upon work schedule
- Follow the instructions of the supervisor, ask questions if you don't understand
- Notify work supervisor of illness or other emergencies that cause absences from work
- Keep a journal of your work related experiences
- Notify the School Internship Adviser of any problems relating to the internship
- Complete a periodic self-evaluation
- Students are expected to dress professionally in the attire recommended by the site.
- Student is expected to return weekly attendance form to teacher on a weekly basis.

BUSINESS SPONSOR RESPONSIBILITIES

- Provide student with an orientation to the business and the larger industry
- Provide student with appropriate tasks and direction to successfully complete tasks
- Suggest appropriate materials for students to understand "all aspects of the industry"
- Notify the School Internship Adviser of any problems relating to the internship
- Set goals and evaluate the intern using the Learning Plan

I have read, understand and agree to adhere to the above.

_____ Student Signature - Date

_____ Business Sponsor Signature - Date

_____ Parent/Guardian Signature - Date

_____ School Internship Adviser Signature - Date

White: School Advisor Copy Pink: Student Copy Yellow: Business Copy

Appendix 31

Worcester Consortium Bus Schedule

The Consortium coordinates a free shuttle bus service, operated by Worcester Airport Limousine. This intercampus transportation service connects six Worcester colleges - WPI, Becker, Assumption, Clark Worcester State, and Holy Cross - and the downtown area. The service is designed to provide access to other campuses for cross-registration, library use, and athletic and social events. Through connections with the RTA public bus system, the special intercampus shuttle also provides full access to the Worcester community for commuting students, jobs and internships, cultural events, entertainment and shopping.

Special signs are posted at each stop with the shuttle route map and schedule of stops. Routes and schedules will also be posted inside the vans, along with information directing riders to the nearest RTA stop. Brochures on the shuttle service and other transportation options are also available in the registrar's' and student dean's offices on each campus, and in the Consortium office.

Questions or problems should be directed to Worcester Airport Limousine at **508-835-1187**.

Dates of Operation

For the 2001 - 2002 academic year, the shuttle will begin operating on Monday, August 27 and end on May 17. There will be NO service on the following dates: September 3; October 8 and 9; November 22 and 23; December 20 and 21, 24 through 28, and 31; January 1 through 4 and 7 through 11; February 18; March 4 through 8, 28 and 29; and April 1.

Schedule & Stops

The service runs Monday through Friday, from 7 a.m. to 7 p.m. There are hourly stops at the six colleges as well as the Worcester Public Library and Worcester Common Outlet Malls. Please consult the schedule below for exact times.

1. WPI - Riley Hall
2. Becker College/Worcester Campus - William & Sever Streets
3. Assumption College - Plourde Recreation Center
4. Worcester State College - side entrance of Admin. Building
5. Clark University - Atwood Hall, Downing Street
6. Holy Cross College - main door of Hogan Campus Center
7. Worcester Public Library - Salem Street
8. Worcester Common Outlets - Media Play entrance, Front Street (RTA Hub)

Starts at WPI	Leaves Becker	Leaves Assumption	Leaves Worc. State	Leaves Clark	Leaves Holy Cross	Leaves Worc. Public Library	Leaves Worc. Common Outlets	Ends at WPI
7:00 AM	7:03 AM	7:11 AM	7:19 AM	7:26 AM	7:35 AM	7:45 AM	7:47 AM	7:56 AM
8:00 AM	8:03 AM	8:11 AM	8:19 AM	8:26 AM	8:35 AM	8:45 AM	8:47 AM	8:56 AM
9:00 AM	9:03 AM	9:11 AM	9:19 AM	9:26 AM	9:35 AM	9:45 AM	9:47 AM	9:56 AM
10:00 AM	10:03 AM	10:11 AM	10:19 AM	10:26 AM	10:35 AM	10:45 AM	10:47 AM	10:56 AM

11:00 AM	11:03 AM	11:11 AM	11:19 AM	11:26 AM	11:35 AM	11:45 AM	11:47 AM	11:56 AM
12:00 PM	12:03 PM	12:11 PM	12:19 PM	12:26 PM	12:35 PM	12:45 PM	12:47 PM	12:56 PM
1:00 PM	1:03 PM	1:11 PM	1:19 PM	1:26 PM	1:35 PM	1:45 PM	1:47 PM	1:56 PM
2:00 PM	2:03 AM	2:11 PM	2:19 PM	2:26 PM	2:35 PM	2:45 PM	2:47 PM	2:56 PM
3:00 PM	3:03 AM	3:11 PM	3:19 PM	3:26 PM	3:35 PM	3:45 PM	3:47 PM	3:56 PM
4:00 PM	4:03 PM	4:11 PM	4:19 PM	4:26 PM	4:35 PM	4:45 PM	4:47 PM	4:56 PM
5:00 PM	5:03 PM	5:11 PM	5:19 PM	5:26 PM	5:35 PM	5:45 PM	5:47 PM	5:56 PM
6:00 PM	6:03 PM	6:11 PM	6:19 PM	6:26 PM	6:35 PM	6:45 PM	6:47 PM	6:56 PM

RTA stops near the six campuses

Assumption: Salisbury Street
Becker: Highland & Dover
Highland & Russell (Elm Park)
Highland & Roxbury
Highland & Einhorn
Highland & Sever
Highland & Tech Pizza
Highland & N. Ashland
Clark: Main & Grand
Main & Gates (University Center)
Main & Beaver
Holy Cross: Southbridge & College Streets
Worcester State: Chandler & Claridge
Chandler & May
Chandler & main entrance (Temple Emmanuel)
WPI: Dean & Salisbury
Salisbury & Kavett Hall
125 Salisbury
Highland & Tech Pizza
Highland & N. Ashland

Appendix 32

CLASS SCHEDULES FOR DHS SPRING 2002

CLASS	PERIOD
AP Calculus AP Prob & Stats Prob and Stats Algebra Pre-Calculus	5th / 6th 4th Anytime Anytime Anytime
AP Physics Honors Physics Physics	8th / 9th / 10th (off Compus) Anytime Anytime
AP History US History	3rd / 1st Anytime
Law Honors Law	2nd, 4th, 6th / 7th 2nd, 3rd, 6th / 7th
AP English ESL Advanced English 4 English 3 English	1st / 2nd Any period Any period Any period Any period
Engineering	8th - 10th
AP Chemistry Chemistry	8th - 10th Anytime
GYM	All periods
Phychology Honors Physchology	Anytime Anytime

Appendix 33

Timeline of Events for Enrolling in a College Course

- **September** – Students should browse through the college course pamphlets and should have a good idea of what they want to take by the end of the month.
- **October** – Students should have a course selected and should verify the times that their course is offered by checking a current catalogue.
- **October** – Students planning on attending Quinsigamond Community College should contact Mrs. Pamela Fitzgerald to matriculate and register. Students planning to attend WPI should contact Professor Lance Schachterle to matriculate only.
- **November** – Students matriculated at WPI should visit the registrar's office to official register for their classes.
- **November (before Thanksgiving)** – Contact should be made with Ms. Tracey Pakstis-Claiborne to recruit WPI student mentors for the upcoming modules.
- **December** – Students should purchase books and all other materials necessary for classes before the colleges go on winter vacation.
- **December (Before Holiday break)** – Students should make contact with their student mentors.
- **January** – Students begin attending classes. Spring semester begins at QCC; C term begins at WPI.
- **January** – Students begin filling out Assessment Journals daily. These are to be checked weekly.
- **January** – Students will meet at Doherty once a week until the end of the year to discuss any problems.
- **March** – Students attending WPI should purchase books for Term D at the beginning of the month.
- **March (Second week)** – D term begins at WPI.
- **April (Last Tuesday)** – Classes end at WPI.
- **May (Second Wednesday)** – Classes end at QCC.
- **May** – Students begin working on presentation for debriefing.
- **May** – Students will be asked to fill out course evaluation forms
- **May (Last Friday before seniors graduate)** – Students present before the 9^{th}, 10^{th}, and 11^{th} grades.

Appendix 34

Timeline of Events for an Internship

- **September** – Students should fill out the Student Interest Survey and the Student Placement Survey.
- **September** – An appropriate number of companies should be selected from the list found in Worcester Area Employers. These companies should reflect the result of the Student Interest Survey.
- **September** – Students should create a resume using the Resume Writing Guide.
- **October** – Companies should be contacted using Phone Interview Script 1. If interested, the Internship Info Pamphlet should be sent out via email immediately after the first phone call to each company. At appointed time, as determined in the first phone call, a follow up call should be made to answer any additional questions and to schedule a meeting, if still interested, using Phone Interview Script 2.
- **November (Second week at latest)** – Teachers should meet with companies. Students will accompany teachers if requested by the company. Teachers should have students in mind that they would like students placed in each company and should bring their resumes with them.
- **November (Before Thanksgiving)** - Contact should be made with Ms. Tracey Pakstis-Claiborne to recruit WPI student mentors for the upcoming modules.
- **December** – Companies should be secured and students should be briefed on what they will be doing over the next semester.
- **December (Before Holiday break)** – Students should make contact with their student mentors.
- **January** – Students begin working at their companies.
- **January** – Students should begin writing their Assessment Journals daily. These journals will be collected weekly. Company supervisors should also fill out their Weekly Assessment of the students. These should be emailed to the teacher.
- **March** – Companies will be given the option to extend the internships for another ten weeks.
- **March** – If either party wishes to terminate the internship, the student will begin work on an independent design project.
- **May** – Students complete internships
- **May** – Students must prepare their presentation for the debriefing period. Students must also fill out internship evaluations and rate their experience. Sponsor companies should fill out a final evaluation of the student's effort.
- **May** – Students present before the 9^{th}, 10^{th}, and 11^{th} grades.