A Lehigh Valley Partnership to Enhance STEM Education through G4-12 Teaching Fellows
Sponsored by the National Science Foundation’s GK-12 program (Grant #0231768)

1. Participants
1.1. What People Have Worked on the Project?

Glenn D. Blank  Principal Investigator
William M. Pottinger  Principal Investigator
Henry U. Odi  CoPrincipal Investigator
Glenn D. Blank  CoPrincipal Investigator
Horace Moo-Young  CoPrincipal Investigator
Michael J. Schulte  CoPrincipal Investigator
Gary DeLeo  Senior personnel
Jean Russo  Senior personnel
Keith Schray  Senior personnel
Lynn Columba  Senior personnel
Jennifer Swann  Senior personnel
Roy C. Herrenkohl  Senior personnel
Susan Szczepanski  Senior personnel
Sally Moritz  Graduate student
Donna DeMarco  Graduate student
Kelley Caflin  Graduate student
Melodie Kent  Graduate student
Patrick Gorman  Graduate student
Steven Sweeney  Graduate student
Michael Gyamfi  Graduate student
Christopher Janneck  Graduate student
Ryan Siu  Undergraduate student
Lisa Dychus  Undergraduate student
Lola Ademosu  Undergraduate student
Adrian Ramsay  Undergraduate student
Adam Lupinacci  Undergraduate student
Alysa Zellner  Undergraduate student
Mirna Galdamez  Undergraduate student
Ellen Lempereur  Undergraduate student
Mark Dilsizian  Undergraduate student
Adrienne Blount  Undergraduate student
Rebecca Resneck  Undergraduate student
Nicholas Moukhine  Undergraduate student
1.2. What other organizations have been involved as partners?

**Agere Systems, Inc.** collaborated with the CS at Dieruff High School., providing $25,000 to provide equipment and renovate computer labs as well as speakers with technical background to describe state of the networking technology.

**Air Products & Chemicals Inc.** Dr. Frank Petroceli has been involved with the HMMS math/science teams along with five other Air Products employees. Together with the teachers at HMMS and the Math Team Leader, they worked on a plan for Air Products to lead several activities for the 6th grade. These include: Using solar cells to generate electricity, powering an electric motor, and calculating the power produced; Using LEGO's to build an object, and then writing instructions on how it was built; Building a container which could hold the maximum volume given the set of building materials, and then exploring the relationship between container shape and volume held.

**Binney & Smith, Inc.** donated a Martian Display worth over one million dollars for the Martian Landscape and Mission Control at Harrison-Morton High School. Personnel from Binney & Smith were active members of the Chemistry team a Freedom High School, making presentations on the chemistry involved in their product development and arranging for field trips to their plant. Marketing specialists from Binney & Smith assisted the evaluator in conducting focus groups with teaching fellows and STEM teachers as a part of project evaluation activities.

**Insaco, Inc.** funded the Lehigh Valley Science and Engineering Research Fair for students in grades 6-12 at the level of $25,000, providing 3/4 of the total cost of the fair. Mr. Robert Haines, President of Insaco helped recruit over 100 scientists and engineers to serve as judges for the fair. Dr. Petroceli, from Air Products will serve as a judge for the students' science and engineering research projects, as well as scientists and engineers from Binney & Smith and Pennsylvania Power and Light Corporation (PPL). Dr. Henry Odi invited all the STEM teachers to encourage their students to participate. Participation in the
regional fair in turn inspired the successful HMMS science fair.

**PITA** (Pennsylvania Infrastructure and Technology Alliance) provided over $300,000 of leveraged funding to support the project.

**PPL** (Pennsylvania Power & Light) collaborated with two STEM teams, Environmental Science at HMMS and CS at Dieruff, sponsoring field trips, practice with resume writing, and employee shadowing. Nine PPL employees participated in these outreach activities.

**Suntex International** contributed site licenses of the web-based “24” game program at half price to Broughal Middle School, Fountain Hill Elementary School in Bethlehem. The Math standard and performance of students in these STEM partner schools were raised. As a result of the success in these two schools, Bethlehem Area School District negotiated a contract for Suntex to put the program in all of the Elementary and Middle Schools in the District. Suntex in partnership with the project then placed the program at Harrison-Morton Middle School. Suntex President Bob Sun visited the team during a summer workshop and proposed a collaboration to improve the program by detecting when students get “stuck” and providing hints about how to use the site more effectively or providing remedial help. Profs. Blank and Clumba have developed this idea into a project which PITA is currently funding, to develop an intelligent tutoring system providing multimedia assistance.

### 1.3. Have you had other collaborators or contacts?

**NASA:** Harrison-Morton Middle School and Broughal Middle School become NASA Explorer Schools as a result of the Martian Landscape robotics initiative and relationships developed through this project.

## 2. Activities and Findings

### 2.1. Research and Education Activities


### 2.2. Findings from Activities


### 2.3. Training and Development


### 2.4. Outreach Activities

Graduate teaching fellows were part of outreach teams. Each team consisted of a faculty team leader, a graduate teaching fellow, one or two undergraduate teaching fellows, and two STEM teachers. This section summarizes activities of each of the eight teams, per year.

**Chemistry Team at Freedom High School, Bethlehem, PA:**

- Dr. Keith Schray – Professor, Faculty Team Leader
- Kelly Caflin – Graduate Teaching Fellow (Years 1-3)
- Tracy Vrablik – Undergraduate Teaching Fellow (Years 1-2)
- Adrienne Blount – Undergraduate Teaching Fellow (Year 2)
- Kristin Baltrusaitis – Undergraduate Teaching Fellow (Year 2)
In the first year of the project, it was determined that the graduate fellow, Kelley Caflin, would go to Mr. Teeno’s honors chemistry class and Ms. Frederick’s ninth grade chemistry and physics class. The undergraduate fellow, Tracy Vrablik, focused on the chemistry and physics class. Then it was determined that we should focus on the chemistry and physics class rather than the honors courses, because of the aim of this study, to get women and minorities interested in scientific careers. In the honors classes there is a very low percentage of minorities, whereas there is a large percentage in the chemistry and physics class. Moreover, the chemistry and physics students are also younger and more impressionable. We developed two lessons for this class. One was on modeling, looking into scientific discovery of properties of a system to the discovery of an atom. Principles in physics such as force, speed, and momentum were learned hands-on by making cars out of film canisters. Students also learned how to troubleshoot, getting their cars to travel in a straight line in order to test on speed, velocity, etc. The second lesson focused on Newton’s three laws of motion. Students had to demonstrate the three laws and make calculations, using hot wheel cars and straws to make a car powered by a balloon.

In the second year, the Chemistry team developed learning activities targeting content areas based on new science standards, including simple machines, gas laws and bonding. Altogether, the Chemistry team developed 22 learning activities for the introductory physical sciences (chemistry and physics) course at Freedom High School. These included four developed by volunteers from one of our industrial partners, Binney & Smith (Crayola), demonstrating fundamental chemical properties applied to things the students have experienced their whole lives but not appreciated from a science standpoint. These activities cover virtually all of the topics covered in the course with a good integration into that course content. These have been adapted to the different ability and interest levels found in the high school student population. Our project provided much of the materials for experimental activities, including liquid nitrogen, a Van de Graaf, a bowling ball pendulum, and countless other supplies. Fellows helped students working with “dangerous” materials, such as liquid nitrogen.

Fifty-one students from the lowest ability level classes traveled with the Freedom Chemistry Team traveled to Corning, NY, to visit the Corning Glass Museum. Tours emphasized the science aspect of glass making and composition. The goal was to show the students that the chemistry that they are learning, even the seemingly most basic principles, are important to their everyday world.

Another initiative built on Ms. Frederick’s outreach activities to middle schools. Honors level (and later academic level) high school students developed presentations for middle and elementary school students as enrichment activities related to topics in their curricula. These outreach programs were a valuable teaching/learning experience for both groups of students.

Computer Science and Engineering Team at Harrison-Morton Middle School (HMMS), Allentown, PA
Dr. William M. Pottenger, Assistant Professor, Faculty Team Leader
Jesse Wolfgang, Graduate Teaching Fellow (Years 1 and 2)
Chris Janneck, Graduate Teaching Fellow (Year 3)
In this first year, The HMMS CS team developed Flash-enhanced web pages to assist Mr. Stahl with teaching Microsoft Word to his sixth grade classes, improving substantially on previously existing material. The new pages hold the attention of students longer and thus assist them in better learning the material. The project purchased a site license for Macromedia Studio MX for HMMS. Teaching fellows led a workshop introducing teachers to the basics of Flash, including how to use shape tweens and create buttons to be used in simple animations. During two advanced sessions teachers the graduate fellow taught HMMS teachers how to use Flash to create quizzes. For Mr. Scappaticci’s class, the team developed a new bridge building lesson utilizing the West Point Bridge Design software package. Students first experimented with different bridge designs in a simulated computer environment. After creating an acceptable design, students built their design out of K-NEX, then balsa wood. The students thus learned about the advantages of using computer simulations for developing and testing designs, before creating an actual bridge. This lesson was developed in collaboration with Wayne Ogorzalek, an engineer at Air Products. To expand upon the bridge building lesson, two field trips investigated the design of actual bridges. In each trip, approximately 150 HMMS students visited a bridge along route 33 as well as The Engineering Research Center for Advanced Technology for Large Structural Systems (ATLSS) at Lehigh University. The ATLSS center is responsible for monitoring this bridge for structural ware and tear. With this trip the students got a chance to see how the material they learned in class is applied locally in the “real world.” A second field trip to the bridge also featured a stop at Lehigh’s Virtual Reality Lab. In the lab, the students helped construct a rollercoaster in a virtual environment.

After Dr. Pottenger brought a couple of ER1 mobile robots from Lehigh (used in a first year engineering course he had taught), the teachers saw the tremendous potential for robotics generating excitement technology, mathematics and science in an integrated curriculum. With help from the project, HMMS bought eight ER1s and started developing a curriculum. The team then developed then created include a two week summer camp on mobile robotics using ER1s. At this camp, students had the opportunity to work with the robots and to complete various science-related tasks. For example, they worked in teams to remotely control the robots to grasp, transport and weigh rock samples of various densities. Encouraged by the success of the robotics program at Harrison-Morton, Allentown School District Assistant Superintendent Dr. John McAdams decided to proceed with a district wide middle-school technology curriculum development initiative based on the HMMS mobile robotics curriculum. Originally, this curriculum included activities such as measuring the lengths of the school’s various hallways and programming the robots to traverse the halls. Then it developed into an initiative to establish a Martian Landscape and Mission Control Center in what used to be a storeroom in the basement of HMMS. Students will operate the robots remotely from the Mission Control Center (or remotely via the web) in order to learn the math/science concepts. A website depicting these exciting developments can be found at www.allentownsd.org/HM/TechnologyLiteracy/MartianLandscape/index.htm.
In the first year, the CS team at Broughal developed a lesson on misconceptions about computer science using multimedia from the CIMEL project, for six sixth grade technology classes. Through the three-day lesson, we asked students about their current impressions of computer science and people who worked in the field, and talked to them about what computer science is really like. The students took pre and post tests to measure their attitudes before and after the classes. The results were mixed, in part because of the vocabulary of the multimedia too sophisticated (i.e., words like “misconceptions” went over their heads), especially since many of the students were Spanish-speaking.

The project purchased a site license for the Macromedia suite of web development tools (Flash, Dreamweaver, Fireworks, etc.). Students in Ms. Kearns’ class began using Flash to create their own multimedia presentations. We made our own Flash tutorial available, along with teaching fellow assistance. The teaching fellows developed new multimedia and mini-lessons on the Internet and working with graphics files.

In the second year, the Broughal CS team developed a curriculum for the sixth grade technology curriculum with web-based materials and Flash multimedia. Students learned spreadsheet basics through analyzing an airplane trip. Part of this project involves using various web sites to gather airplane performance data (speed, fuel consumption) and geographical information (distance and heading between two points), then the use a spreadsheet to calculate time and cost to compare the three planes. In year 3, this curriculum was enhanced with materials from NASA (http://futureflight.arc.nasa.gov). For the seventh grade technology curriculum on animated web page development, students created their own animated pages on the topic of cell mitosis. One seventh grader describes her experience: “I created this web page in my 7th grade technology class which is instructed by my teacher as well as student teachers from Lehigh University right across the street. I used a program called Dreamweaver to create this page. Dreamweaver allows students to create web pages using HTML code and signs.”

By the end of the program, the CS team at Broughal had created 5 completely new curricula in the Technology and Industrial Arts classes. Each course teaches one or more technology tools in the context of a science, technology or engineering topic:

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<thead>
<tr>
<th>School Year</th>
<th>Class</th>
<th>Curriculum</th>
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<tbody>
<tr>
<td>2003 – 2004</td>
<td>6th grade Technology</td>
<td>Research and Preparing Reports, Avionics</td>
</tr>
<tr>
<td>2004 – 2005</td>
<td>7th grade Technology, 6th grade Industrial Arts</td>
<td>Research and Web Site Design, Mitosis, Robotics Design and Programming</td>
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<td></td>
<td>7th grade Industrial Arts</td>
<td>Bridge Design with West Point Bridge Designer</td>
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<tr>
<td>2005 – 2006</td>
<td>8th grade Technology</td>
<td>Research and Multimedia Presentations, Technology</td>
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Initially, the curricula were developed as a joint effort between the teaching fellows and teachers. The teaching fellows taught a number of the lessons the first time the course was taught. Now that the curricula are in place, the teachers have taken ownership and are taking the initiative to enhance the courses. We have attained sustainability in these courses and the teachers will continue to improve the courses with each year. In a new building (under construction in 2007), Broughal will become a Science
and Technology magnet school for Bethlehem Area School District; the curricula we have developed play a key role in the plans for this school. Below is a description of each curriculum.

6th grade Technology: Research and Preparing Reports, Avionics
This curriculum introduces students to the field of avionics. Using word processing and spreadsheet applications, students research a specific area of avionics. The first year, we developed a web quest for the students. The teachers determined the web quest was too “boring” for the students and discovered the NASA website. They incorporated various activities from the NASA site to make the online experience more engaging for the students. Undergraduate fellow Nick Moukhine (a graduate fellow in our continuing GK12 project) added an activity that has students demonstrate pitch, roll and yaw.

7th grade Technology: Research and Web Site Design, Mitosis
Taking into consideration that the existing seventh grade science curriculum is a study of the life sciences it was decided that the topic of cell mitosis would enhance both the existing science curriculum and through technology enable the students to create web pages and animations. To this end, a curriculum to teach the students to create web pages and animations in Macromedia Dreamweaver and Flash was designed. Students became adept at using virtual share to both send and receive all work, enabling the students to eliminate any paper trails and become very technologically advanced. The curriculum also incorporates the Appleworks, Inspiration, Keynote, and iPhoto software, but increasingly emphasizes the use of complex animations and interactive programming with ActionScript.

6th grade Industrial Arts: Bridge Design with West Point Bridge Designer
The 6th grade is learning the engineering design process and using the West Point Bridge Design software to design and test bridges (an idea borrowed from the HMMS CS team). The students test their bridge design via simulation (a truck driving across their bridge), then improve their design based on the tension and compression forces exerted on each section of the bridge. The students are actively engaged and enjoy the class. However, Mr. Neveling noticed that students were having trouble visualizing the concepts of tension and compression. So we modified the curriculum using K’Nex bridge building kits, adding lessons on tension and compression using manipulatives (marshmallows) and K’Nex. Students now build a bridge with K’Nex and then test its strength using West Point Bridge Design.

7th grade Industrial Arts: Robotics
The 7th grade is learning the software design process and how to program ER1 robots, purchased in a partnership between this project and the school. These robots have sophisticated vision, speech and hearing capabilities and a simple “if-then” structured programming interface. The students learn to design a solution before programming, a very important concept in software engineering, by developing flowcharts to program the robots’ behaviors. The students were excited about using the robots, but found the flowchart process tedious. So we modified the lesson so that students list all steps and decisions on paper in a first draft, then draw the corresponding flowchart as a second draft. Breaking down the process improved student interest and learning. Another change is that each student is responsible for part of the flowchart (the design to get to one city in a four-city road rally.) The students then physically walk through each other’s flowcharts to make sure they are complete and accurate. These team building activities further enhanced the effectiveness of the curriculum.

8th grade Technology: Research and Preparing Multimedia Presentations, Technology
In this curriculum, students must answer an essential question: “Does life influence technology, or technology influence life?” They research a topic of interest (cell phones, music, automobiles, etc.) and then put together a multimedia presentation that supports their answer. The students use a number of different applications including Inspiration, Keynote, Dreamweaver, Flash, garageBand and iMovie. The intermediate result is a website and the final product is an iMovie demonstrating their expertise in their technology topic. Ms. Carr organized an excellent scaffolding website for the students.
In response to a recommendation from our NSF site visit urging us to put a CS team at a high school as well as to the developing research agenda of graduate teaching fellow Sally Moritz, Dr. Blank secured supplemental funding making it possible to establish a new team at Dieruff High School. The main focus of this team was the development of a novel “design-first” curriculum to introduce Java programming. The design-first curriculum was developed and improved successfully over four semesters at Dieruff High School. Graduate fellow Sally Moritz also developed tools for the curriculum which form the basis of her Ph.D. research. She constructed an integrated development environment (IDE) using freely available software—the Eclipse IDE combined with DrJava, an interactive Java processor for students, and LehighUML, in which students create UML class diagrams. LehighUML also generates code stubs from class diagrams, thus supporting students as they moved through the development process from design to coding. Results using the curriculum and tools have been disseminated through several publications and conference presentations, and shared via the web with other high school and college teachers (see www.lehigh.edu/stem/teams/dieruff/). A high school teacher in the Seattle area plans to use our curriculum and Java development environment. Ms. Moritz also shared her expertise in a Database class, teaching entity-relationship modeling and SQL. She also helped in a computer literacy class required for all ninth-grade students, using portions of CIMEL multimedia introducing the breadth of computer science and creating video clips of CS/IT professionals at Lucent Technologies describing what they do.

The Dieruff team also collaborated with PPL employees. In a field trip to PPL headquarters in Allentown, students saw a demonstration of PPL’s Geographic Information System (GIS), which maps the location of all electric distribution lines and equipment, and all customers connected to the grid. PPL’s GIS expert explained how much of the supporting data was stored in a back-end database (Ms. Moritz later reminded the Database class students about this point when she emphasized the pervasiveness of databases systems) and also showed how his team worked in NYC after 9/11, mapping the entire area affected by the attack, including infrastructure (subway, water and sewer, electrical lines, etc.) that was damaged and repaired, traffic into and around the area, and other critical data. PPL also hosted students who shadowed an employee for a day. Students spent the day with PC support technicians, software developers and business analysts and got hands-on experience. As one student said, “This was an awesome experience because I actually got a chance to do the type of work that I want to do. I’ve always been interested in computers, but now I’ve got a better idea of the different areas I can pursue in this field.”
Finally, PPL conducted résumé writing and interviewing workshops. Students submitted résumés to apply for one of three actual jobs; PPL volunteers chose the six best, and then interviewed those students in front of the class. This experience helped the students think about what they can do now to better prepare for finding the job or career they want, whether they will start working after high school or after college; it also gave them a head start on applying for summer or after-school jobs.

Earth Science Team at Harrison-Morton Middle School, Bethlehem, PA
Dr. Horace Moo-Young, Associate Professor, Faculty Team Leader (Year 1)
Dr. Jennifer Swan, Professor, Faculty Team Leader (Years 2 and 3)
Ted Dufrense, Graduate Teaching Fellow (Year 1)
Rene Waterman, Graduate Teaching Fellow (Year 2)
Michael Gyamfi, Graduate Teaching Fellow (Year 3)
Melodie Kent, Undergraduate Fellow (Years 1 and 2), Graduate Teaching Fellow (Year 3)
Lola Ademosu, Undergraduate Teaching Fellow (Year 3)
Rebecca Resnick, Undergraduate Teaching Fellow (Year 3)
Samuel Vaughan, STEM Teacher (Year 1)
Joan Preston, STEM Teacher (Years 1-2)
Jessica Donahue, STEM Teacher (Years 2-3)
David Moyer, STEM Teacher (Year 3)

In the first year, the graduate fellow showed HMMS students how dark colored surfaces absorb energy and light colored surfaces reflect energy. The demonstration consisted of getting two pieces of aluminum cut in 4 in squares, fairly thin with painting one the sides of one square black. A 250watt light bulb was then shone on the aluminum squares, which were suspended in the air. The students then one at a time felt the temperature difference between the aluminum square that had one side not painted black versus the aluminum square with the one side painted black. Students were so excited and intrigued by the demonstration that many wanted to take part in the demonstration over and over again. The graduate fellow also presented a lesson on weather, discussing the layers of the atmosphere and different types of clouds. A Weather Jeopardy game used materials from the lesson. The undergraduate fellow developed a Marshmallow Solar Cooker Presentation. While presenting the solar cooker in class, students were asked several concept questions to reiterate the purpose of the presentation. Students were very interested because not only were they able to identify the components of the solar cooker, but they thought it was cool that we were roasting marshmallows. After the presentation, the students created their own solar cooker on a smaller scale. Students enjoyed this hands-on experience and were able to identify the importance of each component of the solar cooker.

In the second year, the graduate fellow developed lessons on air pressure, air resistance, Bernoulli’s Principle, and the properties of flight. The students performed several in-class demonstrations. Together with Dr.
Frank Petrocelli from Air Products, the team presented activities using a solar cell to generate electricity and power an electrical motor. Students determined the maximum weight that the motor can lift, and calculate the power produced.

Undergraduate and later graduate teaching fellow Melodie Kent, an African-American student, spearheaded a science banquet to recognize exceptional student work in the 7th grade science class. With over 170 attendees, the entire night was dedicated to exposing parents and students to “fun science,” including everything from metal fluorescent burning presentations to liquid nitrogen ice cream demonstrations. The banquet was initiated to increase parental involvement and raising student’s awareness of science education, and because of its success, it became implemented by three other schools in the Allentown/Bethlehem area. The HMMS science banquet reprised with similar resounding success in year 3.

In year 3, a goal was to improve students’ reading and writing better, because the team realized that their poor performance in math in science was largely due to their inability to totally comprehend the assignments set before them. As part of all of our labs, the students received a lab notebook where they record all of the labs that we give them to perform and then they have to explain their observations. The students performed and recorded results from about 15 labs ranging from capturing hydrogen, capturing oxygen to measuring shadows. Along with the labs, the students have technical and leisure writing assignments to get them in the practice of writing scientific and non-scientific ways. One technical assignment was entitled “How to Sharpen a Pencil” and the students really hand a hands-on experience with the importance of being clear with directions and not assuming that all knowledge is common. A leisure writing assignment let the students write about their parents and how they use math, science, technology, and/or engineering in everyday life—and the students were surprised to see that no matter if their parent is a housewife, or an aeronautical engineer, they use one or all of those subjects in some fashion. At first, the students didn’t like to write because they were afraid of their spelling issues and some of their language barriers, but now the students enjoy writing time and they treat their lab notebooks as not only scientific papers, but personal journals where they can practice bettering their writing skills and also write about topics that interest them.

Mathematics Team at Harrison-Morton Middle School, Allentown, PA
Dr. Bennett Eisenberg, Professor, Faculty Team Leader (Years 1 and 2)
   Dr. Susan Szczepanski, Faculty Team Leader (Year 3)
Patrick Gorman, Graduate Teaching Fellow (Years 1 and 3)
   Jeanine Hoff, Undergraduate Teaching Fellow (Year 1)
Ellen Lempereur, Undergraduate Teaching Fellow (Year 3)
   Karen Baurkot, STEM Teacher (Years 1-2)
   Donald Battle, STEM Teacher (Years 1-3)
   Joan Service, STEM Teacher (Year 3)
   Joan Preston, STEM Teacher (Year 3)

Early on, the math team decided that we would have the most impact in the schools where students were doing poorly in the standardized mathematics tests. We also decided to integrate math and science, jointly with the Earth and Environment team. The first topic for the year was statistics. To enliven the material we took surveys from the class and do our analyses on them. The statistical surveys went well. A test on the statistics section of the book was given to the students and student did much better than students in past years. The next topic was whole number operations including integer exponents. The graduate fellow showed a movie about powers of ten and the size of the universe. The fellows created a game of mathematical jeopardy in which categories of questions corresponded to topics the students have studied so far this semester such as fractions, estimation, and decimals. The card-based “24 game” helped students learn about order of arithmetic operations. This game had
an unexpected benefit in that many of the students needed a review of basic arithmetic. Seeing the potential, HMMS worked with our project and Suntex International to enroll in the online version of this game for the third year of the project, further improving basic math skills through the incentives of the game.

In subsequent years, the math team developed a number of activities for 6th grade students using graphic calculators, demonstrating topics recently learned in class or to introduce new topics. The HMMS Math and Science teams collaborated to create an after-school program that meets once a week. It is a peer tutoring system, where sixth graders are assisted by eighth graders in a variety of subjects, and also features engaging science and math activities, including a four week bridge design project in which students had to work in teams to design and build a bridge out of straws and masking tape to hold as many pennies as possible.

In the second year, the Math team developed learning activities for sixth and seventh graders working with balance scales and the use of decimals and the metric system, baking cookies and the use of fractions, the game of Battleship and the coordinate system, dice and the number line, model cars and the rate of change, and shadows and proportions. The fellows also helped at the robotics camp for HMMS students developing mathematical activities related to moving robots along the floor as well as taking a trip to Mars, determining how long the trip would take, how many meals to take, and how to take a certain number of pounds of miscellaneous items.

In the third year, activities and projects were integrated into the 6th grade math curriculum with much more efficiency than in previous years. The main topics covered by our activities are data analysis and interpretation, number sense, order of operations, fractions, decimals, geometry, early algebra and graphing techniques, and probability and statistics, etc. Most activities we use are one- or two-day activities used to enhance topics already covered in the classroom. This is partly because of a tight calendar that the Allentown School District follows for their math program. The team expanded its outreach to gifted math students, challenging them with long-term projects and challenging problems to help them think outside the box.

Physics Team at Fountain Hill and Spring Garden Elementary Schools, Bethlehem, PA
Dr. Gary DeLeo Professor, Faculty Team Leader (Years 1-3)
Steven Sweeney, Graduate Teaching Fellow (Years 1-3)
Sandra Kopp, Undergraduate Teaching Fellow (Year 1)
Nink Fink, Undergraduate Teaching Fellow (Years 2-3)
Jeanne Deets, STEM Teacher, Spring Garden Elementary School (Years 1-3)
Robert Choma STEM Teacher, Fountain Hill Elementary School (Years 1-3)

The Physics team chose the subject of aviation, creating a complete core unit based on the subject of aviation. Dr. DeLeo presented a program on space flight, using this as an introduction to both astronomy and the aviation unit. The fellows performed demonstrations setting up hands-on activities, modeling the way sunlight strikes the earth, the separation of light into colors, and the use of air pressure to implode a metal can. The graduate fellow introduced materials from the Lehigh University Outreach Center such as slinkies and oscilloscopes.

In the second year, the team deployed a full version of the aviation curriculum (now available at www.lehigh.edu/teams/fountain/). A favorite aviation lesson at both schools focused on the construction of paper airplanes. The lesson actually focused on axes of control, wing shapes, control surfaces, and specialized types of aircraft. By giving the students different paper airplane designs, we were able to get these ideas across, and also keep the students excited. For aviation, the essential concepts are the four forces that act on an airplane: gravity, lift, thrust, and drag. In order to help the students grasp the lift concept, we build model wings using just a piece of paper, a straw, fishing line, and a fan. By
physically building a wing and observing it rise as air passes across it, the students have a better shot at understanding how the design of the wing is crucial for flight. To demonstrate thrust, we build simple air engines using balloons, straws, and fishing wire. The students experiment with different sizes and shapes of balloons, different amounts of air in the balloons, and alter other variables to observe which provides the most thrust. The Fountain Hill students were taken to a nearby park for “Flight Day” to try out their various models of planes and gliders.

The Fellows often brought equipment and educational materials from the Science Outreach Center which Team Leader Dr. DeLeo has developed over many years to support outreach activities to many schools in the Bethlehem area. During the spring of 2004 alone, he gave 16 presentations at these two schools to a total of over 600 distinct children (plus, some experienced multiple programs). These programs include “Light, Sound, Color, and the Nature of Matter” and “Astronomy and Space Travel.” Prof. DeLeo also gave presentations describing the operation of a remote weather station which he and the School Principal (Mr. Joseph Rahs) installed on the roof of Fountain Hill Elementary School. Each third grade class has a remote receiver that records wind speed and direction, temperature, relative humidity, rainfall, etc. He also led a large-scale program called “Timeline: Planet Earth!” in which each grade level follows a theme. For example, the Kindergarten classes were provided with an 18x18x5 inch Plexiglas container and colored sand. They place a sand layer in the display container every day or so, and embedding in the layer an object that relates to the time of its placement, thus demonstrating how digging down through the layers of the Earth is like going back in time.

In the third year, the teaching fellows expanded the range of their teaching to include biological science in fifth grade classes at Fountain Hill (studying the difference between vertebrates and invertebrates) and to third grade classes at Spring Garden (studying the weather and the composition of the earth). The fellows helped the young students to explore science beyond what can be found in their textbooks and in the books they have found so far in their library.

Technology Team at Regional Academic Standards Academy, Bethlehem, PA  
Dr. William M. Pottenger, Assistant Professor, Faculty Team Leader (Year 3)  
Maryann Kearns, STEM Teacher (Year 3)  
Ryan Siu, Undergraduate Teaching Fellow (Year 3)

To begin disseminating successful results from the project, this new team spun off innovative activities at Broughal and HMMS Middle School, using ER-1 robots and Flash. Lehigh students in a first year Engineering course helped to demonstrate capabilities of the robots. The team also arrange for field trip to the Blake Shuttle launch at Harrison Morton Middle School.

3. Publications and Products

06/2003 - 05/2004


Web/Internet Site
BETHLEHEM -- Lehigh University students are helping out in local classrooms, thanks to a National Science Foundation grant.

The grant's goal is to help school children gain a better appreciation for science, technology, mathematics and engineering. "The goal is to expose the students to these fields as well as helping enhance skills for teachers in these fields," said Henry Odi, executive director of academic outreach and special projects for Lehigh.

The $1.2 million, three-year National Science Foundation grant aims to help children prepare for careers in science and math by helping them relate to key concepts.

Broughal Middle School, Freedom and Liberty high schools, Spring Garden and Fountain Hill elementary schools and Harrison-Morton Middle School comprise the area schools participating in the Lehigh Valley Partnership in STEM (science, technology, education and math) Education. "It's our goal to go back to NSF to request a second, three-year cycle," Odi said. "We want to continue to work with and track the students involved with the program for at least a six-year time frame."

The National Science Foundation grant pays for Lehigh graduate students and advanced undergraduate students to spend about 10 hours per week in the schools helping teachers introduce new teaching tools and technologies into their classrooms. Graduate student Sally Hiestand said she enjoys meeting students at Broughal and teaching them about technology. "I really enjoy getting to know them, and I'm really impressed with how eager they are to learn," Hiestand said. The grant specifically aims to help educate female and minority students in the fields of math and science. "The STEM program will give Lehigh's science and engineering students the opportunity to share their enthusiasm for their subjects with students from local elementary, middle and high schools," said Mohammed S. El-Aasser, dean of the P.C. Rossin College of Engineering and Applied Science. "In doing so, we're strengthening the relationship between Lehigh and the local community as well as society in general." The partnership has worked out well at Broughal, Principal Joe Santoro said. "The school is looking at a fundamental change in focusing on science, math and technology as a theme for our school," he said. "The NSF grant fed right into that idea." Reporter Beth Braverman can be reached at 610-258-7171 or by e-mail at bbraverman@express-times.com.

05/2004 - 05/2005

Books or Other One-time Publications

Blank, G.D. Hiestand S., and Wei, F., "Overcoming Misconceptions about Computer Science with Multimedia.", ( ). Faculty Poster, Accepted Bibliography: Proceedings of SIGCSE, Norfolk, VA, March 2004


**Web/Internet Site**

URL(s): [www.lehigh.edu/STEM](http://www.lehigh.edu/STEM); [www.cse.lehigh.edu/~cimel](http://www.cse.lehigh.edu/~cimel); [www.cse.lehigh.edu/cimelits](http://www.cse.lehigh.edu/cimelits); [www.allentownsd.org/HM/TechnologyLiteracy/MartianLandscape](http://www.allentownsd.org/HM/TechnologyLiteracy/MartianLandscape);

**Other Specific Products**

**Product Type: Teaching Aids**

**Product Description:**
"A Teacher Guide to Integrated Science, Technology, and Mathematics Instruction," Version 1 (for testing with teachers and in the classroom) is complete (not marketed at this time).
"Educational Kits" constructed and modified (e.g., electric circuit construction; electric motor construction, etc.) (not marketed at this time).

**Sharing Information:**
Copies distributed to teachers for testing. More extended distribution to be considered after testing.

**Product Description:**
A Design-First Course in Java Outline and Materials, Eclipse/Dr. Java/LehighUML IDE
A curriculum outline for teaching object-oriented concepts, UML and Java to high school students, with worksheets, the Eclipse/UML/DrJava IDE, and other supporting materials, is available at [www.lehigh.edu/stem/teams/dieruff](http://www.lehigh.edu/stem/teams/dieruff)

**Sharing Information:**
The Design-First Course in Java is being developed at Dieruff High School, with a 57% minority and 50% low-income student population. Dieruff is one of 12 national pilot Technology Academies organized within the National Academy Foundation. They are involved in developing courses that will be taught by several hundred other Technology Academies across the country. California, for instance, will have 37 state funded AOITs (Academies of Information Technology). The goal of the program is to prepare students to pursue IT careers after high school, and teachers in the pilot schools meet three times a year to discuss what works and to exchange curriculum ideas. Dieruff is a strong partner with us on our project, and through Dieruff we gain the potential to impact not only one but also many hundreds of AOITs and thousands of G4-12 students nationwide with our design-first with Java course.

**05/2005 - 05/2006**

**Books or Other One-time Publications**
Ron Devlin, Freelance Writer, "School hopes to make learning out of this world Allentown educators work with NASA and Lehigh on programs", (2006). The Morning Call (newspaper).


Moritz, S., Wei, F., Parvez, S., and Blank, G.D., "From Objects-First to Design-First with Multimedia and Intelligent Tutoring", (2005). Proceedings of Innovation and Technology in Computer Science Education (ITiCSE), Lisbon, Portugal, June.


Rhodes, K and Swann J. Postnatal steroid treatment alters hormonal regulation of social preference. Hormones and Behavior 48 (1) 222.


Web/Internet Site

URL(s):
http://www.lehigh.edu/teams/hmms-tech/ and
http://www.allentownsd.org/HM/TechnologyLiteracy/Mars/MarsMissions/Documents/TechED1PlannedInstruction.doc

Product Description:
Mobile Robotics Technology Curriculum:
http://www.allentownsd.org/HM/TechnologyLiteracy/Mars/MarsMissions/Documents/TechED1PlannedInstruction.doc

Sharing Information:
Materials are online.

Product Type: Teaching aids

Other Specific Products

Product Description: Mobile Robotics Technology Curriculum

Sharing Information:
http://www.lehigh.edu/teams/hmms-tech/ and
http://www.allentownsd.org/HM/TechnologyLiteracy/Mars/MarsMissions/Documents/TechED1PlannedInstruction.doc

Product Description: Curricula and lesson plans for the Computer Science at Broughal Middle School (Bethlehem) team, including:
6th Grade Industrial Arts: Designing Bridges with West Point Bridge Designer and Technology: Aeronautics
7th Grade Curricula: Industrial Arts: Robotics Programming using the ER1 and Technology: Developing and Animating Websites
8th Grade Curricula: Technology: Designing and Developing Multimedia Presentations

Sharing Information: http://www.lehigh.edu/teams/broughal/

05/2006 – 05/2007


Contributions

3.1. Contributions to the principal discipline(s) of the project

05/2003 - 05/2004
The following are examples of contributions within STEM areas:

Mathematics:
We have made mathematics more interesting and more fun for 6th graders in a mid-city school by the use of teaching fellows helping the regular teachers developing new classroom ideas. We are archiving the lesson plans for future years.

Chemistry:
(a) Twelve chemistry/physics related classroom activities have been developed/used to enhance the interactivity/learning of mid-level high school ninth-graders.
(b) Materials have been gathered/organized and detailed user-friendly descriptions have been written and a database has begun to be developed.

Physics:
We significantly enhanced enthusiasm for science displayed by students and expanded hands-on science activities experienced by students. An aviation curricula unit was developed that integrates fields of science, mathematics, technology, and other, non-science disciplines. Aviation is a vehicle for learning elementary-school science, technology, and mathematics that has been adapted by another team for use in middle-school computer technology learning.

Computer Science (Technology):
The Broughal team has presented lessons on spreadsheets and database concepts which tie in to the theme of aviation. For example, students learned spreadsheet basics through analyzing an airplane trip. Part of this project involve using various web sites to gather airplane performance data (speed, fuel consumption) and geographical information (distance and heading between two points), then use a spreadsheet to calculate time and cost to compare the three planes.

The Harrison-Morton team has developed multimedia curriculum for teaching technology to middle-school students. We are currently in the midst of brainstorming a unit that employs mobile robotics to teach technology across disciplines such as math and earth science.

05/2004 - 05/2005
The following are examples of contributions within STEM areas:

Mathematics:
Developed a whole array of lesson plans designed to give students enjoyable, hands-on experiences in
applying the mathematical ideas that they have been learning.

Chemistry:
Continue to develop and refine activities and have moved Fellows into additional classrooms. Last year we were exclusively with the Honors physical sciences classes, Honors chemistry, and the materials science class. This year we have added academic chemistry, academic physical sciences, and applied physical sciences. This has added classes, range of student abilities, and increased the diversity of the students we reach.

Computer Science:
A novel “design-first” curriculum introducing object-oriented design and Java programming was developed and described in a SIGCSE inroads publication (see above). A design for an intelligent tutoring system supporting this curriculum was developed, described in an AIED publication (see above). A Martian Landscape and Control Center was developed in the basement of Harrison-Morton Middle School and a preliminary curriculum for its use was developed. Curricula for four different sections of 6th and 7th grade technology classes at Broughal Middle School were developed.

Physics:
Integrated Science/Aviation unit was developed that integrates fields of science, mathematics, technology, and other, non-science disciplines.
A program, 'Timeline: Planet Earth!' was developed, integrating science and other disciplines across all K-5 grades in a school-wide thematic program. By Spring 2005, this flexible program was used in three area schools. A program introduction for teachers is reproduced below: in this thematic learning adventure, students in grades K through 5 will explore a variety of topics relating to the changes experienced by our home planet over time. In some sense, the themes of this program cover a variety of timescales.

05/2005 - 05/2006
The following are examples of contributions within STEM areas. Please see the Activities and Findings section for additional detail:

Computer Science: One project has contributed to the design and implementation of the D-HOTM (Distributed Higher-Order Text Mining) System, which implements the DiHO ARM (Distributed Higher-Order Association Rule Mining) algorithm. This system is the first known to generate association rules from distributed datasets of heterogeneous textual data sources, which are neither horizontally nor vertically fragmented. One result of this work is another proposal to the NSF, depicting a proposed framework that will serve as the foundation for Mr. Janneck’s Ph.D. research. This “Interactive Automation” framework proposal, through the Information Integration & Informatics (III) research area of the NSF, has been funded at a level of $175,000 and will expedite the completion of Mr. Janneck’s Ph.D. research.

The development of a novel “design-first” curriculum and intelligent tutoring system has been discussed above. A new plug-in for the Eclipse integrated development environment was created that novices use to create class diagrams in the Unified Modeling Language. At each step of development, an intelligent tutoring system diagnoses the student's work and may offer hints or tutorial advice. This project is currently in the prototype state, with plans for evaluation in several high schools and colleges in 2006, as part of the PhD research of three student under the supervision of Dr. Blank. See www.lehigh.edu/stem/teams/dieruff for Eclipse with the most current version of the plug-in is available.

Physics: By Spring 2006, the flexible program for 'Timeline: Planet Earth' was used in four area schools.
Mathematics: Hands-on activities were developed by the Mathematics undergraduate teaching fellows and who have given the students in this inner city school opportunities to apply skills learned in class to new situations. Such experiences are vital for students and lead to improved scores on state achievement tests. As these activities are tried and refined, they are documented in lesson plans to facilitate future use of these activities in other classrooms in the Allentown School district and potentially elsewhere. This is the logical extension of the current effort which will impact others outside the classrooms' of the STEM teachers' classrooms and extend the outcomes beyond the time frame of the current NSF grant.

Chemistry: Learning activities have been developed along with associated materials which support them, blanketing the instructional content of the introductory chemistry/physics curriculum for freshman in high school. These have been shown to be adaptable to all three levels of student abilities.

05/2006-05/2007

Physics: Further development of program, “Timeline: Planet Earth,” that integrates science and other disciplines across all K-5 grades in a school-wide, thematic program. By Spring 2007, this flexible program was used in five area schools, including Miller Heights (2005-06) and Calypso (2006-07). A new school-wide program, “Exploring Outer Space: The Last Frontier,” was begun at Asa Packer Elementary School in Bethlehem. Many Lehigh science and engineering students have participated in these programs.

Computer Science: The “design-first” curriculum and DesignFirst-ITS was deployed and evaluated at Whitehall High School, Pennsylvania, in a special workshop for high school students in Memphis, TN (in collaboration with another GK-12 project), and in the NSF ITEST-sponsored Launch-IT project at Lehigh University. The results of these studies have contributed to the dissertation research of three PhD students, Sally Moritz, Shahida Parvez and Fang Wei. Fang Wei has completed her dissertation and the other two expect to do so in the fall of 2007.

3.2. Contributions to other disciplines of science or engineering

06/2003 - 05/2004

There are several ways in which the two CS/Technology teams have developed coordinated experiences with discipline teams. At Harrison-Morton Middle School, the CS team is working with Arts and Design teacher Chris Scappaticci to connect the use of West Point Bridge Designer simulation software with the hands-on construction of K’Nex bridge models. This aspect of the project crosses over with the Earth Science curriculum which also has a bridge modeling component. The Technology STEM teacher Maryann Kearns at Broughal Middle School is also working with Dr. Gary DeLeo to introduce real-world science applications based on computer technology into the curriculum. At Fountain Hill Elementary as well as Broughal Middle School in the Bethlehem Area School District, the Math 24 instructional software developed by our industrial partner Suntex International, has been placed in every mathematics classroom. Finally, we are currently brainstorming the use of mobile robotics in a cross-disciplinary unit that involves CS/Technology, Math and Earth Science.

05/2004 - 05/2005

The “Timeline: Planet Earth” program run at Fountain Hill Elementary School lets teachers make connections to art, music, history, technology, geography, and the study of other cultures (e.g., sundial construction using ceramics; historical and cultural issue relating to the development of timekeeping and
navigational (geographic) methods; connections with aviation technology, etc).

The Mathematics Teaching Fellows also helped with the science teaching in the schools. They are also heavily involved in the robotic program to explore the Martian Landscape.

The CS/Technology team at Harrison-Morton is developing a district-wide technology education curriculum that employs engaging technology to enable learning of math, science, engineering and technology. A premier example of this approach is the Martian Landscape under construction at Harrison-Morton.

05/2005 - 05/2006

The Distributed Higher-Order Text Mining system has potential for use in integrated information systems. Applications will be seen in law enforcement as well as medicine, as doctors may leverage this technology to quickly compile comprehensive documentation (stemming from numerous sources and formats) of their patients; and law enforcement, as officers develop modus operandi in a rapid and more automated fashion, tapping reports from numerous jurisdictions. Similar contributions may also be seen in the area of Literature-Based Discovery, which seeks to discover links between information across different published documents.

Many of the hands-on activities that were created for the classes aided by the MATH Team have related directly to the science curricula assisting students with the application of science skills to laboratory experiments and to FOSS kit activities. Some math activities were designed with a science theme enabling students to see the usefulness of the mathematical skills in other areas. For example, one activity developed for use with the unit on proportions discusses the composition of atmospheres on different planets in the solar system. Students learn not only that the atmospheres differ but consider, through visual aids, the proportions of different gases in the atmosphere of each planet. Another activity utilizes the triple beam balance scales as a tool for measurement and comparison, reinforcing skills met in the science lab.

05/2006 - 05/2007

Ms. Melodie Kent, who served as an Undergraduate then Graduate Teaching Fellow with the Earth & Environmental Science team at HMMS, completed her Master’s thesis in Mechanical Engineering in August 2007. Here is the abstract of her thesis:

Mechanical ventilation of injured lungs involves the reopening of fluid filled airways and the application of mechanical forces to the airway epithelium. These forces may cause cellular deformation, necrosis and modified protein expression. In this study we designed in vitro experiments to investigate the biological response of lung epithelial cells (ATII) to various mechanical forces. Static pressures of 0 cm/H2O, (+) 5 cm/H2O, (+) 7.5 cm/H2O, (+) 10 cm/H2O, 18 cm/H2O, and 22 cm/H2O did not cause cell death. Static pressures ranging from 0 cm/H2O to 10 cm/H2O did cause a significant upregulation of surfactant protein C (SP-C) secretion of SP-C. Normal lung function is dependent on the production of SP-C because it is used to decrease surface tensions experienced in the lung during breathing. Constant shear forces of 15 dynes/cm2 and 30 dynes/cm2 did not cause cell death but a constant shear force of 5.1 dynes/cm2 did cause an upregulation of SP-C secretion. Bubble propagations, which represents a more complex and physiologically relevant situation, resulted in a higher percentage of cell death at slower bubble speed (0.3 mm/s) than at faster bubble speed (30 mm/s). There was also an upregulation in the secretion of SP-C after bubble propagations. These results suggest that individual mechanical forces do not cause cell death, but the combination of the mechanical forces, as seen in the bubble propagation and the pressure gradient experienced in the bubble propagation at lower speeds, may result in cellular damage during the mechanical ventilation of fluid-filled lungs. Our results also suggest that there is an upregulation in the secretion of SP-C in response to pressure, constant shear and during bubble propagation which involves the combination of these two forces.
3.3. **Contributions to the development of human resources**

All eight of our outreach teams contributed to human resource development. The project has as its major focus a two-fold development of the teaching fellows in which their training in research towards the PhD will enable them to assume an important position in the scientific community and their exposure and support of K-12 STEM education will foster a future involvement as a resource for these educational levels. Inside the classroom, the teachers and Teaching Fellows are gaining practical experience in seeing the many aspects of the project being realized. All aspects of this project provide this experience from the designing of the Martian Landscape and Mission Control Center, to the integration of wireless communication, to the maintenance and implementation of networked robotics, to the upgrading of the Technology Laboratory to include updated computer technology, display walls, and a new floor plan. All teachers and Fellows are experiencing the many stages and components necessary to make each of these a reality: from the initial design, to enlisting related experts and partners, to securing funding and personnel, to construction and implementation, to discussions on maintenance and long-term sustainability. Through these experiences, we believe that all of the project personnel are gaining an invaluable respect and understanding on the processes and planning of substantial projects, and that this experience will serve them well throughout the lifespan of this and any future projects they endeavor to complete.

The Computer Science team at Broughal included a female graduate teaching fellow pursuing a Ph.D. Her research topic—an intelligent tutoring system to support an introductory “design-first” with Java curriculum—was stimulated by this project. Two other Ph.D. students (not supported by this project) are working on other aspects of this tutoring system for their dissertation research. Two African-American undergraduate teaching fellows gained experience and confidence in their presentation skills in the classroom and completed their undergraduate studies during the lifetime of this project: one in CS at Lehigh and the other planning to transfer from a local community college to Lehigh next year.

The Math team supported a Ph.D. student in Applied Mathematics and an undergraduate double-major in Mathematics and Environmental Science. Both gained valuable experience working with 6th grade students. We have also helped two middle school teachers to expand their classroom techniques.

The Earth & Environmental Science & Engineering team included two minority students (African American), one female undergraduate and one male graduate student. The female student went on to graduate studies in Mechanical Engineering, completing her M.S. in August 2007) and became the Program Director for the NSF ITEST-supported Launch-IT project in January 2007.

3.4. **Contributions to resources for research and education**

**06/2003 - 05/2004**

(a) Two in-focus computer projectors  
(b) Two site licenses for Macromedia Suite (Flash, Dreamweaver, etc.) which is being incorporated into the two participating schools' Information Technology classrooms.  
(c) Nine mobile robots for use in the new unit on technology, earth science and math  
(d) Several wireless routers and associated peripherals to improve the networking infrastructure at participating schools.

**05/2004 - 05/2005**
Computer Science: A sophisticated large-scale simulated Martian Landscape in under construction that enables STEM learning using the latest in engaging technology. Multimedia in the CIMEL framework, introducing object-oriented concepts, UML and Java in the Eclipse environment are available at cimel.cse.lehigh.edu (interested instructors may request logins and passwords).

Chemistry: Our defined activities for physical sciences and chemistry now number 23 which includes three topics presented by our corporate partners at Binney & Smith. The majority of these are available on the website but we are restructuring that site to make it more useful and accessible to STEM teachers and others. We have expanded our outreach activities to this year include two grade schools with high school students under the guidance of teacher, Linda Frederick, and graduate fellow, Kelley Caflin. Several members of the team also were involved in the ScienceFest outreach to a broader audience of schools in the area.

Math: The lesson plans, once posted, will be a resource for anyone interested in mathematics education.

05/2005 – 05/2006

Computer Science: grants have been secured for the development of DiHO ARM and the D-HOTM system. These grants have provided the resources to, among other things, perform a needed update on the laboratory research computers. In the classroom, besides the physical development of the Martian Landscape (the renovation of a room in the middle school's basement for use by remote-controlled mobile robots), and impending updating of the Technology Lab's computers and floor plan to create a Mission Control Center, a new curriculum (and corresponding website) is being developed that encapsulates the project's work. This curriculum, for grades 6, 7 and 8, will provide lessons that can utilize the Martian Landscape and remotely-controlled robots, or guide teachers through alternative procedures if these resources are not available. The curriculum incorporates the Pennsylvania State Standards where appropriate and covers the breadth of skills necessary to successfully complete such tasks (including navigation, generating plans, working as a team, following instructions, writing reports and calculating measurements). The 8th grade curriculum is nearly complete, with plans to implement it district-wide in the near future. The 6th and 7th grade curricula should be completed within approximately the next year.

Harrison-Morton Middle School has also been named a NASA Explorer School (NES) starting this year. This designation provides the HMMS teachers direct access to NASA's educational resources, including visits from scientists and astronauts, the borrowing of celestial material, games, software, and video conferencing opportunities with researchers and staff. So far, NASA officials have given a presentation at the school's open house in the fall, and provided a game where students design a space mission with budgetary, power and weight constraints. There are also plans to have an astronaut be present at the dedication of the Martian Landscape, in the near future. This designation will last for three years.

Physics: an Integrated Science/Aviation unit that integrates the fields of science, mathematics, technology, and other, non-science disciplines and the program; 'Timeline: Planet Earth', that integrates science and other disciplines across all K-5 grades in a school-wide, thematic program.

Math: both STEM teachers from the Math Team currently serve on the school district's science or mathematics curriculum committees. They share materials and lessons plans that the Math team has developed throughout the Allentown School District. Students were enrolled in the online “First in Math” program (e.g., Math 24). FThis innovative program increases students’ math skills by introducing concepts and reinforcing rote skills with exercises presented in a format that mimics video games. Insight into student use of this program will guide the implementation of this online program as an effective teaching resource on a broader basis in the Allentown School District.
A minor contribution is to the infrastructure of the high school science community we interact with which they are unable to supply themselves. These include projectors for computer learning experiences, field trips to active science in the real world, teacher in-service activity developed in the project and laboratory equipment to enable more sophisticated experiments and data acquisition.

A hands-on project in conjunction with Air Products that teaches the students about separation of chemicals and the application of these techniques to the real world has been developed by the Science team at Harrison-Morton. The same team has also developed an after school program that tests the reasoning skills of middle school students, and pioneered the 'Science Night' program, which was a dinner meeting for the students and their parents that showcases their science projects. The program was so successful that it has been adopted by other teams on the project.

05/2006 – 05/2007

Harrison-Morton Middle School is now the home of a state-of-the-art mobile robotics and telecommunications system – the only one of its kind in the nation. This system includes the “Mars Yard,” a simulated landscape in the basement, and the “Mission Control Center,” an upgraded classroom technology laboratory. Through this system, students collaborate to use the robots and “satellite” (ceiling camera) to perform various tasks, which involve many aspects of science, technology, engineering and mathematics concurrently. The classroom is also outfitted with a high-end videoconferencing and display wall system, providing much of the same functionality that is found in present-day command-and-control environments. This system is designed to be easily maintained and operated by the staff at the school, with or without Lehigh personnel assistance. This resource, while themed towards space exploration and technology, can be applied to many other curricula as well. It is our goal to have this room be a resource not only to STEM teachers, but to all teachers in HMMS – should they choose to use it. Plus, at the end of a trial period of usage in the classroom, we plan to work with the Allentown School District to rollout its availability first to other district schools, and then to others outside the district in the local area. Ultimately, as the Mars Yard robots can be technically accessed by any Internet-capable computer, we plan establish the capability to make this available to students and schools worldwide.

The NSF’s ITEST program awarded Drs. Blank, Columba and Odi, all associated with the LVPTF GK-12 project, an award to create the Launch-IT project. (In the original proposal it was called Students That Are Ready to Start Technology). Ms. Melodie Kent, former Undergraduate and Graduate Teaching Fellow, is the Launch-IT Program Director. The goal of Launch-IT is to launch at risk middle and high school students in the greater Lehigh Valley into college and careers in Information Technology. Bringing students to Lehigh University, it builds on the novel curricula that the Computer Science teams for the LVPTF project developed, i.e., the Martian Landscape, the Flash multimedia and the Design-First curricula. See www.lehigh.edu/launchit for more details.