

**Annual Report for Period:** 03/1/2007 - 12/1/2007 (3/31/08)

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**Principal Investigator:** Blank, Glenn D.

**Award ID:** 0638664

**Organization:** Lehigh University

**Title:** Lehigh Valley Partnership for GK-12 Teaching Fellows: Widening the Pipeline

## **Part I. Principal Investigator Report**

### **A. Participants**

**(1) Senior Personnel** (all at Lehigh University; the Co-Directors, Evaluator and Administrative Assistant contributed over 160 hours and all the Team Leaders between 40 and 120 hours):

- Dr. Glenn D. Blank, Associate Professor of Computer Science, is the PI, Project Co-director, and Team Leader of the Computer Science Team at Liberty High School, Bethlehem School District.
- Dr. Henry U. Odi, Executive Director for Academic Outreach & Special Projects, Office of the President, and Adjunct Professor, Lehigh University, is Co-PI and Project Co-director, overseeing interaction with Lehigh administration, school districts and corporate sponsors.
- Dr. H. Lynn Columba, Associate Professor in the College of Education, Lehigh University, is a Co-PI and Team Leader of the Information Technology Team at Harrison-Morton Middle School, Allentown School District, and Fellows' Workshop training coordinator.
- Dr. Gary DeLeo, Professor of Physics is a Co-PI and the Team Leader of the Physics Team at Asa Packer and Clearview Elementary Schools, Bethlehem Area School District.
- Dr. Terry Hart, Adjunct Professor of Mechanical Engineering and former NASA Astronaut, is the Team Leader of the Engineering Team at Allen High School, Allentown School District.
- Dr. N. Duke Perreira, Professor of Mechanical Engineering, Team Leader of the Physics Team at Asa Packer Elementary School, Bethlehem Area School District.
- Dr. Keith Schray, Professor of Chemistry, is the Team Leader of the Chemistry Team at Freedom and Liberty High Schools, Bethlehem Area School District.
- Dr. Jennifer Swann, Associate Professor of Biological Sciences is the Team Leader of the Biology Team at Raub Middle School, Allentown School District.
- Dr. Susan Szczepanski, Professor of Mathematics, is the Team Leader of the Math Team at Broughal Middle School, Bethlehem Area School District.
- Dr. M. Jean Russo, Research Scientist, Center for Social Research, Evaluation Specialist, Project Evaluator.
- Mrs. Priyani Jayetileke, Administrative Assistant for LV STEM.

**(2) Graduate Students (Fellows)** (all contributed over 160 hours, about 15 hours per week):

- 1) Anthony Dzaba, second year PhD student in Mechanical Engineering, African-American male, Fellow with Engineering Team at Allen High School,. "My advisor (Prof. Eugenio Schuster) has submitted a grant proposal to obtain the funding for certain pieces of equipment we require to proceed. Once funds are forthcoming we will begin wind tunnel testing micro air vehicle models. In the meantime, I will be taking courses in mechatronics and advanced controls (this spring) which will provide the requisite knowledge to construct the physical models and design the analytical models for continuing research."
- 2) Nicholas Maiorino, second year PhD student in Mechanical Engineering, Caucasian male, Fellow with the Engineering Team at Harrison-Morton Middle School. "I am currently in the process of identifying a research topic in the field of mechanical engineering by linking biomechanics and robotics. My emphasis right now is developing a robotic and biomechanical system, such as a prosthetic, that will enable elderly people to move around more readily."

- 3) Ruthie Malenda, third year PhD student in Physics, Caucasian female, Fellow with Physics Team at Asa Packer Elementary Schools, “Over the past two summers I have worked with Dr. A. P. Hickman. The work I have done relates to the dissociative recombination of the molecular ion  $C_3H_3^+$ . I have created computer programs that study the molecules geometry and vibrational normal modes. This work is helping me identify my Ph.D. research topic.”
- 4) Nickolai Moukhine, second year PhD student in Computer Science, Caucasian male, Fellow with Computer Science Team at Liberty High School. “I recently passed the Ph.D. qualifier exams. After this semester I will have fulfilled my breadth requirements and I am currently working on my depth requirements, conducting a literature survey in the area of computer graphics. In a graduate course on intelligent tutoring systems, I am developing a prototype system to help novices learn the basics of debugging programs. Earlier this month I co-authored a paper together with fellow Ph.D. student Michael Sands and Prof. Blank, which we submitted [since accepted] to the Northeast Conference of the Consortium for Computing Sciences in Colleges.”
- 5) Raymond Pugh, fourth year PhD student in Chemistry, African-American male, Fellow with Chemistry Team at Freedom and Liberty High Schools. “My research has involved studying the role of Map Kinase Phosphatase-1 (MKP-1) in Heparin-induced decreases in vascular smooth muscle cells (VSMC) extracellular signal-regulated kinase (ERK) activity. Since August, I have completed experiments using agonistic heparin receptor antibodies in place of heparin and doxorubicin (decreases levels of MKP-1) to study MKP-1 and ERK levels simultaneously. Previously, I had completed the experiments using heparin itself and doxorubicin. These results were presented at the *47th Annual American Society for Cell Biology (ASCB) Conference* in D.C. (12/3/07). I completed some preliminary experiments in which I am using siRNA MKP-1 to decrease levels of MKP-1 and at the completion, will publish all findings in a paper. As well as studying MKP-1 and ERK, I have been in the process of isolating and purifying a novel heparin receptor. At this point, I have what is believed to be the heparin receptor and is in the process of determining the quantity and purity of the sample before sending it to an independent lab for characterization.”
- 6) Isaac Rieskts, first year PhD student in Computer Science, Caucasian male, Fellow with Information Technology Team at Harrison-Morton Middle School. “In my graduate level classes I have identified areas of research that I am considering for my Ph.D. In one graduate class, I am working on an intelligent tutoring system that helps middle school students learn how to solve fraction problems, so they can enjoy the web-based FirstInMath “24” game. I have developed an interface and simulator for mobile robots in the Martian landscape at Harrison-Morton Middle School. The latter is the subject of conference papers that Prof. Blank and I have recently submitted to the *Consortium for Computing Sciences in Colleges* and the *Society for Information Technology Education*. [both papers have been accepted].”
- 7) Kandiss Schrader, fourth year PhD. student in Biological Sciences, Caucasian female, Fellow with Biology Team at Raub Middle School. “My research is on ribosomal proteins L23a has progressed. My proposal has been written and will soon be presented. It is focused on the ribosomal protein L23a, an evolutionarily conserved rRNA binding protein. In *Drosophila* (and a few other fly species) this protein contains a large N-terminal region which is not found in other eukaryotes, eubacteria or archaea. Little is known about the function of this domain which is the basis of my studies. L23a is an essential protein in ribosome biogenesis, making the complete understanding of such a protein important to unraveling ribosome evolution and function.”
- 8) Melissa Stoner, second year PhD student in Mathematics, Caucasian female with Math Team at Broughal Middle School. “In a few months I will have completed my Master’s Degree and

will begin serious work on my dissertation. Currently, I have identified an area of research and secured a faculty advisor. My research will focus on the neuroscience field of mathematical biology. More specifically my advisor and I have begun to look at problems involving the existence and stability of traveling wave solutions in a synoptically coupled neuronal network rooted in a system of model equations. I expect to continue this study and consider the stability of traveling wave solutions in other similar model equations.”

### (3) Organizational Partners

The following table summarizes data about our partner schools in the Allentown and Bethlehem Area School Districts, all of which are *urban*.

Allen High School	Minority 76% Low income 60%	Mechanical Engineering	1 fellow 1 teacher	Anthony Dzaba William Busoliti	10 <sup>th</sup> & 11 <sup>th</sup> grade robots
Asa Packer & Clearview Elementary	Minority 18% & 49% Low income 9% & 43%	Physics	1 fellow 2 teachers	Ruthie Malenda Gale Sydlowski Renee Mitchell	4 <sup>th</sup> & 5 <sup>th</sup> grade Science
Broughal Middle School	Minority 82% Low income 84%	Mathematics (construction)	1 fellow 2 teachers	Melissa Stoner Linda Baker Kristin Stuby	7 <sup>th</sup> grade Math
Freedom & Liberty High Schools	Minority 33% & 43% Low income 26% & 36%	Chemistry	1 fellow 2 teachers	Raymond Pugh Beth Guarriello Linda Frederick	10 <sup>th</sup> & 11 <sup>th</sup> grade Chemistry
Harrison-Morton Middle School	Minority 78% Low income 86%	Information Technology	1 fellow 3 teachers	Isaac Rieksts Jessica Donahue Jennifer Walz Tom Carlstrom	7 <sup>th</sup> & 8 <sup>th</sup> graders Mars Rovers
Harrison-Morton Middle	Minority 78% Low income 86%	Mechanical Engineering	1 fellow 2 teachers	Nicholas Maiorino Dave Moyer Joan Preston	6 <sup>th</sup> grade Mission to Mars
Liberty High School	Minority 43% Low income 36%	Computer Science	1 fellow 2 teachers	Nick Moukhine Kevin Jones Rebecca Wetzel	9 <sup>th</sup> grade Flash, 11 <sup>th</sup> grade C++
Raub Middle School	Minority 87% Low Income 87%	Biological Sciences	1 fellow 3 teachers	Kandiss Schrader Melanie Fehlinger Joseph Lathrop Kathy Resnick	6 <sup>th</sup> grade Science

#### School District Science and Mathematics Coordinators:

- 1) William Gibbard, Science Coordinator, Allentown School District, (20-40 hours)
- 2) Barbara Kautzman, Mathematics Coordinator, Allentown School District (about 10 hours)
- 3) Eric Smith, Science Coordinator, Bethlehem Area School District (about 10 hours)
- 4) Julie Victory, Mathematics Coordinator, Bethlehem Area School District (about 10 hours)

**Air Products:** Dr. Frank Petroceli and a team of scientists and engineers are collaborating with the Engineering teams at Allen High School and Harrison-Morton Middle School.

**Binney & Smith Inc.** provides a team of scientists and engineers from the company to work with the Chemistry Team at Freedom and Liberty High Schools.

**Insaco, Inc.** funds 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, recruits 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 PPL.

**PITA** (Pennsylvania Infrastructure Technology Association) has approved over \$30,000 of leveraged funding to supplement support the project for fiscal year 2007-8. PITA also supports two projects closely related to LV STEM: 1) Enhancing First In Math™ Online With Teacher's Guides, Multimedia and Intelligent Tutoring, for \$52,789 and TLC (Technology Literacy Curriculum) Development in Harris-Morton Middle School in Support of the Launch-IT Outreach Program, for \$67,501. The latter project supports the acquisition of three Mars Rover robots and a state-of-the-art multimedia display wall for the Mars Mission Control Room, in support of the curriculum we are developing in Allentown School District.

**PPL (Pennsylvania Power & Light)** sponsors in class demonstrations, field trips and opportunities for high school students to “shadow” PPL employees on the job.

**Suntex International, Inc.** provides the FirstInMath web-based program at Broughal Middle School, Harrison-Morton Middle School and Fountain Hill Elementary School at half cost. As a result of the great success of the “24 game” at these schools, the Bethlehem Area School District negotiated a contract to put the program in all Elementary and Middle Schools in the District.

#### **(4) Other Collaborators or Contacts**

Two of our partner schools (Broughal and Harrison-Morton Middle Schools) are NASA Explorer Schools. Former astronaut Paul Richards visited Harrison-Morton Middle School in Allentown.

### **B. Project Summary – Goals and Activities**

#### **Goal 1. Developing and disseminating novel curricula regionally and nationally**

All of our graduate fellows were recruited and ready to start at the end of August. Due to significant turnover of key administrators and teachers in our partner school districts and schools, however, we were not able to identify most of our teachers until September. Allentown School District also required that all fellows had to pass criminal background checks before they could work in classrooms. As a result, we experienced delays getting fellows into the schools, ranging from October to December. Nevertheless, all teams were meeting with teachers to plan their activities and develop innovative curricula, as described below.

The Engineering Team at Allen High School faced the challenge of working with a new teacher, hired shortly before the beginning of the school year. Dr. Hart and Fellow Dzaba met in October with the principal of the Allen High School, the assistant superintendent of the Allentown School District, science coordinator Bill Gibbard, and their pre-engineering coordinator Bill Busilits to introduce the STEM project and to assess the school's willingness to proceed with it. With excellent support expressed by all school officials, a plan was established to introduce the project for two pre-engineering classes. Mr. Dzaba then proposed a robotics project that would shadow some of the research. With funds from PITA, Lehigh has procured the robots, which will be loaned to the school for this project. Allen pre-engineering students will assemble the robots and learn how to program them to follow a variety of instructions. The curriculum will build on Mr. Dzaba's research. For example, one robot follows a scent by using special sensors being developed for that purpose. Mr. Dzaba reports: “My class discussions have focused on singular autonomous behavior as well as constructive intelligent behavior among independent agents. I demonstrated these ideas with simple robotic tasks like obstacle avoidance and 'following the leader.’ Once the students

understand what is possible with basic robot platforms (sensors and microcontrollers), we'll move toward advanced topics such as feedback control and optimization. I also gave a demo of a project from my mechatronics course. We are building a surface-to-air missile launcher (SAM) using a Stamp 2 (Boe-bot) microcontrollers. The SAM can track ground and aerial objects up to ten feet away using 2 pairs of sonar rangefinders. It features a dual servo two degree of freedom turret that responds to closed-loop feedback from the ranger pairs. Accordingly the SAM can precisely track targets in both azimuth and elevation. Once it locks onto a target, a trigger signal will be sent to a ping-pong ball launcher. I plan to incorporate RF radios which will allow the SAM to communicate with other robots in order to orchestrate complex operations and intelligent behavior.”

The Physics team at Asa Packer and Clearview Elementary Schools seeks to integrate outreach contributions with the newly formulated science curriculum in the Bethlehem Area School District. We are developing of teacher support materials using computers, video, audio, and web-based tools. We began with a pair of related FOSS kits used at the first and fourth grade levels: Pebbles, Sand, and Silt (1st grade) and Earth Materials (4th grade). Our team has created teacher learning materials and additional outreach activities to complement the FOSS programs. Fellow Melenda describes how she brings her research experience into the classroom: “Since my expertise is in the areas of atomic physics and dynamics and forces and motion (as they relate to atoms and molecules), I convey my experiences as these topics are covered. The science of atoms and molecules and the physics of motion are covered at the fourth and fifth grade levels. We introduce students to the concepts of forces, motion and energy, along with the atomic theory of matter. I describe the importance of these areas in the context of my research in molecular dynamics and dissociative recombination phenomena. Another important aspect I contribute is reinforcement of the value of the scientific method. This procedure is being introduced in the fourth grade, and as a research physicist I assure the children that the concepts they are learning are actually employed in real scientific research. Finally, as a woman, I present a new concept of “scientist” to many students. The idea of scientist usually conjures up images of either Einstein or a mad scientist in his lab. I feel very strongly that my presence helps young girls realize that even though science may still be a male dominated field, it is perfectly acceptable path for them to choose as a career.”

The Mathematics Team at Broughal Middle School had a unique opportunity. Visible through the window of the seventh grade classroom is a construction site—the future location of Broughal Middle School (which will be a science and technology magnet school for the district). The Mathematics Team has used this “visual aid” to motivate students and to inform them of the importance of mathematics in the world outside the classroom. The challenge has been to create projects and lessons plans that dovetail with the mandated curriculum and that facilitate the students’ ability to apply what they have learned. The later is now a significant component of the standardized tests required by the State of Pennsylvania. Several activities/lessons have been developed, some following suggestions made by the students one day in September when they were asked to gaze out the window at the construction and then make a list of ways in which mathematics was being used to manage this project. The students began with activities in which the estimated volumes of dirt removed in the excavation, number of trucks needed to remove the material and based on the number of trucks used, estimated the amount of soil that was reserved on-site to be used for “fill” after the pouring of the foundation. The students have been observed and heard in the stairways of the existing building, measuring the rise and depth

of each stair to determine if the existing stairway meets “code,” which was researched online. This meshed with a unit on measurement and ratios. In a more recent activity, the students reviewing blueprints and data obtained from the engineers/architects managing the project and will work in teams to make their own scaled models matching the footprint of the three main components of the new facility. The students are engaged and excited; they have devised methods for including windows and doors of appropriate scale for their models. The work so far is perhaps best captured in this one distinctive moment—as one day’s activity was nearing its end, a student along with a friend approached the teaching fellow and with pride announced that “you know, my dad works on a construction site.”

The Chemistry Team at Freedom High School has created twenty learning activities to support the ninth grade physical sciences curriculum. We designed a number of enrichment activities including in the past visits to the Crayola research facilities and the Museum of Glass. Several learning activities have spread throughout the Freedom science division. The team will continue its involvement with Freedom High School, but has now extended its reach to Liberty High School, which has higher percentages of under-represented minority students. This interaction is at the 11th grade level in Chemistry primarily because the participating teacher is teaching at that level this fall. The team will move with her into the 9th grade in some blocks in the spring. Fellow Pugh reports how he brings his research experience into classes: “With the Freedom ninth graders in Physical Sciences I present an overview of my research including a general description of the methods used. As we get to topics like chromatography, I will be able to refer back to that discussion so they get a better grasp of how I do my work. In the biomolecules section of the curriculum, I will give them an overview of that topic with examples of the receptors that I work with. At Liberty, I will discuss forensics as an example of large organic structures and in a course on genetics and medical ethics I discuss the connection with genetics codes for the proteins that I work with.”

The Information Technology Team enhanced the mobile robotics curriculum that was in place, from our first GK-12 project, in both technology and science classes at Harrison-Morton Middle School. In the technology class, each year is divided into cycle; each cycle has a different set of students. Combining technology, science and engineering concepts, activities include mobile robotics, West Point Bridge building software, building a launcher for a film canister, film canister rockets, etc. Fellow Rieksts created a simulation program that lets students test robotic mission, then download them to Mars rovers in the Martian landscape in the basement of the school. Rieksts (with PI Blank) presented two papers about the Mars rovers and simulation, cited below. The goal is to enhance and disseminate the mobile robotics curriculum developed in the first STEM project to all the middle schools in the Allentown School District. Fellow Rieskts reports, “In 7<sup>th</sup> and 8<sup>th</sup> grade technology classes, I explained how selecting instructions in the simulation is similar to writing actual code. I walked the students through a short example, then give them a two day assignment that makes two short programs to be run in the simulation. Then I do a recap of the lessons and the logic behind the lesson. This is related to my current research on learning environments for programming.”

The Engineering team at Harrison-Morton Middle School has begun developing a ‘Mission to Mars’ curriculum that complements the Information Technology Team’s Mars Rovers curriculum, with the goal disseminating these curricula to all the middle schools in the Allentown School District. Fellow Maiorino reports, “I have been trying to help the students understand what exactly an engineer does.

This started on the first day with discussions about the differences between engineers and scientists, and how they both directly impact all of their lives in one way or another. I gave a presentation about concept cars where I showed them some images of recent and future concepts and we discussed where some of the design ideas came from, and how certain features of a car serve different purposes. The students were then able to choose an everyday household object that they had to use as inspiration in the design of their own vehicle. While they were doing the basic aesthetic design of the vehicles, they were also responsible for describing how their vehicle accelerates, decelerates, and changes direction. These assignments were graded on completeness of information primarily in the descriptions of the systems used to move the vehicle. Our new ‘Mission to Mars’ curriculum will consist of three phases: (1) Earth to Mars; (2) landing on Mars; (3) living on Mars. In the first phase the students will design air powered rocket ships that will have to travel a certain distance and hit a target to successfully complete the trip from Earth the Mars. The second phase is an egg drop experiment where the students will design a carrier that will enable an egg to withstand a drop from a given height. And in the third phase the students will construct ‘biodomes’ and survival kits for 3 people to simulate what would be needed to live on Mars. This activity will prepare the students for developing missions for Mars rovers at Harrison-Morton.”

The Computer Science Team at Liberty High School has stimulated more interest in computing in the introductory computer course, required of all students. The MOUS (Microsoft Office User Specialist) course, an introduction to Microsoft Office applications, has historically drawn a somewhat mixed response among the students, certainly not encouraging them to pursue computing. Many parents have complained to administrators that their kids already know these applications. On the other hand, many teachers argue that the students don’t actually know the programs at a level appropriate for high school and college. As a welcome relief for both the students and teachers, fellow Nick Moukhine taught a week long introduction to Macromedia Flash. Students learned how to create animations and were given freedom to create their own projects. Now they experience computing as more than spreadsheets and memos but a creative and fun. The response has been so positive that two more teachers have requested that Moukhine help them expand the Flash curriculum to a two week program, which will also introduce Action Script programming; we will also partner with Liberty and PITA to provide a site license for Adobe Creative Suite at Liberty. Moukhine (with PI Blank) will present a paper about the results of our Flash-based curriculum in the CCSCNE conference in April. Moukhine is also working in the advanced programming class, incorporating ideas from our Design First with Java curriculum as well a new intelligent tutor that helps students learn how to debug programming. Moukhine describes these activities: “We have found that one of the biggest difficulties of students new to programming is finding why their program behaves differently from what they expect. This is commonly referred to as a bug, and tracking down their sources within the code is a task more difficult than writing the actual code to start with. For this reason, we have developed the Debugging Tutor, which is aimed at novice programmers of any age group. The tutor behaves in the following manner. It presents the pupil with a piece of code, and the ability to run it to see what happens. On the initial run, they will see that the code will misbehave; in other words, contain a bug. Students are then free to edit the actual code to try to get the bug to go away. If they are stuck, hints are available to point them in the right direction. The tutor keeps track of their progress in several categories so it can serve up problems they are most likely to need help on. Our plan for the tutor is to test it in an intro to C++ classroom at Liberty High School. Our request is pending IRB approval and we hope to take any results we see and improve the tutor accordingly.

The Biology Team meets bi-weekly to develop curriculum for teaching 6th grade science which focuses on environment, ecosystems and ecology. The curriculum is inquiry based: the students start each week learning concepts and terms through exercises and demonstrations. The students use these concepts to develop testable hypotheses, culminating each week with the experiments. Students are encouraged to write informally about their class experiences and formally about the experiment. So far we have constructed lesson plans for three of the 10-week curriculum, which will be tested in a class in the spring. The team will work with the Allentown School District Science Coordinator Bill Gibbard to ensure that it meets local as well as national and state standards and requirements, then disseminate it district wide, with the help of PITA outreach students.

#### **Other contributions to dissemination:**

Dr. DeLeo has also been providing support to Broughal Middle School's participation in the NASA Exploring Space Challenges Program, "Mission: Moon Math." About 20 students are engaged in four exploratory projects, including one where lunar phases are carefully recorded to determine if the Moon's orbital speed changes with time, and another where crater densities are compared between mare and highland regions

Dr. Blank led a workshop introducing Object-Oriented Programming in Java was held in the East Career and Technology Center in Memphis, TN , March 14-15, 2007. Dr. Linda Sherrill helped to make the arrangements and invited students at high schools associated with a GK-12 program at the University of Memphis. Twelve high school students participated in the workshop; the demographics included , six African-Americans and six Caucasian, four females and eight males. The curriculum for the workshop draws from materials developed for the Launch-IT program. Multimedia introduced object oriented concepts and guided them through practice exercises modifying two Java graphics-oriented projects in Eclipse IDE, creating objects and manipulating them with methods, then modifying a constructor and methods to draw scene of a sun setting next to a house. In the second day of the workshop, students a step-by-step procedure for designing a class diagram given an instructor's prose problem description, then designed a class diagram for a Movie Ticket Machine. As they created the class diagram in our novice-oriented LehighUML plug-in, an intelligent tutoring system provided hints based on their actions. All of the students successfully created a valid class diagram for the problem. The data from the workshop helped to evaluate the student model. The accuracy of the student model is represented by average correct diagnostic rate. The analysis result from the student data in the work shop showed that the student model has an accuracy of 88%.

After the Object-Oriented Programming in Java workshop, Dr. Blank presented a seminar about the intelligent tutoring system to the Computer Science Department at the University of Memphis. The seminar closed with a discussion about the LV STEM and Launch-IT projects. Prof. Blank gave similar talks at the University of Pittsburgh in April and Ramapo College of New Jersey in May 2007. Dr. Blank also presented a tutorial on "Novel Curricula and Tools for Java in CS1 Courses" at the *Eastern Conference for Computing in Small Colleges*, at St. Joseph's College, Patchogue, NY, October 12, 2007.

#### **Goal 2: Outreach Students**

In a recently awarded grant for fiscal year 2008, PITA will provide funds to support Outreach students (at no cost to the NSF). We anticipate fielding three to five undergraduate or graduate

outreach students to disseminate our most effective and innovative curricula in other schools, after they have learn LV STEM curricula and lessons alongside fellows and STEM teachers. (Dr. Blank has recently submitted a white paper to Dr. Stephen Cooper proposing the idea of Outreach Experiences for Undergraduates analogous to NSF's successful Research Experiences for Undergraduate program.)

### **Goal 3: Industrial corporate participation**

As noted in our list of organizational partners, we have already identified many governmental and corporate partners. Notably, Air Products is collaborating with our Engineering programs at Allen High School and Harrison-Morton Middle School and Binney & Smith (Crayola) with our Chemistry Team. Graduate Fellow Isaac Rieksts, along with other graduate students supported by PITA, helped to develop an intelligent tutoring system that helps middle school who have difficulty solving fraction problems. Later this spring, we will demonstrate the fractions tutor to our Suntex International partners, in order to plan how we work with them to further develop and ultimately link this technology with the "24 game" at the FirstInMath.com web site, used in both our partner school districts as well as nationally.

### **Goal 4: Pre- and in-service training for STEM teachers**

Our priority for the first few months of the project has been to recruit Fellows and STEM teachers and train the fellows. We have already noted the difficulty we had determining teachers; as a result, they were not able to participate in our training of fellows over the summer of 2007. Nevertheless, the Fellows received training along side other STEM teachers and fellows by participating in the Launch-IT program ([www.lehigh.edu/launchit](http://www.lehigh.edu/launchit)). Launch-IT, funded by NSF Innovative Technology Experiences for Students and Teachers (ITEST) program, featured a three summer program, four days a week, from July 23-August 9. Incoming LV STEM Fellows each participated for one week in the Launch-IT program. This hands-on experience gave the LV STEM Fellows experience working with innovative curricula, Launch-IT fellows, STEM teachers and at risk middle and high school students similar to what they would experience in the schools.

A training workshop for Graduate Teaching Fellows was held on August 22, 2007. We explored different ways students learn and how to teach more effectively by understanding how students acquire, process, and retain information. These goals were accomplished by exploring different learning theories such as the following: modality strengths; ways to perceive and order information; and, multiple intelligences. Also, we examined effective schools, teachers, and instruction. Through interactive dialog, the key behaviors of effective teaching were developed which include: lesson clarity, instructional variety, task orientation, engagement, and success rate. Our working definition of effective teaching is teaching that involves the orchestration and integration of key and helping behaviors into meaningful patterns to achieve specified goals. In addition, planning for effective instruction through lesson plan design was expanded upon throughout the workshop. A seven element format, a guided inquiry format, a technology-based format, a 5 E model (constructivist), and a general lesson plan model were the tools used to facilitate lesson plan design.

"The Essence of Physical Sciences for Educational: Professionals and Science Enthusiasts" (Summer 2007, 3 credit hours) acquainted the seven students enrolled with aspects of physical sciences, and introduced applications that emphasized technology. The primary goal of the course is teacher preparation in the physical sciences leading to enhanced subject-matter

confidence and enthusiasm. The development and use of K 12 classroom demonstrations and inquiry-based activities was integrated with the treatment of scientific content.

A “Large Group” Workshop for graduate teaching fellows, STEM teachers and coordinators, and faculty team leaders was held on November 14, 2007. Since this was the first workshop for most of the STEM teachers, Dr. Blank explained the overall project vision, goals and objectives, highlighting some of the novel curricula that were developed in our first project which will continue to be developed and disseminated in the continuing project. Dr. DeLeo discussed our plans for pre- and in-service training to STEM teachers through Lehigh’s Graduate College of Education Integrated Professional Development Schools, using curricula and Learning Kits developed by outreach teams anchored by NSF Graduate Fellows.. Dr. Russo then reviewed our plans for evaluation, including the use of writing exercises with a standardized rubric. Finally, Dr. Odi led a discussion about how to build teams that each have a clearly vision, goals and objectives.

In-service training for teachers is now in the works. The Information Technology and Engineering Teams at Harrison-Morton are planning an in-service day for science and technology teachers at the other three middle schools in the Allentown School District. The Computer Science Team at Liberty High School plans an in-service training for all MOUS teachers to learn the Flash curriculum. The Lehigh Valley Computer Science Teachers Association will introduce area teachers to innovative IT curricula at a meeting this coming May.

#### **Journal Publications:**

Columba, L. (2007). Exploring weighty matters with *Cucumber Soup*: An interdisciplinary approach. In Classroom Idea-Sparkers, B. Chakraborty & S. Stone (Eds.). *Childhood Education*, (84)/1, 30R-30U.

Govek E. K. and Swann J. M. (2007). Stereological sex difference during development of the magnocellular subdivision of the medial preoptic nucleus. *Brain Research* 1145:90-6.

#### **Books or Other One-time Publications:**

Columba, L., Mastery of Basic Facts with the First in Math Online® Program. *People-to-People Ambassador Professional Forum*, Mathematics Education Delegation, Semiramis Intercontinental Hotel, Cairo, Egypt, November 29, 2007.

Columba, L., Assessing Basic Fact Fluency with the First in Math Online Program (PAMTE Spotlight), *56th Annual Pennsylvania Council of Teachers Mathematics Meeting*, Valley Forge, PA, November 9, 2007.

Columba, L., Assessing and Assisting At-Risk Students Achieve with the First in Math Online® Program. *International Conference on Technology in Mathematics Teaching*, University of Hradec Králové, Prague, Czech Republic, July 2, 2007.

Talbi, D., Hickman, A., Kashinski, D., Malenda R., and Redondo, P. A., Comparative Study of the Dissociative Recombination of c-C<sub>3</sub>H<sub>3</sub><sup>+</sup> and l-C<sub>3</sub>H<sub>3</sub><sup>=</sup>: Preliminary Theoretical Studies, *International Conference of Dissociative Recombination*, July 2007.

Rieskts, I. and Blank, G. D., Inspiring Future IT Professionals with Mars Rovers, *Northeastern Conference of the Consortium for Computing Sciences in Colleges*, Wagner College, Staten Island, NY, March 2008.

Rieksts, I. and Blank, G. D. Mars Rovers in Middle Schools, *Society for Information Technology Education (SITE) 2008*, Las Vegas, March 4, 2008.

Sands, M., Moukhine, N. and Blank, G. D., Widening the Pipeline of K-12 Students With Flash, *Northeastern Conference of the Consortium for Computing Sciences in Colleges*, Wagner College, Staten Island, NY, March 2008.

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**Web Site URL:** <http://lvstem.cse.lehigh.edu> (alias [www.lehigh.edu/stem](http://www.lehigh.edu/stem)), project web site.

## **Part II. Evaluator's Report - December 2007; Updated March 2008 (Dr. M. Jean Russo)**

### **A. Project Goals and Methods**

(1) The Lehigh Valley Partnership for GK-12 Teaching Fellows project received funding from the National Science Foundation on March 1, 2007. (For the remainder of this report, the project will be referred to as LV STEM.) The vision of the LV STEM project is "... to widen the pipeline of PhDs who are advocates for K-12 education and of K-16 students who can communicate complex concepts of STEM disciplines through writing and multimedia." The goals of the project are: to disseminate novel curricula regionally and nationally; to use outreach students to broaden the impact of the project; to provide pre- and in-service training for STEM teachers; and to expand participation of corporate partners.

(2a) A number of methods will be used to determine the extent to which goals have been met. They are listed below.

- 1) Novel curricula and resources will be made available to more schools in the region and nationally. All methods of dissemination will be documented as well as the numbers of school districts, schools, and teachers exposed to new resources. As resources are made available online, adopting teachers will be asked to complete an online survey that requests the numbers of K-12 children exposed to the new activity, and the effectiveness of the instructions, and the adopted activity. On-line surveys will also be sent to the administrators in the school districts to get feedback on their knowledge of the dissemination activities.
- 2) Broaden the impact of LV STEM on Fellows, teachers, and K-12 students. Fellows record time spent in the classroom through Daily Teaching Records. Fellows also describe their

activity and estimate the enthusiasm of the students as well as the percentage of students who participate. Participating STEM teachers complete a mid-year survey to detect whether there are any questions or concerns about the program. End-of-year surveys from Fellows, STEM teachers, and faculty team leaders provide feedback on interactions with other participants, impacts of participation, and suggestions for improvement. All participants in workshops will complete evaluation forms. Teachers working with Outreach students will use a rubric to evaluate the effectiveness of the students' presentation.

3) Fellows will provide pre- and in-service training to STEM teachers. The evaluation will document the number of workshops and participating Fellows, Outreach students, and pre- and in-service teachers. Participants in these activities will complete evaluation forms. Evaluation tools of the activities in the form of K-12 writing assignments and scoring rubrics will be provided to participants.

4) Corporate partners will expand their current participation with LV STEM and Outreach teams, by joining teams and by contributing support for projects and Outreach student supplements. The evaluation will document the participation of industry partners, and they will be asked to complete an end-of-year on-line survey regarding level of participation. Parents, who are also crucial partners for outreach programs, will have expanded opportunities to learn with their children, and the evaluation will document the number of parents at Science Fairs and other activities and make feedback forms available.

5) In order to present evidence for the sustainability of the program after NSF funds are no longer available, the evaluation will provide the annual levels of support for Outreach students from university, industry, school districts, and other sources. Other evidence of the impact of the program will be the number of teachers who participated in pre-service and in-service training who are continuing to use and share the new resources.

(2b) At the time of the first evaluation report submitted in December 2007, the evaluator documented the implementation of the programs and activities to that date. Feedback forms were emailed to participants of the workshop, and the data were analyzed and are presented below. Data from the Daily Teaching Records were summarized and reported. A generic rubric was developed with the help Dr. Gregory Skutches, Coordinator of Lehigh's Writing Across the Curriculum Program. The rubric was distributed to the teams who were encouraged to write their own age- and content-appropriate descriptions for the rubric categories in order to score the writing assignments of the K-12 students. The rubric scores will reflect the effectiveness of the newly developed activities in teaching new concepts as well as the writing level of the students. These assessments were done in January and February, and the evaluator has since visited with six of the teams to discuss the assessment results. The results will be discussed in the next annual report along with a second assessment that will occur at the end of the school year. Also, since the time of original annual report, STEM teachers responded to the Mid-Year Survey.

## B. Evaluation Findings and Executive Summary

The project leaders decided to support eight teams, each consisting of a faculty team leader, STEM fellow, and two STEM teachers, one of whom would assume the lead role. The teams represent several STEM disciplines. Part I of this report describes these eight teams. The faculty team leaders were responsible for recruiting a graduate student to serve on their teams. They were told to look for students who were far enough into their research program that they could

bring research into the classroom. Of the eight fellows recruited, two of the fellows are black males, and three are white females, which translates to 62.5% of the fellows who are women or underrepresented minorities.

During the spring, the project leaders and evaluator recruited an Evaluation Advisory Committee (EAC), consisting of three individuals with expertise in research and/or science: Dr. E. Jill Hirt, Director of Planning & Institutional Research, Northampton Community College, Bethlehem, PA; Ms. Nicole Hammel, Director, Institutional Research & Records, Muhlenberg College, Allentown, PA; and Mr. Robert A. Fox, Associate Director and Director of Education, Da Vinci Science Center, Allentown, PA. During the NSF Site Visit on May 9, 2007, the EAC met with NSF Program Director Dr. Umesh Thakkar and Ms. Zaneta Tyler. Dr. Thakkar explained to the project leaders and EAC why he felt the EAC was an important supplement to LV STEM.

On July 2, 2007, the EAC met for the second time to clarify the role of the committee members. The EAC will provide an independent assessment of the project, although they will have access to Dr. M. Jean Russo's Evaluation Reports. EAC members will be invited to attend general meetings for all program participants and will be granted access to participants without program administrators present. They will meet with the Leadership Team to discuss their findings and will provide a written report for the NSF for each of the three years of the program. For these services, they will receive an honorarium of \$500 per year. Two members of the EAC attended parts of the workshop, and two attended the large group meeting held on November 14<sup>th</sup>.

On June 6, 2006, the project leaders met with administrators from the Allentown and Bethlehem School Districts, including Assistant Superintendents and Math and Science Coordinators. The purpose of this meeting was to identify the areas of need within the school districts, to decide which schools would benefit most from having a LV STEM team, and to recommend teachers to serve on the teams. However, because of turnovers among the school administrators, (both upper level and principals) some teams could not identify the schools and teachers until well into the fall semester. While some of the fellows have been in the classrooms, others have been working primarily with the teachers and faculty member on their team to develop new curricula.

During the weeks of July 23, 30, and August 6, the LV STEM fellows were required to serve for one week as a volunteer at a summer program that is a part of the NSF ITEST Program. The goal of the Launch-IT program is to "launch at risk middle and high school students in the greater Lehigh Valley toward college and careers in Information Technology." Many of the students in this program are drawn from the same schools and are similar to the students with whom the fellows would be working during the school year.

On August 22, 2007, Dr. Lynn Columba conducted a workshop for all participants. She presented three topics: Teaching Styles/Learning Styles, Instructional Design-Effective Teaching, and Introduction to Lesson Planning. In addition, Dr. Greg Skutches, the Director of Lehigh's Writing Across the Curriculum Program, gave a brief introduction to rubrics and worked with the project participants to create a standardized rubric. This rubric will be used by all teams to assess the effectiveness of newly developed curricula. Since the project hopes to produce K-16 students who can communicate complex concepts of STEM disciplines through writing, the rubric will also rate aspects of the students' writing. Six of the eight fellows

attended the workshop; in addition, seven of the eight faculty team leaders attended at least part of the workshop. Unfortunately, only one teacher attended the workshop, because the project leaders were still working with new school district administrators to identify the schools and teachers who would be participating in LV STEM.

Five fellows, four faculty team leaders, and one teacher provided feedback on the workshop by completing a questionnaire that was emailed by the evaluator shortly after the workshop. The mean responses for the fellows and faculty members were computed separately. The teacher's response was included with the faculty responses to protect confidentiality.

	Fellows	Faculty/Teacher	All
How well do you understand the goals of the Project? Code: 1=Not at all; 2=Somewhat; 3=Fairly well; 4=Completely)	3.4	3.8	3.6
How useful did you find the following? Code: 1=Not at all; 2=Somewhat; 3=Moderately; 4=Very)	Fellows	Faculty/Teacher	All
Teaching Styles/Learning Styles	3.4	3.6	3.5
Instructional Design - Effective Teaching	3.2	3.5	3.3
Introduction to Lesson Planning	3.4	3.0	3.3
Writing Across the Curriculum: Rubrics	2.6	3.7	3.0
Did you find the workshop valuable overall? Code: 1=Not at all; 2=Somewhat; 3=Moderately; 4=Extremely)	3.6	3.0	3.3

When asked how well they understood the goals of the project, the fellows responded that they understood the goals between fairly well and completely; the faculty understood the goals almost completely (3.4 and 3.8, respectively, on a scale from 1 to 4). The most useful presentations for the fellows were those regarding Teaching Styles/Learning Styles and Introduction to Lesson Planning. The faculty felt that the session on Rubrics was most useful; however, the fellows found this least useful (3.7 versus 2.6 on a scale from 1 to 4). The fellows commented that the session would have been more useful if more time had been allotted to the session and if more teachers were present to work with their teams to develop the rubric. The faculty also valued the sessions on Teaching/Learning Styles and Instructional Design, commenting that reinforcement of the different learning styles is always valuable. The faculty thought that, overall, the workshop was moderately useful, and the fellows felt it was between moderately and very useful. When asked how the workshop could be improved, the faculty members suggested that teachers be identified earlier, so that some time could be used for team building. They also suggested reviewing the rubric after the teachers are aboard. Fellows commented that they would have liked more time to work with their teams doing hands-on work during the lesson-planning portion of the workshop and to develop the rubric. When asked to list content areas that would be of interest to them in future workshops, the faculty mentioned team building, and the fellows would have liked to know about differentiated instruction, how to determine whether the material is age-appropriate, and how to deal with problem students. They would also like more information regarding the day-to-day activities of the fellows.

On November 14<sup>th</sup>, the project leaders held the first large group meeting for all project participants. A buffet dinner was served. Six of the eight faculty team leaders, six of the eight teaching fellows, and approximately seven teachers attended. Two members of the EAC also

attended. After introductions, Dr. Glenn Blank provided a brief presentation on the project vision and goals. The evaluator reviewed the evaluation tasks for the various participants and presented a rubric that had been outlined at the summer workshop. Dr. Henry Odi led a brief team-building session, in which each team decided its name and identified the team's goals. This exercise was based on principles introduced by Dr. Roy C. Herrenkohl during a workshop during the earlier grant. Dr. Herrenkohl is the author of the book, *Becoming a Team: Achieving a Goal* (Thompson South-Western: Mason, OH, 2004).

The fellows have been asked to keep a log of the time they spend in the schools by completing a web-based Daily Teaching Record form for each day that they visit the school. It requests the date, time arrived and departed, the number of classes they attended, and a brief description of the activity. The fellows also estimate the percentage of students who participated in the activity, the level of students' participation, and the level of their enthusiasm. To date (early December), six of the eight fellows have been visiting the schools. The other two fellows have been spending time with their team developing new curricula so that they can present it when they begin to visit the schools. The six fellows who have been working in the classroom spent about 210 hours in the classrooms to date. They attended from one to four classes a day, and they presented new materials developed by the team about 40% of the time. They estimated that almost all of the students participated in the activities they led (in all cases, upwards of 80%; most reported 100% of K-12 students participating). The level of participation of the K-12 students ranged from moderately to a lot, and the fellows estimated that they were between moderately and very enthusiastic (a score of 3.7 on a scale from 1 to 4).

Since the program is only in its first year, no pre- or in-service training has been offered.

Dr. Henry Odi recruits the industrial partners through his contacts as Director of Academic Outreach & Special Projects. Binney & Smith, Air Products, PPL, and Suntex participated in the first grant and will be asked to return for this grant. PPL and Air Products have already agreed to work with the teams on the current LV STEM Program.

Addendum as of 3/31/08: All but one of teachers responded to the LV STEM Teacher Mid-Year Survey. Two teachers on one team did not complete the entire form since their fellow with had not yet been in their classrooms but was meeting with them weekly to develop a new curriculum. Fifteen teachers received the questionnaire for a response rate of 94%. When asked if the fellows developed or helped develop new hands-on demonstrations, 79% said they had. Two teachers on the same team answered "no" to this question, and one felt that the LV STEM Program could help by helping develop lessons using graphic calculators. Since the time of the survey, the evaluator met with this team, and the teachers were very enthusiastic about an activity that the fellow had done in the classroom. The assessment demonstrated that the activity was helpful in teaching the concept and the students were very enthusiastic about doing it. The teachers' only suggestion for the future was to allow more time for the activity. Ninety-three percent of the teachers felt that the LV STEM Program could help them in their efforts to develop new curricula. The teachers were asked to rate the fellows' performance on several items. They rated the fellows using a code of 1=Never; 2=Sometimes; 3=Often; 4=Most of the time; 5=Always. The mean ratings are in the table below.

	Mean	Std. Dev.	Count
Is the NSF Fellow well prepared for his/her demonstrations?	4.7	0.85	13
Does NSF Fellow communicate with your students at appropriate level?	4.4	0.96	13
Do the students in your class look forward to the Fellow's visit?	4.2	1.30	13
Is the Fellow dressed appropriately for teaching?	4.8	0.38	13
Does the Fellow arrive on time or classes and meetings?	4.6	0.87	13

The teachers were also asked to rate the fellows on their abilities in the classroom. They rated them using a code of 1=Not at all; 2=A little; 3=Somewhat; 4=Moderately; 5=Very.

How effective is this Fellow in making presentations?	4.6	0.90	12
How effective is this Fellow in tutoring or mentoring the students?	4.7	0.75	13

The fellows received high ratings on all the items regarding their preparedness, communication level, and professionalism. The teachers also believed they were between moderately and very effective in making presentations and tutoring the students. None of the teachers reported any problems with LV STEM or with the fellow or faculty team leaders on their team. They also reported that they did not perceive any problems that principals or school administrators had with LV STEM, and estimated that their principals are “very” supportive of the program.

Since the time of the initial Annual Report in December, the evaluator met with six of the eight teams to discuss the writing assessment of the school students. Despite several attempts, the remaining two teams have not yet set up a meeting time for the evaluator to meet with the team to discuss the assessments. Those who met with the evaluator have been quite pleased with the progress in the schools. The teachers are grateful for the new activities introduced by the fellows, and the students did reasonably well on the writing assignment when scored using a version of the attached rubric. In two instances, the teachers suggested that the students might have performed better if the writing assignment question had been stated differently. The evaluator encouraged the fellows to confer with the teachers on the appropriateness of the questions before administering the assignment to the students. Several teachers also mentioned that it would be beneficial for their classes to have additional Lehigh students visit the school and talk to the students about their STEM studies and their experience in college.

### **Executive Summary**

The LV STEM project is well on its way. The Program has expanded the number of schools and teams from the previous grant, with eight teams serving eight schools; two elementary schools, three middle schools, and three high schools. The schools are located in two school districts; the three schools in the Allentown School District have an average of 80% of students who are nonwhite and 77% who are considered low-income students; the Bethlehem Area School District has, on average, a 46% nonwhite population, with 40% characterized as low income. For some of the teams, the start-up has been slower than hoped; however, this was due to circumstances in the school districts beyond the control of the project leaders. All the teams have been working together to enhance or develop innovative curricula, and six of the teams already had fellows working in the classrooms as of early December 2007. The fellows received training at the Summer Workshop, which they found moderately useful. They also had an opportunity for one week in the summer to serve in a classroom-like setting with students with similar backgrounds

and abilities as the students in the schools participating in LV STEM. Only two teachers in the Mid-Year Survey felt that their fellows needed additional training. One suggested that the fellow may need some guidance to create activities that are at the appropriate level and applicable to the students' lives. The other teacher felt that simply being in the classroom would help the fellow overcome initial nervousness. K-12 students appear to be responding positively to the fellows' presence based on reports in the fellows' daily teaching records and by teachers' responses in the Mid-Year Survey and through discussions with the teachers at the evaluation team meetings. The fellows are continuing their own research, and the LV STEM Program is focusing on finding ways to help the fellows to incorporate their research into their community school activities. It appears as if the project leaders are taking all the necessary steps to put the framework in place to enjoy a success similar to that of the first three years of NSF support.

### C. Recommendations for Principal Investigator and Project

1. Require that all participants attend the summer workshop. The workshop gives the PIs the opportunity to introduce and stress the goals of the program and facilitate team building and planning. Time should be set aside toward the end of the workshop for fellows to meet as a group to discuss their questions or concerns. Similarly, teachers should meet as a group to get acquainted with each other and share their experiences with LV STEM fellows in their classrooms. Finally, all team members should be present to begin planning their activities so that the fellows can start in the classrooms when school opens.
2. LV STEM should make available a list of resources that fellows can use if they need help getting acclimated to the school atmosphere. Dr. Lynn Columba, of Lehigh's College of Education, is an excellent resource here. This list should be compiled as soon as possible, and presented to all at this year's summer workshop.
3. Offer support to the fellows to help them find ways to integrate their research into the activities presented at the community schools. First, this should be stressed as a major goal of LV STEM so that the teams consider this as they plan their activities. Fellows should be discussing this on an ongoing basis with the team leader and their team's teachers. Another way of encouraging fellows to pursue this goal is to schedule meetings at regular intervals (perhaps bi-monthly) for all fellows and team leaders. At each meeting, two or three of the fellows (with their team teachers in attendance) should give a brief overview of their research and talk about how they are integrating it into their LV STEM activities. Other team leaders and fellows may be able to offer other suggestions on additional ways to use the research in the classroom. At one meeting early in the academic year, math and science coordinators for the two school districts should be present to answer questions and provide other ideas for using research in ways that will benefit the students, teachers, and the school district as a whole.
4. Attempts should be made to increase the number of industrial participants who are willing to serve on teams and support additional Outreach teams.
5. Each team should submit to the PI one or two activities per year that can be posted on the LV STEM website. PIs should speak with teachers and school administrators to discover ways in which the website can be publicized so that more teachers will have access to the newly developed activities. This should be completed by the end of each academic year.
6. Begin exploring areas in which to provide pre- or in-service training sessions for teachers, then work with school administrators to attract teachers to these sessions.

## Appendix 1: Rubric to Score K-12 Student Writing Assignments

Rubric to Score Writing Assignment						
	Not present	Needs work	Satisfactory	Strong	Outstanding	Criterion Score
Content (Conceptual) - Substantial, relevant and illustrative content that demonstrates a clear understanding of the purpose. Thorough elaboration with effectively presented information consistently supported with well-chosen details. <sup>1</sup>	0	1	2	3	4	
Process (Technical/method) - Clear, effective explanation detailing how the problem is solved. All of the steps are included so that the reader does not need to infer how and why decisions were made. <sup>2</sup>	0	1	2	3	4	
Terminology/notation - Precise and appropriate use of terminology and notation. <sup>2</sup>	0	1	2	3	4	
Sequence/Organization - Effective organizational strategies and structures, such as logical order and transitions, which develop a controlling idea. <sup>1</sup>	0	1	2	3	4	
Clarity - Thorough control of sentence formation. Few errors, if any, are present in grammar, usage, spelling, and punctuation, but the errors that are present do not interfere with meaning. <sup>1</sup>	0	1	2	3	4	
Other optional category	0	1	2	3	4	
Comments:					<b>TOTAL SCORE</b>	
<small>Note: The above descriptions were taken from Pennsylvania Writing Assessment Informational Scoring Guide<sup>1</sup> (provided by Allentown School District) or excerpted from the website of Exemplars<sup>2</sup>, a company in the field of performance assessment tasks that meet national standards to improve assessment and instruction.</small>						

### Part III: Collaborative Response Report

1. We will require that all participants attend the summer workshop as a condition of their contracts, with letters stressing the importance of the workshops and requiring written explanations for absence.
2. We will request that Dr. Columba lead an effort to compile a list of resources to help fellow get acclimated to the school atmosphere and make as much as possible available via our web site and hard copy available in the Academic Office of Outreach.
3. We have already stressed the importance of integrating the fellows’ research into educational activity, but in the process of developing this annual report, it is clear that some fellows do need more advice and feedback. So the faculty team leaders have decided to have meetings, as the evaluator has proposed, when graduate fellows will propose how they can present research into their classroom and get feedback from STEM teachers, faculty and other fellows. These meetings will serve as informal brainstorming sessions that can eventually lead to lesson plan development. We will kick off this activity at our next “large group” meeting and continue them bi-monthly.
4. We will invite current and new industrial partners to our large group meetings with the goal of attracting greater participation and support for Fellows and Outreach teams. We will demonstrate new Fractions intelligent tutoring system to our partners at Suntex this spring. We will seek to match PPL, who partnered with our team at Dieruff High School in our first GK-12 project, with Allen High School and/or Allentown middle schools. Dr. Henry Odi

recruits the industrial partners through his contacts as Executive Director of Academic Outreach. Efforts have been expanded to engage more industries and other federal agencies such as, NASA Goddard Space Flight Center (GSFC). In collaboration with NASA GSFC and several industries, a NASA Mission Control Center will be replicated at a middle school participating in LV STEM project. Several industry partners have agreed to cover the cost of transforming a classroom into a high tech environment which will advance professional development in the STEM fields for teachers and provide on-going opportunities for demonstrating Fellow research. The Mission Control Center, with Internet II and video conferencing capability will provide opportunities for NASA astronauts and engineers to communicate with students and teachers. STEM related companies will also interact via video conferencing with teachers and students.

5. We will ask each team submit to one or two activities per year that can be posted on the LV STEM website, starting this spring. We will seek feedback from STEM teachers and science and math coordinators about how to improve and publicize the web site so that these resources are more widely known and used regionally and nationally.
6. We plan a meeting of the Lehigh Valley Computer Science Teachers Association at Lehigh University which will, among other things, introduce the information technology curricula and tools that we have developed. We plan in-service training for other middle school teachers in Allentown School District to learn the curricula related Martian landscape, probably in June, at Harrison-Morton Middle School. We plan in-service training for high school teachers at Liberty and Freedom High School to learn the Flash and Design-First with Java curricula, probably in June. We are investigating how to provide Pennsylvania “Act 48” credit for teachers who participate in these activities. We will consult with Lehigh’s College of Education as well as other regional university education degree programs about inviting students to participate in these workshops for pre-service training. Similar in-service training activities will be planned to disseminate our novel curricula in other STEM disciplines. With recently acquired PITA funding, we plan to create three to five new Outreach teams, which will help disseminate novel curricula. Teachers at schools where we will place these Outreach teams will be invited to participate in in-service training to learn the curricula and build working relationships with the new Outreach students, in the fall of 2008.

**Appendix: Report on Former Fellows** (“A Lehigh Valley Partnership to Enhance STEM Education through G4-12 Teaching Fellows,” Award #0231768)

Our former STEM graduate fellows are either currently or about to pursue professional careers in industry or in higher education as faculty members. Here are some specific examples: Patrick Gorman is now an Assistant Professor in Mathematics at Kutztown University; Steven Sweeney has accepted a faculty position in Physics at King's College; Melodie Kent was the first Launch-IT Project Director and is now with IBM; Sally Moritz just successfully defended her dissertation, currently works for Travel Impressions, a subsidiary of American Express and plans to pursue a faculty position in Computer Science); Rene Waterman was hired by a Civil and Environmental firm in Florida, but unfortunately died in a car accident; Ted Dufresne now works for a Mechanical Engineering firm in Quarkertown; and Kelley Caflin is completing her dissertation in Chemistry.