

## Students That Are Ready for Technology

### (Preliminary Proposal for Youth-Based Component of ITEST)

#### Project Summary

Building on the infrastructure of the successful [Students That Are Ready \(S.T.A.R.\) academies](#), a novel Launch-IT program will launch at-risk middle and high school students in the Greater Lehigh Valley toward college and careers in information technology (IT). Launch-IT will include summer and Saturday academic year programs on IT for seventh through twelfth grade students. Launch-IT will also build on successful curricula developed for the [Lehigh Valley Partnership for STEM project](#), an NSF GK-12 project. Summer and year-round curricula will include programming remotely controlled mobile robots in a simulated Martian landscape, creating a web-based music juke box using Macromedia Flash™, and enhancing a “design-first” approach to learning Java, for AP credit. IT faculty, school teachers, undergraduate mentors and industrial partners will work together to help students overcome stereotypes about computer science, foster a positive awareness of IT opportunities in the workplace, and develop exciting projects with mobile robotics, interactive web design, and object-oriented design and programming. Math skills will be developed continually with the help of the web-based “24” game. Self-directed multimedia, intelligent tutoring, and frequent mentoring by college undergraduate and graduate students will encourage more women and minorities to pursue computer science and enter the IT workforce. Extending these novel curricula in new directions, with hands-on activities, multimedia courseware and intelligent tutoring support, constitute the *intellectual merits* of this proposal. Its *broad impacts* include its focus on expanding the pipeline of women and minorities in IT, recruiting students from schools with high percentages of minority, low-income students, getting teachers and parents from these schools involved in the program, and disseminating novel curricular materials and learning environments regionally and nationally. The Launch-IT Program will be completely integrated into Lehigh’s existing academic infrastructure for S.T.A.R. to ensure that the new IT outreach activities are sustainable long term.

### **Need—Connecting and widening the pipeline for women and minorities in IT**

Discussions with IT teachers in middle and high schools in the Lehigh Valley confirm national trends. The number of computer science degrees awarded to women declined from 35.8% to 22% between 1984 and 2002 (Robb 2003). The trend has worsened with overall declines in CS enrollments. *Computing Research News* reports that “interest in CS among women fell 80 percent between 1998 and 2004, and 93 percent since its peak in 1982” (Vegso 2005). As Camp (1999) observes, “the computing community cannot sit back and assume that as the numbers of students rises, the percentage of women students will automatically rise and that the ‘[incredible shrinking pipeline] will take care of itself.’ We must take direct action to attract and retain more women to computing at all points in the pipeline (i.e., K-12, undergraduate, graduate, faculty and industry).” Indeed, the pipeline shrinks even before female students get to high school. One high school in our region reports having just one girl out of 125 students in IT elective courses.

A look at Taulbee Reports (Zweben 2005) for Computer Science enrollments indicates that the situation for minority students is similar. During a recent tour of Historically Black Institutions around the country, Microsoft Founder Bill Gates highlighted the need for more aggressive action to increase the number of women and minorities who pursue college degrees in IT/computer science.

To enhance the quality and diversity of the American workforce, it is essential to encourage minority and women students to pursue college degrees in IT fields, where the demand in the work force is expected to grow for the next decade. Based on discussions with regional teachers and administrators and projected demands for a future workforce in the field of IT, Lehigh University is proposing to create a year round Launch-IT (Students That Are Ready for information Technology) Program, as an extension of the highly successful S.T.A.R. (Students That Are Ready) Academies. S.T.A.R. already has a strong track record of success, combining parental involvement, teacher led programs, and undergraduate student mentoring and tutoring, to help struggling K-12 students succeed and become college-track material. The Launch-IT Program will follow the successful model of S.T.A.R., utilizing existing structures and partnerships of the S.T.A.R. Academies, with a focus on IT.

### **Target audience—grades 7-12 in the Lehigh Valley, Pennsylvania**

Launch-IT will provide a year-round program designed to connect and widen the school-based curricula segments of an educational pipeline put in place the Lehigh Valley Partnership for Teaching Fellows (LVPTF), an NSF GK-12 project hosted at Lehigh University. Launch-IT will provide summer and weekend programs for middle and high school students in the region, focusing on inner city schools in the Allentown and Bethlehem Area School Districts.

At the middle school level, curricula has been introduced for web page design using Macromedia Dreamweaver™ and animation using Macromedia Flash™ and using mobile robotics technology to explore a large simulated Martian Landscape. Math skills are developed at the middle school level through the donation of the web-based “24” and First In Math games, encouraging achievement through competition, and helping weaker students learn and develop math strategies for success. At the high school level, a novel “design-first” approach to learn object-oriented software development in Java has been introduced (Moritz and Blank 2005, Moritz et al. 2005). Extending these novel curricula in new directions, with hands-on activities, multimedia courseware and intelligent tutoring support, constitute the *intellectual merits* of this proposal. Its *broad impacts* begin by recruiting students from schools with high percentages of minority, low-income students, and getting teachers and parents from these schools involved in the program.

Launch-IT will connect the pipeline by providing summer and weekend programs that recruit from LVPTF-impacted schools, build on what they have learned, and provide the consistent mentoring and parental involvement that have made S.T.A.R. successful. It will also widen the pipeline by offering to train and support teachers in other regional schools prioritizing high minority, low-income students, to implement the school-based GK-12 curricula, so that students in these schools can also participate in Launch-IT. In other words, Launch-IT teams will offer in-service training to teachers at other schools and offer to help them introduce the curricula during the school year. As a result, more students will be exposed to successful GK-12 curricula and be ready to participate in Launch-IT.

### **Project Goals—from S.T.A.R. to Launch-IT**

Since 1989, Lehigh University Office of Academic Outreach and Special Projects has conducted the S.T.A.R. (Students That Area Ready) Academies, a year round intervention program promoting academic

achievement and college placement of economically and academically disadvantaged and/or at-risk middle and high school students in Greater Lehigh Valley (Allentown, Bethlehem, Easton and surrounding communities). S.T.A.R.'s goal is to recruit and retain minority students in the college-bound STEM pipeline, giving them the incentives, skills, and support systems they need to succeed in school and pursue higher education. Its primary features are: intensive tutoring and mentoring by Lehigh students, hands-on STEM laboratory experiences by faculty, a parent program with strong involvement, positive role models, career and college counseling, study skills, and internships in STEM fields for high school juniors and seniors. Co-PI Henry Odi is the Executive Director for the department where the S.T.A.R. Academies is housed and the other co-PIs are actively involved with S.T.A.R.

S.T.A.R. currently involves over 35 local middle and high schools in a weekend program. This year, over 100 sixth to twelfth grade students are participating. The Academies have remarkable retention and graduation rates: over 70% of the students return from year to year and more than 96% complete the program each year; 100% of the students graduate from high school and better than 95% have gone on to college; 100% have graduated from college within five years; over 85% of the parents are involved; retention is better than 96% for college tutors and 100% for faculty. S.T.A.R. includes 75-80% underrepresented minority students. As a result of the Academies' success, a three-week summer program was created in 1992 for rising 6<sup>th</sup> through 9<sup>th</sup> grade students who are economically and academically disadvantaged and/or at-risk. The program was developed as a result of the need to expose students from the underrepresented backgrounds to the fields of science, technology, engineering and math. The instructors include Lehigh faculty, graduate and undergraduate students in STEM, and math and science teachers from ten local schools. Of the 35-40 students who participate each year, 99% complete the program and all have continued on to participate in the S.T.A.R. academic year program.

Discussions with Lehigh University faculty and S.T.A.R. Academies Board have recently focused on program expansion through the development of new components dedicated to specialized academic fields on a year round basis. New components must focus on diversifying students who pursue academic fields of critical importance to future workforce development. To enhance the quality and diversity of the American workforce, it is essential to encourage minority and women students to pursue college degrees in IT fields such as computer science, where the demand in the work force is expected to grow for the next decade. Launch-IT will build on the success and infrastructure of S.T.A.R., with the goal of comparable results.

### **Focus—mobile robotics, interactive web design, and AP Java**

Launch-IT will create programs, including a three-week summer program and a year-round weekend program, for three groups of students: 7<sup>th</sup> and 8<sup>th</sup> graders, 9<sup>th</sup> and 10<sup>th</sup> graders, and 11<sup>th</sup> and 12<sup>th</sup> graders. With the first group, the goal is to teach skills for conducting science, math and technology 'missions' using remotely controlled robots in a simulated Martian landscape that has been created in the basement of a local middle school. The curricular materials for this program will be new and innovative, building upon existing curricular materials that students currently learn about mobile robotics in 6<sup>th</sup>-8<sup>th</sup> grade in curricula that LVPTF teams have created in two middle schools. With the second group, the goal is to create a web-based juke box or iPod™ as an interactive, animated web site using Flash™ and ActionScript, giving them a taste for programming, user interface design and accessing music files on the network, enhancing what middle schoolers learn about Flash animation in LVPTF curricula, and also addressing security and copyright issues. With the third group, the goal is to prepare students for the AP Java exam for college credit, building on the introductory "design-first" course for object-oriented software development in Java that a LVPTF team has developed and introduced in a local high school. The new curricula will incorporate inquiry-based activities and multimedia e-learning. Throughout the year, undergraduate students from Lehigh, Northampton Community College and other local colleges will mentor Launch-IT students to succeed in their educational and career goals and expose them to other exciting applications of IT via field trips to local IT-oriented business partners and science centers. The anticipated outcomes are to expand the success rates of S.T.A.R. to a wider group of students, at least half of them from minority groups and over half of them female, specifically headed toward IT college majors and careers.

Launch-IT will offer workshops, in the summer and winter of each year, to train participating teachers, graduate fellows and undergraduate mentors in the material to new curricula. Launch-IT faculty and graduate students will also offer to train teachers at other schools to learn successful Launch-IT curricula, for example in workshops at national conferences such as SIGCSE.

## Results from Prior Support

The PIs already have extensive experience with curriculum development and outreach projects supported by NSF, the Pennsylvania Infrastructure Technology Alliance (PITA), Lehigh University, and several corporate sponsors including Agere, Air Products, Binney and Smith, PPL Corporation, and SunTex International. We summarize the projects most salient to this proposal.

## CRCD grant: Constructive, Inquiry-Based, Multimedia Learning in Computer Science Education (Grant Number EIA-0087977 for \$578,000)

The screenshot shows a software interface for a Turing Machine simulation. On the left is a sidebar with a 'CHAPTERS' menu listing various topics. The main window is titled 'The Turing Machine' and features a central diagram of a Turing Machine with a state box labeled '0', a tape with 'SFASDF' and an 'X', and control buttons 'Run', 'Reset', and 'Step'. To the right is a 'Rule List' table:

	State	Read	Next	Action
1)	0	X	0	W
2)	0	W	1	->
3)	1	-	1	E
4)	1	E	2	->
5)	2	-	2	L
6)	2	L	3	->
7)	3	-	3	C
8)	3	C	4	->
9)	4	-	4	O
10)	4	O	5	->
11)	5	-	5	M
12)	5	M	6	->
13)	6	-	6	E
14)	6	E	7	Stop

Below the main window is a text box: 'The machine is capable of just a few primitive operations: symbols, reading, writing, moving the tape one square to the right or left, and halting.' At the bottom is a navigation bar with icons for 'COLLABORATE', 'EXPLORE', 'FIND', 'TOOLS', 'PREFERENCES', 'INFO', 'JUST THE FACTS', 'BACK', 'PAUSE', and 'NEXT'.

Figure 1: Screen capture from CIMEL multimedia for *The Universal Computer*

The CIMEL project (Constructive, collaborative, Inquiry-based Multimedia E-Learning) began in October 2000. The PIs built and evaluated a multimedia framework and content for an introductory graduate level course, Object-Oriented Software Engineering, two upper level undergraduate courses, Software Engineering and Programming Languages, and two introductory level courses, for majors (CS1) and non-majors (CS0). Multimedia content has been developed to complement a new textbook for CS0 or CS1 (Blank, Barnes and Kay 2003). Our preliminary results are promising. Our papers and other documents, evaluation materials and a demo version of the multimedia are available at [www.cse.lehigh.edu/~cimel](http://www.cse.lehigh.edu/~cimel).

Figure 1 on the previous page illustrates several features of the CIMEL multimedia framework. In the lower left is a persona representing a professor. Personae model a diverse community of teachers and students studying material together and working through interactive exercises. They suggest exploratory research on relevant topics using online information as well. In addition to graphical images, they speak in audio and/or text boxes. A JUST THE FACTS mode lets users switch to viewing non-interactive content (text and graphics) presented in HTML pages. From there, one can switch back to rich media mode via hyperlinks to corresponding Flash pages.

While our approach is to present enough didactic material in the multimedia that it can be a standalone learning experience, interactivity is frequent and rich in CIMEL content. Personae provide feedback to all responses, which are in turn logged to a web-based tracking system for evaluation purposes. *Constructive* exercises challenge a learner to build solutions to problems by dragging and dropping pieces of structures into place, incrementally. With both full audio narration and JUST THE FACTS summaries, as well as interactive, constructive and inquiry-based learning exercises, CIMEL facilitates learning for students with different learning styles (Blank, Roy, et al. 2002). Experimental evaluation shows that the multimedia has a significant effect on learning, both in objective tests and homework assignments, for graduate students learning how to design abstract data types in a graduate level course on Object-Oriented Software Engineering (Blank, Kay, et al. 2002) as well as for undergraduates learning the same material in an upper level undergraduate course on Software Engineering (Blank, Roy, et al. 2002, Moritz et al. 2005).

More germane to this proposal, we also conducted two studies targeting first year students. In one study (Blank et al. 2003), we compared how well students in a CS0/CS1 class learned from the first chapter of a textbook introducing Java with BlueJ and a strongly objects-first approach (Barnes and Kölling 2002) versus our corresponding multimedia. Scores on the first posttest were higher for those using the multimedia (mean of 14.50) than those using the textbook (12.46), a significant difference ( $p < 0.001$ ). Moreover, the multimedia adds to what they learn from the textbook. Students using the textbook first, then using the multimedia improved their scores on the second posttest (12.46 to 15.40), a significant improvement ( $p < 0.001$ ). We infer that the multimedia helps students learn conceptual material better than if they were exposed only to the textbook.

Another study (Blank et al. 2004) compared CS0/CS1 students' attitudes before and after students interacted with multimedia incorporating animation, video interviews with "real world" computer scientists and software developers, and a follow-up interactive exercise. The multimedia had the effect of overcoming all six misconceptions that it addresses ( $p < 0.01$ ). There were also significant gender differences. For two pretest/posttest statements ("Computer scientists get to work with lots of interesting people" and "Most computer scientists spend a lot of time building newer and faster hardware") females scored significantly lower on the pretest than males, but showed a much larger gain on the posttest ( $p < 0.01$  in both cases).

Launch-IT programs will use CIMEL multimedia materials in all three programs: to overcome stereotypes about computer science, and to introduce robotics, basics of Flash programming, principles of usable interface design and web design, Eclipse and the LehighUML plug-in with the shapes example, how to go from use cases to classes, and elements of Java programming.

**NSF GK-12:** The NSF funding related to the proposed project is an NSF GK-12 Track 1 Teaching Fellows grant (grant number 0231768 from June 2003 for three years, \$1,355,912) entitled "A Lehigh Valley Partnership to Enhance STEM Education through G4-12 Teaching Fellows" (LVPTF STEM). The PI of the LVPTF project is William M. Pottenger. The co-PIs/Senior Personnel on the Track 1 project are Henry U. Odi, Glenn D. Blank, Gary DeLeo, Keith J. Schray, Bennett Eisenberg, Jennifer M. Swann, Susan Szczepanski, Lynn Columba and Jean Russo. Partner organizations include the Bethlehem Area School District, the Allentown School District, Air Products & Chemicals, Inc., Suntex International, Inc. Binney & Smith, Inc. Insaco, Inc., Pennsylvania Power & Light (PP&L) and PITA (Pennsylvania Infrastructure Technology Alliance). All of these partners are actively involved in this proposal as well.

The LVPTF STEM project places outreach teams in grades 4-12 STEM classrooms in inner city Allentown and Bethlehem schools. Each outreach team consists of Lehigh faculty member, a graduate Teaching Fellow, one or two advanced undergraduate Teaching Fellows, and two STEM teachers, in one school. Teaching Fellows help teachers design curricula and lessons which introduce inquiry-based learning and use multimedia, wireless and other innovative technologies in local classrooms (Blank et al. 2003 and 2004). The successful structure of LVPTF outreach teams provides a model for Launch-IT teams. The project goals are three-fold: to increase interest and learning in STEM disciplines, especially for women and underrepresented minority grade 4-12 students; to instill a life-long awareness and appreciation for grade 4-12 educational issues in our Teaching Fellows; and to provide our grade 4-12 STEM Teachers with training and resources to incorporate inquiry-based learning methods in STEM education. Three of the eight outreach teams focus on IT, at the three schools that this proposal targets, and have produced novel curricula which lay the foundations for the Launch-IT programs.

This project reaps many benefits. Teaching Fellows improve their communication, leadership, and teaching skills. They gain appreciation for high quality STEM education and a better understanding of STEM pedagogy. Grade 4-12 teachers have new opportunities for professional development, are gaining a better understanding of the theory and applications of STEM principles, and have access to useful instructional materials and methods for delivering STEM subject matter. As a result of inquiry-based and problem-based learning experiences, grade 4-12 students are improving their problem solving and critical thinking skills, as well as their understanding of and appreciation for STEM disciplines. They also have excellent role models in the Teaching Fellows, and we expect will be more motivated to pursue degrees and careers in STEM disciplines. The large involvement of under-represented groups in the project is also expected to result in an improvement in the recruitment and retention rates of females and minorities in STEM disciplines. The project is also providing a better understanding of how the process of scientific discovery can be effectively communicated to grade 4-12 students, and how STEM subject knowledge can be more effectively incorporated in grade 4-12 curricula. A fundamental benefit of this project is that it is strengthening existing and cultivating new relationships between students, educators, professionals and parents that are enabling them to exchange ideas and to learn from, support and encourage one another. The Launch-IT project will profit from all these assets, including the strong working relationships that have been established with target schools and districts, state co-sponsorship through PITA, and corporate sponsorship in the form of cash and property donations, volunteer presenting lessons, and field trips.

The LVPTF project has also supported fundamental PhD level research in various STEM fields. In computer science, one of the graduate teaching fellows associated with this project together with the PI has been developing and evaluation the "design first" curriculum (Moritz and Blank 2005) and the expert evaluator component of the intelligent tutoring system designed to support this curriculum (Blank et al. 2005). A second graduate teaching fellow has begun to investigate the development of an ITS to help students who get stuck learning how to succeed with the web-based "First in Math" program. Both of these research projects will have useful applications and opportunities for further development, evaluation, and dissemination of results, in connection with the Launch-IT program.

## **Project Design**

Launch-IT will consist of three year-round programs, taking students from basic to advanced skills over a two year period. In all three programs, participants will meet from about 9AM to 4PM, at a site (either Lehigh University or a partner school), where personal computers and supporting software will be available for each student. Lunch and bus transportation to the program site will be provided. (The cost of buses is one reason this is primarily a summer and weekend program, though there may be occasional field trips to corporate sites after school.) Outreach teams of Lehigh faculty, school teachers and graduate fellows will plan and present lessons. Parents and undergraduates from regional colleges will help as mentors and one-on-one tutors. While Launch-IT will focus primarily on IT, like S.T.A.R. it will also help students develop the math and communication skills needed to succeed in high school, college, and the IT workforce. Each program will also feature field trips to and visits from corporate sponsors, with the goal of showing students exciting applications of IT and the knowledge and skills needed to succeed.

The program for 7<sup>th</sup> and 8<sup>th</sup> graders will explore IT, math and science concepts in a simulated Martian Landscape and Mission Control Center, currently under construction at HMMS, one of our partner schools. Dr. John McAdams, the Allentown School District Superintendent of Curriculum, has mandated the district-wide development of a technology education curriculum. The focus of the mandate is on the ideas under development by LVPTF Technology, Science and Math outreach teams at HMMS. The key philosophy is to use exciting new technologies like mobile robotics to enable learning of science, technology, engineering and math. A recent article appeared in *The Chronicle of Higher Education* highlighting this program.

The Launch-IT program will also incorporate curricular ideas and resources from the Team Jason Online Project ([www.jason.org](http://www.jason.org)). Some features of the TJO project include a secure login area, a journal area, message boards, interactive chats with TJO scientists, realistic labs, national standards based curriculum, teachers guide, online assistance, and monitoring tools. The students will keep an online journal to track scientific data, hypothesis, and their experiences. Students will also be able to participant in message board sessions with instructors, other students, faculty from Lehigh, and local business partners.

Students in the 7<sup>th</sup> grade Saturday program will use various mathematical skills to manipulate the robots remotely. Skills such as geometry, measurement, and coordinates are examples of the informal

math-based activities to be carried out in the Martian Landscape. Students in the 8<sup>th</sup> grade Saturday program will use the landscape to conduct different science experiments such as identifying different types of rocks based on color, weight, and density. The activities will be organized into 'missions' that although informal, are aligned with both state and national established math, science and technology standards. Through the NASA Explorer School (NES) program at HMMS, students can propose a science experiment to be conducted on the International Space Station (ISS). If their proposal is selected, students will be able to use a new video conferencing capability being installed at HMMS in the Mission Control Center. From the school, students will be able to use audio and visual communication with the scientists manipulating their experiment on board. Once the results are obtained, students will be able analyze the data and draw conclusions. Starting in the summer program, rising 8<sup>th</sup> graders will build on their Saturday program by conducting real world experiments using mobile robotics and rockets. For example, students will learn about thrust in a digital environment and then construct different types of rockets that deploy mobile robots—the current thrust of the NASA lunar exploration program. Students will start with alka-seltzer powered rockets, advance to water and air powered rockets, and finally conclude with a ballistic rocket. Launch-IT students will develop an experiment package that uses mobile robotics that will travel on a sounding rocket designed to leave the earth's atmosphere for only a couple of seconds and then return to earth. In conjunction with the HMMS NES Team, Launch-IT students will develop a scientific hypothesis, create an experiment package, travel to Wallops Island, install the package in the rocket with assistance from NASA personnel, spend the night and run the mission control sequence for the rocket. Afterwards, the US Coast Guard will retrieve the rocket and the students will clean the rocket and evaluate the performance of the mobile robotic experiment.

The summer program for rising 9<sup>th</sup> graders will delve into the world of Java programming using the Java application programmer interface (API) provided with the mobile robots. Up to this point, students will have used programmed the robots are readily programmed using a simple graphical user interface based on an if-then programming construct. The Java API supports advanced operation. Using this API, the robots can communicate with geo-locating sensors to identify their relative positions. 12<sup>th</sup> grade Launch-IT students will create a simplified version of this API. The rising 9<sup>th</sup> graders will assign teams of robots 'missions' that cannot be accomplished by a single robot. For example, the students will map the surface of the Martian Landscape in a collaborative mobile robot exploration.

Each year's program will produce projects for regional science and engineering fairs. Students will also enhance their math skills using the web-based "24" and First In Math games; an intelligent tutoring system will enhance their ability to learn math strategies for success in the competitions (a PITA grant has begun researching the knowledge engineering for this ITS). CIMEL multimedia will introduce robotics and seek to overcome stereotypes about computer science (such as "computer science is for nerds"). Students will also participate in career day field trips to and visits from industrial partners in the Lehigh Valley, designed to show positive examples of IT careers, as well as to Prof. Spletzer's robotics lab at Lehigh University, where they were learn about cutting-edge applications of mobile robotics as well as student Robocup competitions.

In the program for 9<sup>th</sup> and 10<sup>th</sup> grades, students will learn how to design and develop interactive web sites, using Flash™ animation, HTML in Dreamweaver™, sound, graphical and video design, user interface design, ActionScript, and client-server technology. Students will begin by learning the Flash workspace, using drawing and text tools, symbols and buttons, animations with motion tweens and guides and how to incorporate Flash in an HTML-based web site. Sample curricula for the basic material are already available at [www.lehigh.edu/stem/teams/Broughal](http://www.lehigh.edu/stem/teams/Broughal). Interactive multimedia from CIMEL will help students learn this material. As they develop these skills, they will also learn design and communication skills by constructing a project for a science fair, identifying the purpose of their project, the audience, researching their topic on the web, creating a storyboard, writing a script, learning how to create appropriate design and layout, and how to incorporate various media, including still images and drawings, sound (musical and narration/voice over), and video, and giving credit where credit is due. Another project will be to critique and modify CIMEL multimedia to make it more age appropriate for the 7<sup>th</sup> and 8<sup>th</sup> grade Launch-IT students.

Building on these basic skills, a more advanced goal for 10<sup>th</sup> graders will be to create a web-based juke box or iPod™. Our current teaching fellows proposed this project as one that will hook students coming out of middle school, including girls and underrepresented minorities, because it relates to a real world application that they are interested in. The jukebox will be an interactive, animated web site using Flash and ActionScript. As they progress through this project, students will learn how to use ActionScript to

control interactive behaviors, how to access music files on the network (peer-to-peer versus client-server access), usability and aesthetic criteria for interface design, and consider security and copyright issues.

Students will maintain their project designs, minutes, and responses to feedback and evaluation as a web-based blog. Students will also learn how to develop an e-portfolio, which they will be able to show parents and potential employers either via the web, CDROM or DVD. Promising students will be recommended to regional corporate sponsors for internships leading to summer or part-time employment.

Each year of this program, at least two corporate sponsors will visit or arrange field trips to study how they develop interactive web sites with Flash. For example, SunTex International in Easton, PA, uses Flash in their web-based First in Math game ([firstinmath.com](http://firstinmath.com)), which many Launch-IT students will have seen in school as well as the first program. InteractiveTube of Bethlehem, PA uses Flash to enhance and personalize online video ([interactivetube.com](http://interactivetube.com)). The lead developer of SunTex's web site and two of the founders of InteractiveTube are Lehigh University graduates who took the PI's class on multimedia design and development. Besides their practical know-how using Flash in state-of-the-art applications, these relatively young people will inspire students with their success stories. They are also looking to hire good talent in the region. Larger corporate sponsors such as Air Products and Binney and Smith will also meet with students to discuss how they make effective use of web technology.

In the program for eleventh and twelfth grades, students will learn object-oriented analysis, design and programming using Java, and prepare for the College Board's Advanced Placement exam in Java in order to earn college credits in Computer Science. The PI leads GK-12 outreach team at Dieruff High School which has developed a novel curriculum introducing Java "design first," which will be the focus of the eleventh grade Launch-IT program (Moritz and Blank 2005). This curriculum, available at [lehigh.edu/stem/teams/dieruff/](http://lehigh.edu/stem/teams/dieruff/), emphasizes how to solve a problem using modern software engineering principles, rather than syntactic details of a language. It begins by comparing how one goes about building a house with how to build a software system—just as a contractor doesn't start by nailing two-by-fours together but by figuring out what kind of house the customer wants and hiring an architect to design it, so a software engineer doesn't start by writing code but by analyzing what the customer wants and designing a software architecture. Students then learn fundamental object-oriented concepts—classes and instances, attributes and methods. They learn how to use the popular and open-source Eclipse integrated development environment ([eclipse.org](http://eclipse.org)), with the DrJava plug-in ([drjava.org](http://drjava.org)) to support interactive execution of Java expressions and the LehighUML plug-in to support the development of class diagrams in the Unified Modeling Language. (The novice-oriented setup is also available at [lehigh.edu/stem/teams/dieruff/](http://lehigh.edu/stem/teams/dieruff/).) In this environment, one of their first assignments will be to use DrJava to execute methods which create and modify graphical shapes, then design a picture of a house with an animated sunset.

For each problem, they will begin to experience the complete software life cycle. They will learn about how to gather requirements as use cases, for a problem such as a movie ticket vending machine. Once their use cases are acceptable, they will next learn how to design a solution as a class with attributes and operations in UML. They learn how to implement methods, incrementally, learning Java constructs as needed, from data types, arithmetic and constants, to input/output and if-else control structures. Subsequent projects, motivated by real world customers with problems that high school students can relate to, will introduce increasingly complex problems, but keep emphasizing requirements gathering with use cases, design with UML, and test-driven development with Java in a modern software development environment. For example, students will learn how to design and implement character-based user interfaces with the Scanner class and graphical user interfaces in Swing, applying the principle of separation of concerns, attaching two different user interfaces to a separate problem domain model. We believe starting with an emphasis on modern software engineering rather than syntactic details will be more engaging to students, especially girls. In keeping with recent trends in software engineering, we will emphasize pair programming, which has been shown to improve retention of novices, especially female students (Van DeGrift 2004, Werner et al. 2005).

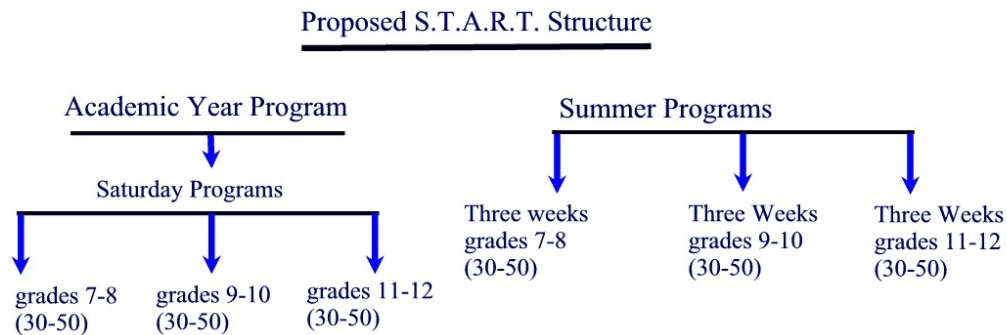
The PI plans to co-author a textbook, to be called *Design First With Java*, to support this curriculum, for use in either a high school or first year college context. Excerpts will be made available to Launch-IT students. Interactive multimedia associated with this text, much of which is available now, will introduce students to the Eclipse environment and help students learn core design and Java concepts (see [www.cse.lehigh.edu/~cimel/prototype.html](http://www.cse.lehigh.edu/~cimel/prototype.html) for sample materials; see Blank et al 2003 for results showing the effectiveness of these materials). An intelligent tutoring system (ITS) will provide hints and tutorials on

an as-needed basis to students learning how to create UML designs (Blank et al. 2005). Each time a student enters a class, attribute or method in LehighUML, the plugin will send a packet over the web to the ITS on a server. An expert evaluator will diagnose the student's work; a Bayesian student model will update its estimate of the student's conceptual knowledge based on current and previous work (Wei et al. 2005, Wei and Blank 2006); and a pedagogical agent will provide feedback that takes into account the student's preferred learning style(s), based on a validated learning style survey (Felder and Silverman 1988).

The twelfth grade program, building on core Java knowledge of the eleventh grade curriculum, will shift to preparing for the AP Java exam. At present, neither the Allentown nor Bethlehem Area School Districts offer a course preparing students for this exam, though the nearby Emmaus High School does. With input from local teachers, we will select a curriculum that meets the requirements of the College Board ([apcentral.collegeboard.com/](http://apcentral.collegeboard.com/)), then adapt it for use in the Launch-IT program, taking advantage of the background these students will already have from their experience with the design-first curriculum.

Again, students will develop an e-portfolio of their work, which they will be able to show parents and potential employers either via the web or CDROM. Building on the successful interaction of PPL Corporation with the GK-12 outreach team at Dieruff, Launch-IT will incorporate field trips to PPL and Agere to learn how they use IT in the workplace and to "shadow" IT employees as they go through a typical work day. (Here is an email note commenting on the shadowing program: "The shadowing experience worked out so well last year, we agreed that no changes were needed for this year. Tony Dreisbach and John Finnegan will coordinate on PPL's side. Last year, students shadowed two different employees - one in the morning and one in the afternoon. John suggested having a shortened GIS presentation around lunchtime, because it was so well received on the field trip last year. Sally suggested that ISD operations (DBAs and system admins) and software development staff be included, as these positions would be pertinent to students who took the programming and database classes. Rob encouraged the Dieruff team to make other suggestions for positions to include in shadowing.") Promising students will be recommended to regional corporate sponsors for internships leading to summer or part-time employment.

Like the S.T.A.R. Academies, the Launch-IT program will be housed in the Office of Academic Outreach and Special Projects under the umbrella of the Provost and Academic Affairs. We envision the proposed program structure as depicted below.



The staff needed to support three Launch-IT outreach teams include:

1. The Program Director will administer the three two-year programs.
2. Three faculty members from Lehigh's colleges of Engineering and Education will oversee the academic content and evaluation of each two-year program.
3. Three teachers, one associated with each lead participating school, will teach in each program.
4. Three graduate fellows in the fields of Computer Science and Learning Science and Technology will help develop curricula materials, help teach in Summer and Saturday programs, manage undergraduate mentors associated with each two-year program, develop software to support the new Launch-IT curricula (including multimedia e-learning and intelligent tutoring systems), and help with dissemination efforts, including workshops and the project web site.
5. Three paid undergraduate mentors majoring in computer science will tutor and mentor students in the summer and Saturday programs and also help develop curricula and software for Launch-IT

6. Thirty volunteer computer science undergraduate mentors from Lehigh University and partner regional colleges will serve as mentors and tutors, primarily in the Saturday program. (Similarly, S.T.A.R. recruits volunteers from STEM disciplines at Lehigh.
7. An Administrative Assistant (half-time) will provide support for the Launch-IT program.

The Office of Academic Outreach and Special Projects under the direction of Co-PI Odi, assisted by a Program Director, will oversee the implementation of the Launch-IT program. This will entail recruiting members of the three Launch-IT outreach teams, then coordinating workshops each summer and winter so that team members understand the goals, curriculum and plans for evaluating each Launch-IT program. Co-PI Columba will plan and help teach the workshop, which will among other things review the use of existing and planned instructional curricula materials and how to use them in Launch-IT. It will involve getting parents involved for their role as supporters of the program and mentors in the program also entail coordinating interactions with industrial partners in promoting awareness of real world applications of IT, designing user interface problems and real world programming problems. Industrial partners that are already involved with LVPTF include Binney and Smith (who donated a Martian Display valued at over \$1 million to Harrison-Morton Middle School), Air Products, PPL Corporation, Agere, and Suntext (who discounted the web-based version of the "24" game and FirstInMath web site), and more partners will be recruited. Industrial partners provide volunteers and real world curricula and have helped to fund the S.T.A.R. project and will be a key component for the sustainability of Launch-IT beyond the duration of the proposed project. Teams of graduate, undergraduate and Launch-IT students will work on problems posed by industrial partners and promising Launch-IT students will avail themselves of interviewing and internship opportunities with industrial partners and at Lehigh (e.g., working on multimedia development for this project). The half-time administrative assistant requested in this proposal will work with the Program Director in the Office of Academic Outreach and Special Projects to coordinate the program.

Launch-IT outreach teams will develop instructional material for use in the Summer and Saturday components of the program. PI Blank, co-PI Pottenger and co-PI Columba will each coordinate a team, where each team will include one teacher, one graduate student teaching fellow, one undergraduate teaching fellow, and ten undergraduate volunteers, giving instruction and hands-on mentoring to 30-50 grades 7-12 students. They will meet either at an associated public school and/or Lehigh University (e.g., during the summer, the rising 7<sup>th</sup> and 8<sup>th</sup> grade team will use the Martian Landscape and Mission Control Center at Harrison-Morton, etc.).

Curricular materials will be enhanced and supplemented with multimedia courseware and intelligent tutoring system support for use in the Launch-IT Program. At the end of the summer and each semester, IT teachers and graduate and undergraduate mentors will write a report with recommendations for improvements to the curricula and supporting software. Co-PI Columba and a Learning Science and Technology graduate student will summarize these recommendations along with the results of formative evaluation. PI Blank and co-PI Pottenger and their students will use these recommendations and results to guide incremental improvements to multimedia e-learning materials (Blank 2003), the Martian Landscape and Mission Control Center curriculum, as well as an intelligent tutoring system to support learning object-oriented software development in Java (Blank 2005).

## Recruitment

We are already working with several schools within the Allentown and Bethlehem Area School Districts and have contacted several teachers who have expressed interest in partnering with the Launch-IT program. These schools have large enrollments of low-income under-represented minority students and a history of working with Lehigh University in educational outreach. The targeted schools and their percentage of under-represented minorities and low-income students are as follows:

Broughal Middle School (BASD)	82% minority	84% low income
Harrison-Morton Middle School (ASD)	76% minority	86% low income
Dieruff High School (ASD)	68% minority	61% low income

While these schools will be targeted for recruitment of both students and teachers, Launch-IT like S.T.A.R. will be open to and recruit from all schools in the region. The TechGYRLS program at the Bethlehem YMCA, which introduces girls of ages 9-13 to animations, graphic arts and robotics, is another target for recruiting female students across the region.

The Program Director will communicate with schools, agencies and local churches via a Launch-IT website, hardcopy brochures and a letter of invitation. Middle and high school principals and guidance counselors and agency

directors will be invited to recommend students for the program. As with S.T.A.R., the criteria for student selection will focus on students who academically below average to average, rising 7<sup>th</sup>-12<sup>th</sup>; who seem not to believe that college is a viable option, lack motivation and vision for the future, low self esteem, yet show interest or talent in science and technology, especially IT. Emphasis in the selection process will be given to students from low income backgrounds, underrepresented minorities and female students. The Office of Academic Outreach and Special Project at Lehigh will host a breakfast meeting for school administrators, agency directors and church youth pastors to officially introduce the project, Launch-IT website and distribute the hardcopy project brochure. An orientation program will be developed for selected students and with a separate component for their parents. Parents of the selected students will be invited to attend wrap-up sessions for the summer and academic year Saturday program.

### **Key Staff and Consultants**

PI Glenn D. Blank, Associate Professor of Computer Science and Engineering, will act as the Project Director and will be responsible for the administration of the award, management of the project, and interactions with the NSF, as well as one of the Launch-IT outreach teams (33%). He was the PI of a Combined Research and Curriculum Development project (Grant No. 0087977) which developed multimedia e-learning materials introducing computer science to novices (for a demo, see [www.cse.lehigh.edu/~cimel/prototype.html](http://www.cse.lehigh.edu/~cimel/prototype.html)). He is also a Co-PI of the LVPTF GK-12 project (Grant No. 0231768), for which he serves as Faculty Team Leader for the Broughal Middle School and Dieruff High School outreach teams, as well as several related projects sponsored by the Pennsylvania Infrastructure Technology Association (PITA). He is also lead author of *The Universal Computer: Introducing Computer Science with Multimedia* and supervises several graduate students developing an intelligent tutoring system to help students Java “design-first.”

Co-PI Henry Odi, Executive Director for Academic Outreach and Special Projects, will coordinate the activities of the Launch-IT program in conjunction with the S.T.A.R. Academy (33%).

Co-PI William M. Pottenger, Assistant Professor of Computer Science and Engineering, will lead one of the outreach teams. He is PI of the LVPTF GK-12 project and PI of several research projects in his research area of textual data mining. He will lead the 7<sup>th</sup> and 8<sup>th</sup> grade programs (20%).

Co-PI H. Lynn Columba, Associate Professor in Education and Human Services in Lehigh University's Graduate College of Education, will plan and lead the workshop for the Launch-IT outreach teams before each summer session as well as lead one of the Launch-IT outreach teams. She is a Co-PI of the LVPTF GK-12 project and brings broad expertise in STEM education and experience in performing assessment in an educational setting to the project (20%).

Consultant M. Jean Russo, Senior Research Scientist and Scholar at the Center for Social Research at Lehigh University, will oversee and carry out the evaluation (20%).

Teachers will be recruited from the Bethlehem Area and Allentown School Districts. The PIs already have excellent working relationships with teachers and administrators through the S.T.A.R. and LVPTF programs. Indeed, three teachers helped write the project description section of this proposal: Maryann Kearns and Jane Carr of the Bethlehem Area School District and Don Stahl of the Allentown School District, all of whom are members of the GK-12 teams; Ms. Kearns is a long time teacher in S.T.A.R.

### **Partners—School Districts, Regional Corporations, and Parents**

The Office of Academic Outreach and Special Projects at Lehigh University has successfully developed an infrastructure in cultivating external partners to participate in its various academic programs, including pre-college programs. The existing partners for S.T.A.R. and other outreach programs include several school districts in the connecting cities in the Greater Lehigh Valley (Allentown, Bethlehem, and Easton) and surrounding communities.

In addition, partners will include five multinational companies with headquarters here in the Valley (Air Products, PPL, Binney & Smith, Suntext International and Just Born, Inc.); youth programs at local churches; local agencies such as the TechGYRLS (YWCA initiative); and parents. The S.T.A.R. Academies and Lehigh Valley Science & Engineering Research Fair consistently attracts the most number of sustained parental participation than any pre-college program in the state. These two programs are housed in the Office of Academic Outreach and Special Projects at Lehigh University. The proposed Launch-IT Project will benefit from the above infrastructure. A newly recruited partner for the Launch-IT Project is the Private Industry Council of Lehigh Valley/Pennsylvania Career Link. The Careerlink Centers are located across the Lehigh Valley and funded primarily by the Pennsylvania Department of Labor and Industry and chartered by the Lehigh Valley Workforce Investment Board, Inc. This organization will be

critically important to the Launch-IT project's sustainability plan which will be discussed below in the proposal. As a result Lehigh University's recent collaboration with NASA and NASA Explorer School Site program in the fields of science, technology, engineering and mathematics will enhance the Launch-IT Project. Harrison-Morton Middle School, one of the participating schools was recently awarded the NASA Explorer School Site grant and Broughal Middle School (located across the street from Lehigh University) has just applied for the same grant.

For Launch-IT, which focuses more narrowly on IT, we plan to recruit from computer science departments in other regional colleges, including Northampton Community College and Cedar Crest College (a small women's college). Our experience with S.T.A.R. and LVPTF has shown that undergraduates are excellent role model for K-12 students, in part because they are closer in age.

## **Evaluation Plan**

The figure on the following page shows the connections between the vision, goals, program components, and evaluation mechanisms for S.T.A.R.T.

The vision of this project is to widen the pipeline of information technology students. It will focus on at-risk middle and high school students in the Greater Lehigh Valley. It is believed that exposing G7-12 students to the Launch-IT programs, with their intensive mentoring, inquiry-based learning experiences, interactive, intelligent e-learning, increased involvement by corporate partners and parents, will increase the numbers of students interested in CS/IT education and careers, including young women and underrepresented minorities. Dr. M. Jean Russo of the Center for Social Research at Lehigh University will be responsible for this aspect of the evaluation, and all data will be made available to the NSF and to the ITEST Learning Resource Center.

The evaluation plan includes both formative and summative aspects. The formative evaluation, which is ongoing throughout the project, monitors and documents the program implementation and activities. It will include both quantitative and qualitative methods, including counts, pen and paper and/or online surveys, rubric scores, and focus groups.

The evaluator will document the numbers of teachers, graduate and undergraduate mentors, as well as the number of students in the summer and Saturday programs and the science fair, as well as the number of parents participating in any of these Launch-IT activities. Student information will be broken down by gender and ethnicity. At the beginning of each session, the evaluator will collect information from the Launch-IT students currently being collected on S.T.A.R. participants as well as any information requested by the ITEST Resource Center.

To evaluate curricula, IT teachers and graduate fellows will write reports at the end of each year's program. These reports will document the content covered and offer recommendations for improvements to the curricula and supporting software. Co-PI Columba and the Learning Science and Technology graduate fellow will summarize these reports and offer suggestions for continuous improvement. In addition, final assignments will be assessed using rubrics developed by the teachers and mentors. Such rubrics are currently being used as a part of the LVPTF project. Scores on these rubrics will demonstrate whether each curriculum was effective in teaching the intended content and computer skills and whether modifications resulted in higher rubric scores.

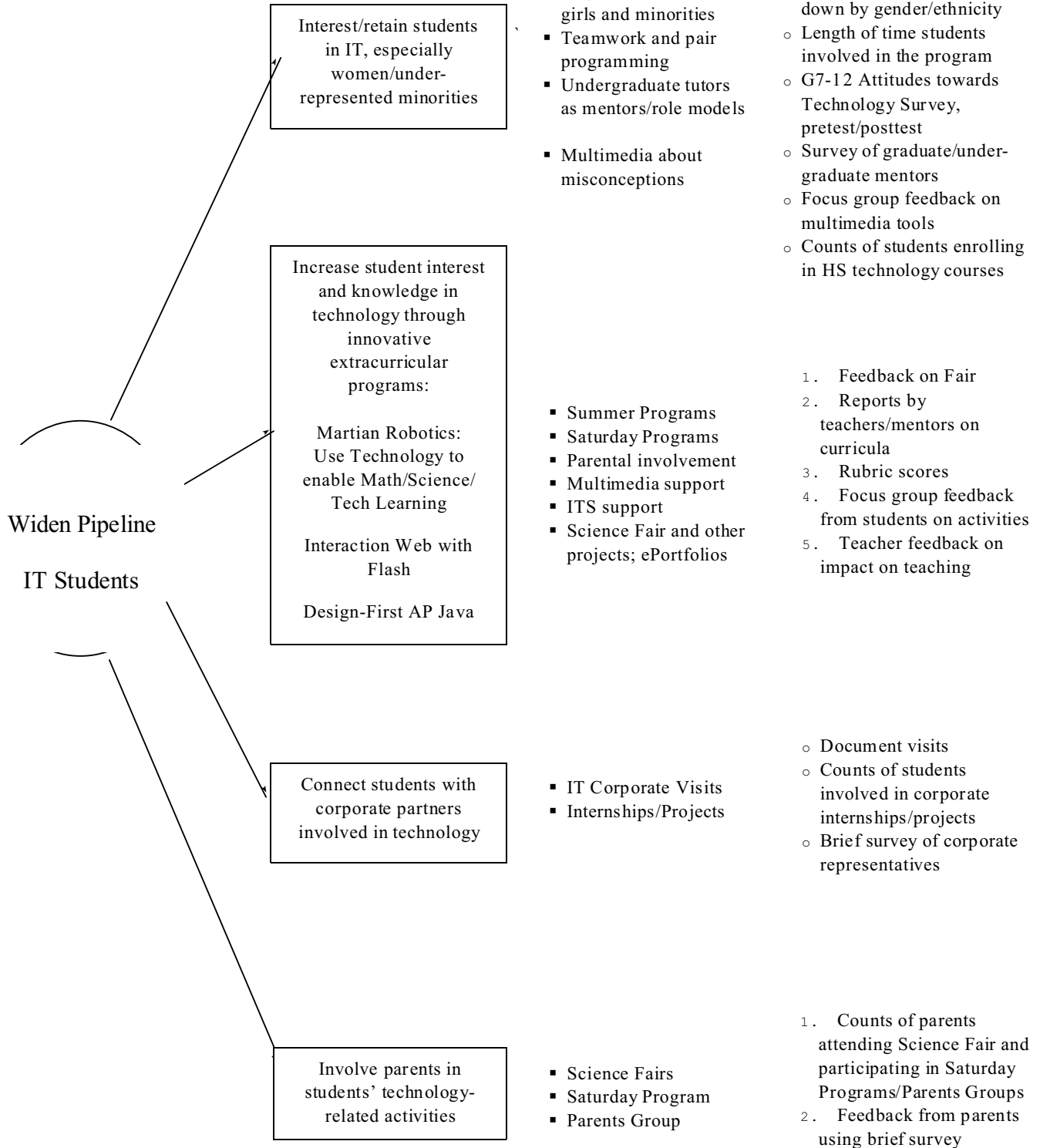
At the beginning and end of each year, Launch-IT students will be asked to complete a survey on their attitude toward technology and careers in IT. A 27-item instrument on this topic is used with 6th and 7th grade students at HMMS as a part of the LVPTF project. This instrument contains items relating to two factors on the Test of Science-Related Attitudes (TOSRA) developed by B. J. Fraser in the early 80s. Items pertaining to the factors, Attitude Toward Science/Career & Leisure, and Attitude Toward Science Classes, were modified to pertain to computer science and technology. Factor analyses on the 27 items in this revised and shortened instrument yielded four factors with reliabilities ranging from .81 to .90. The factors include classroom interest, outside activities, general interest in technology, and career interest. Other students participating in other aspects of the S.T.A.R. program will serve as a comparison group to see whether participating in the technology component increases interest in technology and the likelihood of choosing a career in computer science. T-tests will be used to determine whether differences in factor scores between the two groups are significant. In addition, a total of three focus groups will be conducted at various times over the year, i.e., middle of the school year, end of school year, and end of summer.

## Vision

## Goals

## Program Components

## Evaluation Mechanism



Each focus group will target a different age group to get feedback on their mentors and the activities conducted in their session. This focus group will also provide an opportunity to probe further the students' attitudes toward computer science. Each age group will participate in a focus group at least once a year. At the end of the school year, participating seniors will be given an Exit Survey to see whether they plan to include IT in their plans for college or their career choice.

At the end of each semester, all participating teachers and graduate and undergraduate mentors will be asked to complete an online survey. Areas covered in the survey will include feedback on the experience, suggestions for improvement, and the impact on their own teaching, academic, and career plans. In addition, corporate sponsor representatives will be asked to complete a brief survey on their interaction with the Launch-IT students. These surveys will be available through SurveyMonkey, a tool for creating web surveys, and links will be sent to the participants via email. This data collection method has proven very effective in other evaluations. Parents will complete a brief feedback form after attending the science fair or other project-related activities.

All the information gathered as a part of the formative evaluation will be documented in an annual evaluation report. The formative evaluation will provide feedback to the administrators and teachers as lessons learned in order to guide program changes. It also provides a historical account of the planning and implementation stages and can be shared with other institutions choosing to adopt a similar approach.

The summative evaluation assesses the extent to which a completed project met its stated goals. The summative evaluation will include some aspects of the formative evaluation. However, the information on student attitudes toward technology are subjective and may not necessarily transfer into the student pursuing further IT courses or IT careers. In addition to the feedback from the surveys, focus groups, and project assessment data, the summative evaluation will track by year the number of students, especially women and underrepresented minorities, electing to take IT courses at Liberty and Dieruff High Schools. Descriptive data on the students currently participating in the technology classes at these schools will be collected for the 2005-06 academic year and each subsequent year. If the program is having an effect, one would expect to see an increase in the numbers of the targeted students enrolling in IT-related courses. Descriptive statistics on retention, high school graduation, and college attendance and graduation will be reported for Launch-IT participants as they currently are for the S.T.A.R. Academies.

## **Dissemination**

Launch-IT curricula will be thoroughly field-tested and broadly distributed. The project will use several channels to disseminate its curricular materials, software and programs. Thanks to the successes of the LVPTF and S.T.A.R. programs, the PIs enjoy strong support from the local school districts, with considerable input in the development of IT curricula district-wide (see supporting letters). Harrison-Morton, selected for the LVPTF program because it was perceived to be the weakest middle school in Allentown, has become a NASA Explorer School (NES), attracting considerable attention in the media, with newspaper and television coverage about the creation of the Martian Landscape and Mission Control Center in the basement and the visit of an astronaut to inaugurate the NASA program. NASA now plans to host a state-wide conference for Explorer and non-Explorer schools interested in NASA programs at Lehigh University. Broughal Middle School, selected for the LVPTF program because of its proximity to Lehigh and active participation in S.T.A.R., is now slated to become a science and technology magnet school for BASD, as well as a NASA Explorer School. Both middle schools received LVPTF donations of ER1 mobile robots and Macromedia suite site licenses, which they have incorporated into their IT curricula, with input from LVPTF outreach teams. The LVPTF project strategically chose to focus its initial IT efforts at the middle school level, because school administrators told us that if we want to attract female students, that's where we have to widen the pipeline first. Launch-IT will build on our successes at this level and make our results more widely available in the region and beyond.

Already nearby school districts in the Lehigh Valley have expressed enthusiasm about these programs, and plan to involve their students in it. Likewise, interest from the New Jersey area has grown – the new Liberty Science Center in Jersey City has expressed a desire to set up a site at which students can use the Martian Landscape remotely. This comes at an opportune moment, for the NES program dovetails nicely with the Launch-IT proposal and provides yet another channel for dissemination of curricular materials based on the Martian Landscape and Mission Control Center. In addition to these channels, plans are being discussed to expand the S.T.A.R. and Launch-IT Academies to other geographic regions, for example Connecticut.

At the high school level, Dieruff is one of 150 Academies of Information Technology (AOIT) nationwide at which "academic learning experiences are combined with hands-on work experience to help students develop the thinking

and problem-solving skills so critical to post-secondary education and career success. The AOITs operate as a small learning community, providing a program of study that introduces students to the broad career opportunities in today's digital workforce and equips them with the personal, analytical, technical and communication skills they need to thrive. By introducing high school students to the broad career opportunities of the IT industry, AOIT opens the door to new options, with which students are better able to make sound choices for the future" ([www.naf.org](http://www.naf.org)). PI Blank's curricular materials were presented at a recent AOIT meeting, and new curricular materials developed and deployed in the Launch-IT program will likewise be disseminated through the nationwide network of AOITs sponsored by the NAF. Launch-IT will continue to expand dissemination of curricula materials through NAF.

The PI is organizing the first Lehigh Valley Computer Science Teachers meeting, to be hosted at Lehigh University, on April 24, 2006, with six presentations from regional IT teachers at the middle school, high school and college levels. This idea of this meeting was inspired by participation in a Philadelphia chapter of the newly formed Association for Computing Machinery Computer Science Teachers Association (ACMCSTA). CSTA maintains a web site at [csta.acm.org](http://csta.acm.org) that serves, among other purposes, as a channel to disseminate curricular materials and programs worldwide. Co-PI Pottenger has already been in touch with CSTA Director Chris Stephenson about posting curricular materials developed in the LVPTF project to the CSTA website. This ACM channel will be leveraged for dissemination of curricular materials and programs developed in the proposed Launch-IT project.

The Launch-IT project will build a web site, leveraging on the design and content of the LVPTF STEM site ([www.lehigh.edu/stem](http://www.lehigh.edu/stem)). It will be a repository of Launch-IT curricula and lessons plans as well as media stories. The PIs and graduate teaching fellows will also continue to publish results of the project in suitable academic conferences and journals, with links to these papers available on the web site.

As part of the LVPTF, PI Blank has developed curricular materials for a "Design-First" Java programming class that has been very successful at Dieruff High School. He will be taking a year long sabbatical starting in the summer of 2006, in part to evaluate the design first curricula and intelligent tutoring system that he and his students have been developing at other high schools and colleges, regionally and nationally, and also to co-author a new textbook for first year college and high school students, tentatively entitled *Design First with Java*. These goals dovetail with the goal of disseminating our GK-12 and Launch-IT curricula more widely. The PI expects to be available to supervise the Launch-IT project and an outreach team during his sabbatical, should this grant be awarded. In subsequent years, the PIs, graduate fellows and IT teachers will offer workshops demonstrating Launch-IT curricula workshops at national conferences such as SIGCSE or NAF.

## **TimeLine**

The proposed Launch-IT date (pardon the pun) is August 1, 2006. The PIs will immediately plan and convene an initial three day workshop in August for core outreach team members—the PIs, teachers, graduate fellows, and corporate volunteers, most of whom we can identify relatively quickly because of their activities related to the LVPTF project and developing this proposal. At this workshop, the PIs will review the project goals and design outlined in this proposal and the Program Director will review the structure of the S.T.A.R. program and how Launch-IT will build on this infrastructure. The outreach teams will discuss plans recruit Launch-IT students, parents and undergraduate mentors. Faculty and graduate fellows will introduce any technical content with which other team members may not be familiar. The outreach team will then begin developing the curricula and plans for the first year of Saturday sessions for each program at the workshop, completing them by the end of September 2006.

In September 2006, the Program Director, Administrative Assistant and outreach teams will recruit Launch-IT students, parents and undergraduate mentors. Towards the end of September, at a short workshop, undergraduate mentors (all volunteers at first) will be introduced to the project, connected with outreach teams, and begin to learn a particular curricula and associated technical content.

In October 2006, the three Launch-IT programs will begin, either at Lehigh or a partner public school. For evaluation, the graduate fellow will collect descriptive data and administer an attitude pretest. The Evaluator will lead a focus group with G7-8 students in January 2007 (after the first semester), then with G-9-10 students in May 2007 (near the end of the school year) and with G11-12 students in August 2007 (immediately after the summer program).

In January 2007, after the first focus group, a second workshop will convene all the outreach team members (including the most promising undergraduates and corporate volunteers) to evaluate progress, discuss improvements, plan the rest of the Saturday programs for the year, and plan the curricula for the Summer program. Further development of the Summer program will continue during the spring of 2006.

In April 2007, the evaluator will conduct a survey of teachers, fellows, mentors, corporate partners, and parents, and S.T.A.R.T. student attitude posttest, and an exit survey of graduating seniors. In May 2007, the evaluator will collect and summarize reports by teachers and mentors and score final projects with a rubric agreed upon with the teachers and graduate fellows for each outreach team.

The first summer sessions will convene for three weeks in July 2007. Summer sessions will follow curricula designed to enhance IT, math and communicative skills (especially for G7-8 using the "24" game and First in Math, a game that teaches relationships between numbers), culminating in a project, e.g., for science fair, corporate sponsor, or tools for a younger group of students. Before they get under way, the evaluator will conduct attitude pretests and collect descriptive data and after they are complete, conduct attitude posttests and score the final project with a rubric.

The evaluator will publish the first annual formative evaluation report on the project web site by October 2007. The second and third year time lines will be similar to the first year, except that they will review and improve curricula developed in the first year and also focus more on research and dissemination goals in the region and beyond. A summative report will be published in October 2009.

### **Sustainability**

The products that will be developed in the Launch-IT project will be critical to sustainability through integration for broad based impact for many years after the life of this grant. Lehigh University's Office of Academic Outreach, which coordinates S.T.A.R., LVPTF and other outreach programs, commits to sustaining a successful Launch-IT program beyond the lifetime of the proposed project, by building on the existing infrastructure for the S.T.A.R. Academies.

An enhanced technology component will be integrated in the S.T.A.R Academies three weeks summer and academic year Saturday programs for students in grades 7-12. The S.T.A.R Academies have been in existence for eighteen years. Launch-IT will thus ultimately be a strengthening of S.T.A.R., providing a distinct IT track.

Harrison-Morton Middle School (HMMS) was recently became a NASA Explorer School (NES) site. In collaboration with NASA and LVPTF STEM project, is developing programming remotely control mobile robots in a simulated Martian Landscape lab. The Launch-IT program will strengthen the academic activities in this lab. The students from HMMS transfer to two high schools in the district, one of which is Dieruff.

Bethlehem Area School District has a plan in the early development stages to turn Broughal Middle School into a Magnet School for Science and Technology in the next few years. Launch-IT curricular materials will be instrumental in helping the school launch the IT component. Students from this school transfer to two high schools in the district.

The Lehigh Valley Science and Engineering Research Fair program, which Co-PI Odi co-founded sixteen years ago, will participate as a catalyst for teachers in participating schools support students in developing technology related projects. This fair attracts over 500 students in grades 6<sup>th</sup>-12<sup>th</sup> on an annual basis. The technology projects will add value to the fair and provide much need opportunity for students to compete at the locally, regionally and nationally.

In addition to schools, not-for-profit agencies (YWCA TechGYRLS, Boys and Girls Clubs, Banana Factory, church youth group programs, etc.) will incorporate Launch-IT materials, much as they already do with the S.T.A.R. project.

Development of industry summer internship opportunities for 10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> graders in IT are being discussed with local industry executives and are promising. S.T.A.R. has been won significant fiscal support from corporate sponsors, which Lehigh's Office of Academic Outreach will seek to expand for the Launch-IT program.

An influential and newly cultivated regional partner for this project is the Lehigh Valley Workforce Investment Board, Inc. (LVWIB) and the CareerLink Lehigh Valley workforce system. The LVWIB is a recognized workforce advocate for creating a competitive human capital advantage for the Lehigh Valley region, primarily funded by the Pennsylvania Department of Labor and Industry. The LVWIB assures that the employment, training, labor market services and information that employers and job seekers receive through the workforce delivery system are professional, comprehensive and on target. LVWIB board members, which include a representative from Lehigh University, are appointed by local elected officials and are certified every two years by the Governor. In its efforts for the Lehigh Valley to remain competitive in the global economy, it seeks to connect workforce development to emerging demands of business and industry. It is doing so through industry clusters. According to the organization, "we are working to align education and training institutions with employer and employee needs. Education, workforce, and economic development must be interconnected to ensure that workers have the skills businesses need to be competitive and have the ability to obtain education to compete for higher wage career advancement." The Launch-IT program director will work with CareerLink to identify new corporate sponsors for internship opportunities and long-term support.