Vertically Integrated Partnerships K-16

Report for Year 4 (Oct 2005 –Sept 2006)

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Section 1: Activities and Findings (abbreviated format)

A. Introduction and Summary

During Year 4, the VIP K-16 project continued its rapid growth in the scale and diversity of implementation (especially at the higher education level), in the interaction of partners, and in our efforts to evaluate our progress toward goals. In addition, this was the second year of our CASHÉ supplementary grant, which has taken substantial steps to evaluate sustainability of reforms in science education at the university level. (A report on the specific progress of the CASHÉ supplemental grant is provided as Section 6.)

The cohort of high-school teachers of Earth-Space Systems (ESS) and Matter & Energy (M&E) continued with their second year, along with a new cohort of Physics and Chemistry teachers. Teachers in each cohort participated in their four respective cohort conferences during the year, and will all join together for the Summer Institute 2006. Although the Biology cohort has officially ended, we have kept many of these teachers involved in the project by developing a program to improve their teaching and to help them align it with the statewide High School Assessments in Biology. We also implemented our second Student Inquiry Conference. Many other activities for teachers of the ESS/M&E and Physics/Chemistry cohorts also took place, as detailed below. In addition, we are continuing our development of curriculum guides and field tests in all science content areas.

Project implementation on the Higher Education side has continued to increase throughout Year 4. Existing activities have continued or have been greatly expanded at all IHE's, and many new activities have been created, especially at UMBC. As was the case last year, our IHE partners are leading our efforts to increase K-16 partnerships beyond the cohort conferences and Summer Institute (which are largely aimed at the K-12 teachers and their curriculum). The IHE leadership team has continued its significant development as a learning community, with even more collaboration and mutual support than before. Three of our main strategies are now being implemented by multiple campuses: undergraduate internships in high-school classrooms, faculty learning communities (including collaborative relationships with high-school teachers), and redesign of undergraduate science curriculum.

We have also taken steps to make our most important successes sustainable, mostly through a very productive retreat that was held in November 2005. The retreat featured the active collaboration of over 50 Master Science Teachers, IHE faculty, and other project participants and leaders, and resulted in ideas and action plans as well as new relationships among Maryland's teachers. As described below, this retreat represented our first effort to concretize our conception of a sustainable leadership structure such as the "Maryland Science Faculty."

The details of our project implementation and evaluation can be seen in the tables and narratives that follow. Just as in past years' reports, each partner institution has supplied its own report on implementation and findings for their activities that reflects the individual contributions of that partner to the project's overall goals. However, since there is much more cohesion this year across the partners' activities, and because there

are more centralized activities involving all partners, we begin with descriptions of project-wide and IHE-wide activities.

B. Activities and Findings Narrative

As in previous years, while some of our activities are aimed at either teachers or at IHE faculty or students, others are designed to reach both constituencies and foster productive partnerships between teachers from both levels and the institutions they represent. Usually, these partnership activities are initiated and administered primarily by a single institution. The progress and changes in these activities are reported below as "K12-led" or "IHE-led," depending on the institution in charge of administration. These subsections include tables for implementation and findings by each partner institution.

Although much of these subsections illustrate our efforts at sustainability and participant networking, they are followed by additional, more focused descriptions of these efforts. The important retreat we had in Fall 2005 for teacher leaders and project staff was our first intentional effort to focus on sustainability of the project's many successes. And the rich networks that have emanated from project activities are illuminated with several brief anecdotes.

Please refer to the table of contents to find any of these subsections directly.

1. K12-led activities and findings:

Curriculum guides and professional development:

During the academic year 2005 - 2006, the VIP K16 grant funded the development of 7 new curriculum guides for core science courses in Matter & Energy (4), Earth Space Systems (2), and Chemistry (3). Grant staff worked closely with teachers and MCPS instructional specialists in Science, English Language Arts, Special Education, and ESL to produce the instructional sequence for each guide. Complete sets of curriculum guides are now available for teachers of Biology, Chemistry, and Earth Space Systems. Additional curriculum guides are in production for Matter & Energy (6) and Physics (7) and will be available during the 2006-2007 academic year.

We experienced difficulty this year meeting the original production schedule for curriculum guides for Matter & Energy. It was necessary to rewrite the curriculum framework for the course. The original indicators were simply lifted from chemistry and physics and were not appropriate for grade nine students in a physical science course. Because of this, writing the curriculum guides was delayed. In addition, science instructional specialists were required to assist in the development of elementary science curriculum guides. The secondary specialist for science spent many hours working on elementary curriculum rather than high school. The production delay for guides caused us to miss opportunities for professional development with our teachers. Sessions were held during cohort conferences using portions of the guides, but complete guides were not available for teachers. Therefore, data pertaining to outcomes for Objective 1.1 (students "participate in inquiry activities in the classroom") is incomplete.

Assessments:

The grant also funded and coordinated the development of eight summative assessments, one per semester for Matter & Energy, Earth Space Systems, Chemistry, and Physics. The assessments were aligned with the content of the curriculum guides and the indicators of learning from the Maryland State Department of Education. Item performance data were collected for each assessment and used to revise items that did not meet psychometric performance standards. Student performance data were also collected for each semester. The January 2006 data were included in the Evaluator's Report and disaggregated by outcomes and by school and student subgroups.

Dissemination:

Our work on curriculum, assessment, and professional development is having a positive impact on the larger science education community. In April 2006, we presented at the NSTA National Meeting, on "Using the Assessment Cycle to Improve Learning in Biology." The participant survey results revealed that our presentation met the expectations of those educators who attended the session. The session evaluation data used a five-point Likert scale with (1) signifying "strongly agree." The survey statements and scores are listed below (n was not provided, but there were approximately 75 people in attendance).

1. I selected this session:
    a. for immediate classroom use. 2.3
    b. based on the reputation of the speaker.....3.5
    c. to improve my personal pedagogical knowledge/skill.....1.4
    d. to improve my science content knowledge.....2.9
2. The session met my needs.....2.0
3. The information presented was clear and well-organized.....1.7
4. Safe practices were employed.....1.5
5. The session avoided commercial solicitation.....1.5
6. The session should be repeated at another NSTA conference…...1.8

Through informal discussions with attendees, it became clear that many school systems do not have curriculum guides for core science courses that include pre-assessment, formative, and summative assessments, nor do they have the capacity to develop them. Many teachers indicated that their school system budgets do not include monetary resources for curriculum and/or assessment development. Quite a few inquiries were made about the intent of MCPS to sell their science curriculum guides. Other questions were asked about the availability of professional development to accompany the guides. Participants were impressed that the VIP K-16 grant provided extensive professional development on curriculum, instruction, and assessment through workshops, seminars, conferences, and summer institutes. We consider these reactions as evidence that our methods are valuable and that many feel they can learn a great deal from our experiences.

Science Instructional Guide Review form:

A "must have list" for curriculum guide development was written with input from instructional specialists in Science, Special Education, English Language Learners, and English Language Arts. The collaboration among the specialists produced a document that will be used by writers and editors to be sure that components of effective instruction for all students are included in every curriculum guide produced for Biology, Chemistry, Earth Space Systems, Matter & Energy, and Physics.

2. IHE-led activities:

Although the tables that follow document the new and continuing activities led by each individual IHE partner, some discussion is warranted of the extensive collaboration and cross-fertilization of ideas among IHE partners that has characterized much of our efforts this year. While some of our most successful programs have continued or expanded within an institution (such as the ExPERT program for MCPS teachers at UMBI), a few have spread to other partners. Three in particular deserve closer attention: undergraduate internships in K-12 classrooms, faculty learning communities, and undergraduate course reform. Following these are findings from this year's expanded ExPERT program.

K-16 partnership: Undergraduate student internships in K-12 classrooms

As described in previous annual reports, the Science Educator Internship Program (SEIP) for STEM undergraduates at UMCP has provided students with a window on what life is like in the K-12 science classroom and an opportunity to collaborate with high-school science teachers on getting youth interested in science. In Spring 2005, nine undergraduates and 10 MCPS science teachers participated in the program. The selected undergraduate students spent 10 weeks (with an average of 3-4 hours each week) partnering with a MCPS science teacher. The internship structure was determined by each teacher-student pair; however, at the most basic level, student interns routinely helped tutor students, design assessments, prepare and set up laboratories, and develop lesson presentations with the MCPS teachers. The weekly journal entries that student interns are required to write about their experiences are currently being analyzed to determine the effect the program has had on their interest in teaching.

While UMCP's SEIP has continued, we have now implemented a similar program on the UMBC campus. This new fellowship program recruited 12 undergraduate science majors this year; they worked directly with Montgomery Country teachers in high school science classrooms. As a program requirement, student fellows took pre- and post-surveys about their expectations and experiences in the classrooms, which were used to gauge the impact and effectiveness of the program. The surveys revealed positive results. By participating, student fellows were able to assist MCPS teachers with labs and field trips, answer students' questions about lab procedures and course material, organize a field trip to UMBC to introduce them to opportunities in science at the university level (as well as the biochemistry tools used to study the chemistry concepts about which students are learning), and provide feedback on curricula used by MCPS teachers. They were also encouraged to bring their content knowledge from UMBC into the K-12

classroom. According to one UMBC student fellow, this type of engagement with the curriculum got the high school students "excited about the material" by providing them with, in her particular case, a "future hands on lab and demonstration about aquaculture, hydroponics, fishes, crustaceans, and relative ecosystems, species tolerance, and the balance between man and his environment."

In addition to descriptions of the UMBC fellows' activities, the survey also explored levels of student interest in teaching before and after participation in the fellowship. Interest in teaching, as expressed in the pre-survey, was sustained even after their participation in the fellowship. The results suggest that by participating students were able to have a better and more realistic understanding of teaching as a career. The experience helped to reinforce their desire to pursue this career path. The responses showed an overall satisfactory experience and that the fellowship met their expectations.

Participating MCPS teachers also gave positive feedback on UMBC's program. At a recent networking meeting at Northwood High School, teachers stated they were excited to have interns assist in the classroom, especially the ability for interns to infuse their strong content knowledge into teaching. Teachers further stated that they would love to have an intern in their classroom in Year 5 and will encourage their colleagues to host an intern as well. MCPS teachers are helping to recruit their colleagues by promoting the program, through sharing their experiences and program value, at various meetings around the county.

Faculty-teacher learning communities

One of the most important ways teachers can get the support they need to change their teaching practices, we believe, is by having the opportunity to talk about teaching and learning with other teachers in a safe, collaborative environment. The learning community of VIP faculty fellows at Towson University that was established in Year 1 has served as our best model of this environment, as described in previous reports. We have now extended this model to Montgomery College and UMBC, but with important differences that should be noted. These differences are due to the different kinds of relationships that project leaders have with science faculty at each institution as much as to the differences in the institutions themselves.

As with Towson's learning community, the one at Montgomery College (MC) aims to encourage the infusion of inquiry-based instruction into faculty fellows' courses, and the community meets once a month in working seminars to discuss their lesson plans and share constructive feedback. However, while peer observations of classrooms at Towson are conducted by other faculty fellows, at MC it is only the VIP project director who visits fellows' classrooms, at least to date. He arranges visits to classrooms when inquiry-based activities are in progress and engages in follow-up conversations to help faculty assess the effectiveness of the activities.

One reason for this difference is how the learning communities were initiated and developed. While Towson's community began with long-existing relationships among the project director, Dr. Luz Mangurian, and various science faculty, at MC the project director (who had just joined MC) initiated the community with broad calls to each science department for faculty to attend a seminar he gave on inquiry instruction (see our Year 3 progress report). In addition, at Towson the faculty of science education belongs

to the science departments (rather than the education school), and so the local expertise in inquiry instruction is seen as coming from more familiar departmental colleagues.

The community at UMBC looks even more different. The 7 faculty fellows are also engaged in designing inquiry-based instruction, but they are working directly with several teachers from Montgomery County Public Schools. Additionally, they meet as small groups (of 1-2 faculty and 1-3 teachers) and everyone comes together only at twice-a-year symposia. At last January's symposium, for example, MCPS teachers and UMBC faculty started discussing the inconsistencies across K-16 in pedagogy and curricula, especially in relation to students' transition from high school to college. These symposia are excellent opportunities for faculty and teachers to network and share their VIP experiences, learn from each other, and provide insights and feedback to program administrators, but the program at UMBC is relatively new and now looks more like a collection of several partnerships than a single cohesive learning community.

Again, these differences are due not only to how recently the community was initiated, but also to *how* it was initiated and what relationships already existed among the participants. UMBC project directors at the Shriver Center sent requests for proposals to faculty for individual projects, offering stipends for fellows to work with teachers on learning about and designing inquiry instruction. Although the Shriver Center has many connections with science faculty and departments by virtue of its work with the community on a number of different activities (such as service learning), it is not itself a science department and is thus administering the learning community from outside the science classroom.

Undergraduate STEM course reform

The project goal for improving the teaching of science at the undergraduate level has been one of the most important outcomes of our faculty learning communities. By increasing faculty's understanding of inquiry instruction and providing collaborative environments for instructional design and redesign, we have seen many changes in STEM courses at several institutions. To date, 30 VIP faculty fellows have been involved in reforming some aspect of their science course or courses.

NUMBERS OF STEM FACULTY ENGAGED IN REDESIGNING UNDERGRADUATE SCIENCE (January 2006):

IHE Faculty	N	IHE Partner		
		Towson U.	U. Maryland, Baltimore County	Montgomery College
Biologists	11	6	1	4
Chemists	6	3	1	2
Physicists	5	2	1	2
Geoscientists	4	2	1	1
Education fac.	1		1	
Mathematicians*	3		2	1
Total	**30**	13	7	10

* VIP K-16 does not actively recruit mathematics teachers or faculty, but has attracted some nonetheless.

Course design and revision at Towson University has continued this year as planned. The degree of growth in teaching practice that we have observed among all the participating faculty fellows has been noticeable. As a result, the degree of student involvement and enthusiasm for content learning is above the norm for undergraduate science courses. Dr. Mangurian, the project director at Towson, interviewed fifteen undergraduates enrolled in a general biology laboratory (taught by Prof. Sarah Bruce). After presenting group experiment posters, students were asked to compare Prof. Bruce's teaching style to one they normally receive in other classes. Their responses expressed clearly favorable views of inquiry-oriented teaching and a desire to see similar experiences extended to other courses.

To ensure that these course reform efforts are of high quality, the Towson fellows are also deeply involved in developing new assessments of various aspects of student learning. As a group, they designed pre- and post-tests of critical thinking skills, based on existing educational research, to determine the impact of science inquiry methodology on their students (Westat is in the process of analyzing the data from this instrument). The fellows are also preparing tests to compare student content understanding in units taught traditionally with those taught using science inquiry methodology. In addition, three fellows will have undergraduate student assistants involved in their teaching research because of the increasing desire of the faculty fellows to match their teaching strategies with student understanding of disciplinary content.

At Montgomery College, every faculty fellow in the learning community is changing their instruction in some way. One outstanding example is occurring at the Takoma Park/Silver Spring campus of MC. Dr. Ijeoma Otigbuo, professor of biology, has rewritten large portions of the microbiology course to include many opportunities for students to ask questions, propose solutions, analyze data, and support their positions with evidence. She has also designed a questionnaire to evaluate the effectiveness of her new lessons. The results after the first year are encouraging, which shows a greater retention of students in the course and a significant increase in biomedical majors.

Enthusiasm for inquiry-focused teaching both at Towson and at MC has also motivated several faculty fellows to introduce inquiry practice into courses not directly supported by the VIP K-16 grant as well. For example, Dr. Otigbuo (of MC) is writing ancillary materials that will be shared with adjunct microbiology faculty so that they, too, will know how to teach the inquiry-based lessons. In another example, Towson Prof. Rachel Burks, for many years, gave geology field trips in a standard expository manner. However, through her exposure to inquiry teaching, she decided to incorporate the practice into this year's field trip. Responses from students included a noticeably enjoyable experience and a deeper understanding of the underlying geology principles (as reflected in their journal inquiries and responses to essay questions).

UMBC's faculty fellows have all been working on science course reform, some of them in partnership with MCPS teachers. For example, Dr. Mark Perks has partnered with several teachers to significantly modify the Chemistry 101 course to incorporate Peer-Oriented, Group Inquiry Learning (POGIL), a change that has resulted in increased student achievement and retention. (We have planned similar reforms for Chemistry 102 and 102L for the coming year involving much of the Chemistry department.)

Phil Sokolove, UMBC's senior VIP K-16 faculty fellow, has continued to implement a special discussion section of his introductory biology course in which he

focuses on inquiry-based instruction and teaching as a career. Preliminary information from this special section from Fall 2005 and Spring 2006 shows that 5 of 14 participants and 3 of 7 participants respectively indicated that they had changed their minds about considering a career in teaching (from negative to positive). Also 4 out of 14 participants in Fall 2005 and 3 of 7 participants in Spring 2006 retained their high interest level in teaching.

At UMCP, the VIP project is working alongside a significant initiative by the administration to develop and teach a set of non-major science courses (in several departments) that prioritize science as inquiry. This major project will begin near the end of Year 4, and so is described more fully in Section 5.

Studying the inquiry understanding of ExPERT program teachers

During Year 4, the inquiry learning community of teachers participating in the ExPERT program decided that one way in which they would reflect on their own teaching practice was to use a rubric on inquiry teaching that they modified from one developed by Llewellyn (2002), the same author who designed the basis for the Inquiry Teaching Survey that we also modified. The results of ExPERT teachers' self-assessment using this rubric follow, and clearly show significant increases in their understanding and use of inquiry instruction over the course of the year.

Self-report of ExPERT teachers on modified Llewellyn (2002) rubric:
Curriculum: All teachers indicate they have progressed to "transitioning" or "practicing" inquiry with respect to curriculum items.
Lesson presentation: All teachers except one have increased the breadth/depth of topics and student-centeredness of the activities in their classrooms.
Communication: All teachers are using less lecture and all but one is using more small group work in their classrooms. All teachers except one are offering more positive feedback to students.
Engagement: All teachers except one has increased use of hands-on, minds on activities, cooperative learning, open-ended questioning, and polling for prior knowledge.
Questioning: All teachers have increased questioning to include open-ended questions, reaching all students at all levels, and not right-answer-oriented.
Assessment: All teachers have changed assessment such that multiple methods are employed. Five teachers indicate an increase in use of self-assessment in their classrooms; two have not changed and use it at an "exploratory" level.

In addition, we conducted an epistemological analysis of videotapes of discussion sessions with teachers over the summer and at professional learning community meetings and retreats during school year, and of their summer journaling. Analysis indicates that teachers develop *epistemological resources* (Elby & Hammer, 2001; Louca, Hammer, & Kagey, 2004) for the nature of science and inquiry in the contexts of science and classroom teaching as a result of explicit epistemological discourse around these topics in the context of science and of teaching science. Some teachers recognize their own use of metacognition in "calling up" these resources in conversations about science and science teaching. Resources for some can be unstable when used in the context of origin (science research), but not in the more distal context of teaching. School-year discussions indicate

a benefit to reinforcing and diversifying use of these epistemological resources in the context of curriculum and instruction and explicitly relating them back to the context of origin (science).

3. Networking and new collaborative relationships:

Our external evaluator, Westat Inc., has conducted a survey of our program participants to determine the meaningful connections that have been made among them as a result of participation in VIP. Although the results are still being analyzed at this time, we are confident they will show that faculty, teachers, administrators, and others have developed relationships with colleagues outside of their own institutions. Indeed, we were aware of so many examples of these productive partnerships that we decided to work with Westat to capture the extent of the phenomenon with the survey. To complement the quantitative analysis that Westat is conducting, we share here a few anecdotes about new collaborative relationships among VIP participants and comment on the perceived effects on the institutions they represent.

(1) First, it's clear that MCPS has benefited a great deal from connections made through VIP. The science office staff, particularly project manager Gary Hedges, has developed ongoing relationships with numerous IHE faculty and administrators from the USM office as well as the partner campuses. These connections have been useful for moving curriculum and assessment development along in the higher administrative levels of MCPS, and serve as a basis for what all of us expect to be additional collaborative projects in the future.

(2) We were able to connect Dr. Susan Hoban of UMBC's Goddard Earth Sciences & Technology Center with Dr. Sandy Honda of UMBI's ExPERT program. Dr. Honda was looking for a laboratory in which to place one of the ExPERT teachers for Summer 2006. Dr. Hoban will be hosting this teacher in her lab this summer. This connection would not have been possible without the networking offered through the grant.

(3) The January 2006 VIP symposium at UMBC resulted in several networking and collaborative outcomes including:

   a. Dr. Phillip Sokolove (VIP K-16 Senior Faculty Fellow) now collaborates with Dr. Mark Perks and Dr. John Zweck (whom he didn't know at all prior to this symposium) on best practices in inquiry-based teaching and TA training.
   b. The discussion of the issues surrounding the transition from high school to college has inspired Dr. John Zweck to the point of him doing an informal survey of students to learn more. The results of his survey are compiled online at this address: http://www.math.umbc.edu/nobackup/faculty/zweck/TATrain/StudyHabits.html Dr. Zweck has also gone a step further to include input and insights from 2 of our strongest MCPS teacher partners – David Culpepper and Cathy Cross. This is a great example of how VIP has facilitated connections across educational systems and how teachers can be viewed as mentors to faculty.

c. The discussion of the issues surrounding the transition from high school to college also has lead to a subsequent forum that will be held at UMBC on June 21 and will engage 20-25 MCPS teachers, Baltimore County teachers, and UMBC and Montgomery College faculty and administrators in a dialogue regarding the alignment of curricula and pedagogy across K-16 (including inquiry as a best practices methodology for teaching and learning). Such an intentional and formalized networking opportunity would not have been possible without the grant and the January symposium.

4. Building sustainability: Fall retreat 2005

After the first three years of our five-year grant, we decided it was time for the Master Science Teachers, faculty fellows, and college student fellows to get together with project staff to take stock of what we've accomplished and make plans for the next two years and beyond. In fact, the focus of the retreat was on the "beyond" part. In providing professional development and aiding curriculum design and redesign, the VIP project has created opportunities for science teachers and faculty to become leaders among their peers. The success we've had at developing this leadership is something we all want to sustain beyond the end of the grant. In these two days, the approximately 50 retreat participants identified ways in which we have developed leadership and began to envision how we can sustain it.

The specific goals of the retreat were to:

1. Determine which activities are worth sustaining after the grant expires
2. Generate ideas about how they might be sustained
3. Develop plans for moving these ideas forward

The first part of the retreat consisted of brainstorms, discussions, and votes to determine which aspects of the VIP program participants felt are “successes,” that is, are worth sustaining beyond the end of the grant. The six successes chosen are described below.

Two of the most important successes we identified were not even put on the ballot, because they are already in place and were expected to be sustained with little additional effort. These are the curriculum guides and assessments that have been developed (some of which are currently being developed) by teams of VIP participants for the 5 high school science courses. At the time of the retreat, MCPS had committed to continue the implementation of these essential teaching tools in the hopes they will improve student outcomes as we expect.

In the second part of the retreat, we began the difficult process of envisioning how these six successes might be sustained. We identified what resources, structures, and personnel are required to carry an idea forward. Most of this work was done in small, self-selected working groups, each of which tackled one of the six successes. Their work was then shared with the other groups for feedback and cross-fertilization of ideas. Depending on the complexity of the topic, and the resources available, some groups were able to work out details of working-group communication and determine an action plan for the near future. An executive summary of the notes from these discussions and whatever action plans came out of them is currently in preparation.

SIX SUCCESSES OF THE VIP K-16 PROJECT THAT ARE WORTH SUSTAINING (from Fall 2005 Retreat):

Individual course revision and development for inquiry approach
We envision continuing a process of "retail" development or revision of courses that embody an inquiry approach to learning.
Teacher-faculty learning communities and inquiry support groups
One important aim is to get teachers and faculty who were trained traditionally to buy in to the concept of inquiry teaching and learning, and for others to collaborate effectively in designing inquiry instruction. We have found this to be best achieved through learning communities of practitioners who can support each other in their development toward better understanding and use of inquiry methods.
Professional development
Activities include cohort conferences, summer institutes, Master Science Teacher training sessions, and similar workshops that bring teachers together to improve their knowledge and skill in teaching science.
Undergraduate-teacher partnerships
These are early teaching experiences for science undergraduates, who should continue to have opportunities for interning in K-12 science classrooms and working directly with teachers.
Science research experiences for teachers and students
We have found the existing ExPERT program of VIP to be extremely valuable, as well as the student inquiry conference, and would like to see more such opportunities for K-12 teachers and students, perhaps along the lines of the Research Experiences for Teachers (RET) and Research Experiences for Undergraduates (REU) programs.
Expansion and dissemination
To create a truly statewide community of science teaching faculty, we must reach out to and partner with other school districts and other colleges and universities. We must also bring K-8 educators to the table. At the very least, we should disseminate our ideas, activities, and findings to the larger Maryland science education community.

5. Scholarly work produced:

During the fourth year of our grant, various participants and project leaders disseminated project findings through newsletter publications and presentations at national conferences such as the National Science Teachers' Association (NSTA), American Education Research Association (AERA), and American Association of Physics Teachers (AAPT). Below is a list of publications and presentations on VIP activities:

Publications:

D. Langenberg (2005). "Well, It's About Time!" *Teaching and Learning News* Vol. 14, No. 4, pp. 1, 9-10. University of Maryland Center for Teaching Excellence newsletter.

D. Poese (2006). "Inquiring minds: studying science through inquiry." *Focus on Faculty*, April 2006. Montgomery College, Center for Teaching and Learning newsletter.

Presentations at major conferences:

G. Hedges, M. Szesze, G. Morse (2004). Secondary and Post-Secondary Articulation: Improving Science Instruction. NSTA National Convention. Atlanta, GA.

M. Szesze, T. Townsend, G. Morse, M. Cimino, C. Ulicny (2004). Frameworks to Curriculum Guides: Getting National Science Education Standards into the Classroom. NSTA National Convention. Atlanta, GA.

M. Szesze, G. Morse, G. Hedges, M. Cimino, C. Ulicny (2004). Writing In Science. NSTA National Convention. Atlanta, GA.

G. Hedges. 2004. How Teacher Research Supports Professional Development (2004). International Conference on Teacher Research (ICTR). La Jolla, CA.

G. Hedges, S. Honda, S. Pasha, J. Stewart (2005). ExPERT: Extended Professional Experiences in Research for Teachers. NSTA National Convention. Dallas, TX.

G. Hedges, G. Hearne, W. Krayer, C. VonSecker (2005). SRs and BCRs, What do They Mean For Students? NSTA National Convention, Dallas, TX. (SR = Selected Response item; BCR = Brief Constructed Response item)

D. Levin, P. Hutchison, S. Honda (2005). Teacher Thinking about Student Inquiry in Secondary Science. AERA Annual Meeting, Montreal, QC.

D. May (2005). Science teacher professional development through a large-scale, high-school and university partnership. AAPT National Meeting, Salt Lake City, UT.

S. Honda and D. May (2006). A Resources Interpretation of Teachers' Epistemologies of Science. Paper presented at the International Conference of the Learning Sciences, Indianapolis, IN.

B. Krayer and D. Poese (2006). Recycling Retired Resources for Building Science Inquiry: From High School to Community College. Presented at NSTA National Convention, Anaheim, CA.

6. References cited in the Activities and Findings section:

Elby, A. & Hammer, D. (2001). On the substance of a sophisticated epistemology. Science Education, 85 (5), 554-567.

Llewellyn, Douglas (2002). Inquire Within. Corwin Press: Thousand Oaks.

Louca, L., Elby, A., Hammer, D., & Kagey, T. (2004). Epistemological resources: Applying a new epistemological framework to science instruction. Educational Psychologist, 39 (1), 57-68.

C. Implementation and Goals Matrices

Montgomery County Public Schools (MCPS)

Exhibit 1 a: IMPLEMENTATION MATRIX FOR MCPS

Goal 1: Improve student learning outcomes, as measured by High School Assessments.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
1.1 Participate in inquiry activities in the classroom	Cohort Conference (4 for Matter & Energy teachers and Earth-Space Systems teachers) sessions devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) session devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda	TQQD, CCC, ICS			X			Seminar sessions varied among schools, some offered fewer than seven while others offered more than seven. One school in particular, Springbrook, did not provide seminars for their

	devoted to incorporating inquiry activities into instruction							teachers.
	Student inquiry conference	CCC, ICS	X					90 students and their teachers from 7 different high schools participated. Higher education faculty were also present.
	Summer institute sessions devoted to inquiry in MCPS curriculum guides	TQQD, CCC, EBDO, ICS	X					Expecting approximately 150 participants

1.2 Improve percentage of correct responses to HSA type selected response items measuring science process skills	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to use of science process skill items in instruction	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to use of science process skill items in instruction	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to formative assessment	TQQD, CCC, ICS			X			Seminar sessions varied among schools, some offered fewer than seven while others offered more than seven. One school in particular, Springbrook, did not provide seminars for their teachers.
	Summer institute sessions devoted to use of science process skill items in instruction	PD, TQQD, CCC, EBDO	X					Expecting approximately 150 participants

1.3 Improve percentage of correct responses to HSA type selected response items measuring science concepts	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to use of science concept items in instruction	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to use of science concept items in instruction	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to formative assessment	TQQD, CCC, ICS			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.
	Summer institute sessions devoted to use of science process skill items in instruction	PD, TQQD, CCC, EBDO	X					Expecting approximately 150 participants

1.4 Improve student skills in reading science literature	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to improving science reading skills	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to improving science reading skills	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to formative assessment	TQQD, CCC, ICS			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.
	Biology HSA intervention strategies implemented	TQQD, CCC	X					New activity. Planned meetings and three day-long workshops for biology teacher at each school to replace cohort conferences now that the biology cohort has officially ended.
	Summer institute sessions devoted to improving science reading skills	PD, TQQD, CCC, EBDO	X					Expecting approximately 150 participants

1.5 Improve student writing skills in science	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to improving student writing skills	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to improving student writing skills	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to formative assessment	TQQD, CCC, ICS			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.
	Summer institute sessions devoted to improving student writing skills	PD, TQQD, CCC, EBDO	X					Expecting approximately 150 participants
	Biology HSA intervention strategies implemented	TQQD, CCC	X					New activity. Planned meetings and three day-long workshops for biology teacher at each school to replace cohort conferences now that the biology cohort has officially ended.

1.6 Increase student participation in advanced science courses	Cohort Conference (4 for Chemistry and Physics teachers) session devoted to devising strategies to increase enrollment in Chemistry and Physics	PD, TQQD, CCC, EBDO, ICS	X					
	Summer institute sessions devoted to devising strategies to increase enrollment in Chemistry and Physics	CCC	X					Expecting approximately 150 participants

Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
2.1 Increase the number of inquiry activities in instruction	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) session devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to incorporating inquiry activities into instruction	TQQD, CCC, ICS			X			Seminar sessions varied among schools, some offered fewer than seven while others offered more than seven. One school in particular, Springbrook, did not provide seminars for their teachers.
	Summer institute sessions devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					Expecting approximately 150 participants

2.2 Increase the number of teachers using strategies to promote reading in science	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to improving science reading skills	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to improving science reading skills	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to formative assessment	TQQD, CCC, ICS			X			Seminar sessions varied among schools, some offered fewer than seven while others offered more than seven. One school in particular, Springbrook, did not provide seminars for their teachers.
	Summer institute devoted to improving science reading skills	PD, TQQD, CCC	X					Expecting approximately 150 participants
	Content literacy workshops for each discipline	PD, TQQD, CCC	X					

2.3 Increase the number of teachers using strategies to promote writing in science	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to improving student writing skills	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to improving student writing skills	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to formative assessment	TQQD, CCC, ICS			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.
	Summer institute sessions devoted to improving student writing skills	PD, TQQD, CCC	X					Expecting approximately 150 participants

2.4 Conduct action research	Seminars (7 total held monthly at each high school) with part of the agenda devoted to action research	TQQD, CCC, EBDO, ICS			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.
	Cohort Conference (4 for Chemistry and Physics teachers) sessions devoted to action research	PD, TQQD, CCC, EBDO, ICS	X					
	Summer institute sessions devoted to action research	PD, TQQD, CCC, EBDO	X					Expecting approximately 150 participants
2.5 Implement curriculum guides and assessments into instruction	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) session devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to inquiry in MCPS curriculum	TQQD, CCC, ICS			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.

	guides							
	Summer institute sessions devoted to inquiry in MCPS curriculum guides	PD, TQQD, CCC, ICS	X					Expecting approximately 150 participants
2.6 Utilize "Tuning Protocol" to steer instruction	Cohort Conference (4 for Matter & Energy teachers and Earth Space Systems teachers) sessions devoted to using the Tuning Protocol	PD, TQQD, CCC, EBDO, ICS	X					
	Cohort Conference (4 for Chemistry and Physics teachers) session devoted to using the Tuning Protocol	PD, TQQD, CCC, EBDO, ICS	X					
	Seminars (7 total held monthly at each high school) with part of the agenda devoted to using the Tuning Protocol to review a lesson	TQQD, CCC, EBDO			X			Some schools did not provide seminars for their teachers, particularly from Springbrook. A few schools did not offer seven and some schools offered more than seven seminars.

Exhibit 1 b: GOAL MATRIX FOR MCPS

Goal 1: Improve student learning outcomes, as measured by High School Assessments.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
1.1 Participate in inquiry activities in the classroom	Students experience one inquiry lesson sequence from Earth Space Systems and Matter & Energy guides	X					At least 2 guides are out for each discipline.
	Students experience one inquiry lesson sequence from Chemistry and Physics guides	X					At least 2 guides are out for each discipline.
	Each school will hold 5 seminars		X				On the average schools held 5 seminars; some held more, some held fewer seminars.
	Observations of some classrooms are carried out by Westat	X					
	Student inquiry conference	X					90 students and their teachers from 7 different high schools participated. Higher education faculty were also present.

1.2 Improve percentage of correct responses to HSA type selected response items measuring science process skills	Collect baseline data for Matter & Energy;	X					Increased from 52.5% to 57.5%
	Compare 2005-06 field test data for Earth Space Systems with 2004-05	X					Increased from 47.4% to 60.1%
	Compare 2005-06 data with baseline collected in 2004-05 for Chemistry and Physics.	X					Chemistry increased from 70.7% to 77.4% Physics decreased from 68.3% to 66.1%
	Each school will hold 5 seminars		X				On the average schools held 5 seminars; some held more, some held fewer seminars.
1.3 Improve percentage of correct responses to HSA type selected response items measuring science concepts	Collect baseline data for Matter & Energy;	X					Increased from 43.4% to 49.6%
	Compare 2005-06 field test data for Earth Space Systems with 2004-05	X					Increased from 35.2% to 48.1%
	Compare 2005-06 data with baseline collected in 2004-05 for Chemistry and Physics.	X					Chemistry increased from 57.2% to 61.9% Physics increased from 55.3% to 59.1%
	Each school will hold 5 seminars		X				On the average schools held 5 seminars; some held more, some held fewer seminars.

1.4 Improve student skills in reading science literature	Collect baseline data for Matter & Energy;	X					Improved from 27% to 43% correct
	Compare 2005-06 field test data for Earth Space Systems with 2004-05	X					Improved from 46% to 55% correct
	Compare 2005-06 data with baseline collected in 2004-05 for Chemistry and Physics.	X					Chemistry improved from 62% to 72% correct; Physics improved from 55% to 61% correct
	Each school will hold 5 seminars		X				On the average schools held 5 seminars; some held more, some held fewer seminars.
1.5 Improve student writing skills in science	Collect 2005-06 baseline data for Matter & Energy and Earth Space Systems		X				Teachers have participated in professional development to learn how to score these items; not been met because teachers didn't submit scores as requested; have very little baseline data; some schools did send in sample school responses but didn't send in tally of their scores
	Collect 2005-06 baseline data for Chemistry and Physics		X				Teachers have participated in professional development to learn how to score these items; not been met because teachers didn't submit scores as requested; have very little baseline data; some schools did send in sample school responses but didn't send in tally of their scores
	Each school will hold 5 seminars		X				On the average schools held 5 seminars; some held more, some held fewer seminars.

1.6 Increase student participation in advanced science courses	Collect baseline data on enrollment in Chemistry and Physics	X					Enrollments for school year:	2004-05	2005-06
							Chemistry	7788	7590
							Physics	4398	3741
							AP Chemistry	760	760
							AP Physics	715	694
							See enrollment for all advanced science courses in Evaluator's Report.		

Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
2.1 Increase the number of inquiry activities in instruction	Increase use of MCPS curriculum guides in Earth Space Systems	X					4 guides in place, 2 in production.
	Production of curriculum guides for Matter and Energy	X					2 guides in place, 8 in production.
	Use of curriculum guides in Chemistry	X					7 guides in place, 4 in production.
	Production of curriculum guides in Physics	X					2 guides in place, 8 in production.
2.2 Increase the number of teachers using strategies to promote reading in science	Increase use of MCPS curriculum guides in Earth Space Systems	X					4 guides in place, 2 in production.
	Production of curriculum guides for Matter and Energy	X					2 guides in place, 8 in production.
	Use of curriculum guides in chemistry	X					7 guides in place, 4 in production.
	Production of curriculum guides in Physics	X					2 guides in place, 8 in production.
	3 Content literacy workshops in all five science disciplines	X					

2.3 Increase the number of teachers using strategies to promote writing in science	Increase use of MCPS curriculum guides in Earth Space Systems	X					4 guides in place, 2 in production.
	Production of curriculum guides for Matter and Energy	X					2 guides in place, 8 in production.
	Use of curriculum guides in chemistry	X					7 guides in place, 4 in production.
	Production of curriculum guides in Physics	X					2 guides in place, 8 in production.
2.4 Conduct action research	50% of Matter & Energy and Earth Space Systems teachers will post their research on the project web site		X				Teachers have not be using this part of the website. This benchmark could still be met by the end of the year, as Summer Institute will include opportunities for teachers to post their action research.
	10% of Chemistry and Physics teachers will post their research on the project web site		X				Teachers have not be using this part of the website. This benchmark could still be met by the end of the year, as Summer Institute will include opportunities for teachers to post their action research.
2.5 Implement curriculum guides and assessments into instruction	Teachers document using one inquiry lesson sequence from Earth Space Systems and Matter & Energy guides					X	Teachers are not yet comfortable using activity log on website
	Teachers document using one inquiry lesson sequence from Chemistry and Physics guides					X	Teachers are not yet comfortable using activity log on website
	Increase use of MCPS curriculum guides in Earth Space Systems	X					4 guides in place, 2 in production.

	Production of curriculum guides for Matter and Energy	X					2 guides in place, 8 in production.
	Use of curriculum guides in chemistry	X					7 guides in place, 4 in production.
	Production of curriculum guides in Physics	X					2 guides in place, 8 in production.
	Summative assessments have been developed for all four science courses	X					
2.6 Utilize "Tuning Protocol" to steer instruction	ESS and M&E teachers document using the Tuning Protocol one time					X	Teachers are not yet comfortable using activity log on website
	Physics and Chemistry teachers document using the Tuning Protocol one time					X	Teachers are not yet comfortable using activity log on website
	Each school will document using the Tuning Protocol one time to review a lesson	X					

Montgomery College (MC)

Exhibit 2 a: IMPLEMENTATION MATRIX FOR MONTGOMERY COLLEGE

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
3.1 Increase the number of faculty participants who use inquiry instruction in science -and- 3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Recruit new faculty fellow in physical sciences	TQQD, CCC			X			Two fellows that had been identified but were not participating have now become heavily invested in the project; they are now doing curriculum development.
	Recruit/identify faculty participants in earth/space science and chemistry areas.	TQQD, CCC	X					Two chemists and one geoscientist are now participating. Project director has also communicated extensively with other geoscience faculty.
	Review/ revision of course/lab activities and outcomes in first-year courses in Biology and Physical Sciences.	CCC, ICS	X					One physical science (elementary education) course and three different introductory chemistry courses have been modified by adding elements of inquiry. One meteorology course has been completely redesigned. The microbiology course designed by one faculty fellow is now being taught by other instructors with the same materials.
	Project Director provides individual professional development support to each participant.	TQQD, CCC, EBDO	X					

-and- 3.3 Improve participating faculty's understanding of inquiry teaching practices	Science Inquiry focus groups/learning community gatherings held.	TQQD	X					One focus group per semester and 6 monthly working seminars.
	Establish professional science inquiry library on each campus	CCC, EBDO, ICS		X				Materials have been collected but permanent location has not been found yet. Project director is keeping a file of fellows' exemplary activities so others can have access to them.
	Fellows and faculty participants attend summer institute.	PD, TQQD	X					At least four are expected to attend.
	Science Inquiry workshops offered.	TQQD, CCC, ICS	X					One workshop was initiated and planned entirely by faculty fellows, with minimal support from project director, demonstrating their commitment to leadership in changing teaching practices.
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Fellow attends Cohort conferences.	PD, TQQD	X					At least two have attended.
	Fellow and faculty participants attend Summer Institute.	PD, TQQD	X					At least four are expected to attend.
	College institute course in meterology taught by faculty fellow to high school students at two MCPS high schools.	PD, CCC, ICS	X					New activity. Faculty interact with science teachers at participating schools.

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching -and- -5.2 Increase the number of participating undergraduate students who consider science teaching as a career -and- 5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	Field experience course for potential secondary science teachers is offered and students are recruited.	PD, TQQD, ICS	X					4 science and 3 math undergrads (placed with middle and high school science and math teachers in MCPS) all participate in course together.
	Recruit undergraduate students for participation in MCPS classroom observation/assistance.	PD, TQQD, EBDO	X					All 7 of above students participated.

Exhibit 2 b: GOAL MATRIX FOR MONTGOMERY COLLEGE

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Bench mark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
3.1 Increase the number of faculty participants who use inquiry instruction in science	New physical science fellow has participated in grant activities.	X					Two physics fellows have increased their involvement significantly.
	Two new participants identified for each cohort.				X		Two chemists and one geoscientist are now fellows.
	At least one course has new activity integrated into syllabi for all sections.	X					One physics; three chemistry; one microbiology, one meteorology have been revised.
3.2 Increase the number of inquiry activities used by faculty participants in science instruction	At least 50% of participants report using one new inquiry activity.	X					More than 50% of fellows are using new inquiry lessons.
	Inquiry Teaching Survey (student version) given pre- and post-instruction in the revised courses	X					New benchmark
	Survey designed by one biologist (Dr. Otigbuo) shows increased levels of inquiry in her course.	X					New benchmark
3.3 Improve participating faculty's understanding of inquiry teaching practices	At least three faculty attend the summer institute.	X					Four are expected to attend.
	At least 75% of workshop participants report increased understanding of inquiry teaching practices.			X			Additional inquiry workshop was not offered during this grant year; will be offered in Fall.

3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Fellow attends at least three cohort conferences.		X				At least 2 have attended one or two conferences each.
	At least three faculty attend the summer institute.	X					Four are expected to attend.

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	Sufficient students enrolled to offer field experience course at least once.	X					Course occurred Spring 2006
	At least five students are recruited to do classroom observations and complete at least one observation.	X					All 7 have completed observations in Spring 2006
5.2 Increase the number of participating undergraduate students who consider science teaching as a career	At least five students are recruited to do classroom observations and complete at least one observation.	X					All 7 have completed observations in Spring 2006
	Student questionnaires show increased interest in teaching	X					New benchmark

5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	At least one student transfers to a science teacher certification program in Maryland		X				Benchmark delayed

Towson University (TU)

Exhibit 3 a: IMPLEMENTATION MATRIX FOR TOWSON UNIVERSITY

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
3.1 Increase the number of faculty participants who use inquiry instruction in science --and-- 3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Dr. Joseph Topping, professor of Chemistry will be joining our faculty learning community.	TQQD	X					
	Three more courses prepared or modified for inquiry will be taught in Year 4.	CCC	X					
	Faculty Learning Community continues to meet regularly	TQQD, CCC, EBDO, ICS	X					
	Susannah Feldman taught Bio 201 classes and participated in pre-post tests to her students	TQQD, CCC, EBDO					X	New activity added to compare student performance of "control" students (in Feldman's course) and students learning through inquiry

--and-- 3.3 Improve participating faculty's understanding of inquiry teaching practices								
	Faculty fellows self-assessment survey	TQQD, CCC, EBDO	X					
	Manual for inquiry activities in the biology classroom was developed by Drs. Berkower and Bruce.	CCC, ICS	X					
	Some faculty will present their work at teaching conferences.	PD, TQQD	X					Luz Mangurian gave a workshop at the Lilly Conference (peer-reviewed) with Spencer Benson (UMCP) and Phillip Sokolove (UMBC)
	On-going creation and use of critical thinking survey	TQQD, CCC, EBDO					X	New activity
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Science inquiry activities developed by fellows will be presented to teachers at the Summer Institute.	PD, TQQD, CCC	X					
	Depending on teaching schedules, some faculty will attend Cohort conferences.	PD, TQQD	X					
	Dinner with Towson faculty fellows and MSTs and other teachers from Walt Whitman H.S.	PD, TQQD					X	New activity included networking and collaboration opportunities for working on inquiry instruction in science.

Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Brian Wysocki has increased number of science inquiry activities he uses in a high school Chemistry class in Howard County	PD, TQQD, CCC	X					
	Shira Manhaim has increased science inquiry activities she uses in a Baltimore County Biology high school class	PD, TQQD, CCC					X	New graduate student recruited into the project

4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	Brian Wysocki attended Cohort Conferences and Summer Institute to get acquainted with K-12 faculty	PD, TQQD	X					
	Shira Manhaim has attended the Summer Institute	PD, TQQD					X	New graduate student recruited into the project
4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	B. Wysocki has continued to develop a teaching portfolio	TQQD	X					
	S. Manhaim has developed a teaching portfolio	TQQD					X	New graduate student recruited into the project

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check one)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching --and-- 5.2 Increase the number of participating undergraduate students who consider science teaching as a	Our undergraduate, S. Stratmann will continue her role as "observer" in MCPS classrooms.	PD, TQQD, EBDO	X					
	S. Stratmann had monthly meetings with Dr. Topping and the director.	TQQD	X					
	S. Stratmann will continue to maintain the Science Education Bulletin Board at Towson.	TQQD, ICS	X					
	Will continue recruitment of undergraduate fellows for year 5.	TQQD	X					
	Interaction with MCPS teachers through cohort conferences, Summer Institute, and other opportunities	PD, TQQD	X					

career --and-- 5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS								

Exhibit 3 b: GOAL MATRIX FOR TOWSON UNIVERSITY

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
3.1 Increase the number of faculty participants who use inquiry instruction in science	14 Towson faculty fellows use inquiry instruction in science	X					New benchmark
3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Three completed inquiry-based courses	X					
	Average score on Inquiry Teaching Survey has increased	X					Results delayed. Inquiry Teaching Survey data will be collected at end of year. But anecdotally, we have seen an increase for almost all fellows.
	Baseline measured by classroom observations	X					New benchmark. Observations have been conducted and are being analyzed.
	Laboratory manual developed and implemented	X					Biology for Non-Science Majors course (BIO 202-05)
	Susannah Feldman taught a control group class to study the effects of inquiry on critical thinking skills	X					New benchmark. Data from comparison study are being analyzed.
	Geo 121 class pre and post tests on inquiry (given each year by professor) show	X					New benchmark

	increased knowledge (compared with previous year)						
3.3 Improve participating faculty's understanding of inquiry teaching practices	New courses, course activities, and lab manuals all show increased understanding						New benchmark. Results delayed while data are being analyzed.
	Average score on Inquiry Teaching Survey has increased						Results delayed. Inquiry Teaching Survey data will be collected at end of year.
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	A higher number of faculty fellows attended Summer Institute	X					
	A higher number of faculty fellows attended Cohort Conferences	X					
	There are more opportunities for teacher-faculty collaborations such as retreats and faulty dinner	X					New benchmark

Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Two graduate students (B. Wysocki and S. Manhaim) used inquiry instruction in science	X					New benchmark
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	B. Wysocki participated in Cohort Conferences, VIP retreat and Summer Institute	X					New benchmark
	S. Manhaim participated in Summer Institute	X					New benchmark. She joined the project mid-year

4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	Project director determined that graduate teaching portfolios demonstrated knowledge, skills and competencies were gained	X					

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	S. Stratmann attended Cohort Conferences and Summer Institute	X					New benchmark
5.2 Increase the number of participating undergraduate students who consider science teaching as a career	S. Stratmann's statements showed increased interest in teaching as a career	X					New benchmark

5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	One teacher hired by MCPS by end of grant.		X				

University of Maryland – Baltimore County (UMBC)

Exhibit 4 a: IMPLEMENTATION MATRIX FOR UMBC

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.

(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check one)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
3.1 Increase the number of faculty participants who use inquiry instruction in science --and— 3.2 Increase the number of inquiry activities used by faculty participants in	Revise or teach and evaluate 3 First Year Seminars in Science and Mathematics.	CCC, EBDO, ICS		X				Process of course approval delayed until next year. Next year will bring in more participation because of higher MCPS involvement.
	Recruit 2 earth space science faculty fellows	TQQD		X				One geologist recruited and five other (non-earth/space science) faculty recruited.
	Appoint 1-2 new members to the UMBC VIP Coordinating Council					X		New grant administration team obviates need for such a formal council.
	January symposium for networking between faculty fellows and MST's	PD, TQQD, CCC, EBDO, ICS	X					New activity

science instruction --and— 3.3 Improve participating faculty's understanding of inquiry teaching practices	involved in all of UMBC's projects							
	Senior faculty fellow collaborates with new fellows to increase their understanding of inquiry	TQQD	X					New activity
	Forum for MCPS and UMBC faculty and the other UMBC MSP	PD, TQQD, ICS	X					New activity
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Partnering a UMBC Faculty Fellow with a K-12 MST or RT from MCPS in a related activity.	PD, TQQD	X					Several fellows are partnered separately or in groups with several teachers in different activities. See below.
	Mark Bulmer (UMBC) partnered with a teacher from MCPS	PD, TQQD	X					
	Mark Perks (UMBC) partnered with several teachers from MCPS	PD, TQQD	X					
	John Zweck (UMBC) partnered with teachers from MCPS and Eric Anderson (UMBC) partnered with a teacher from MCPS	PD, TQQD	X					

	UMBC Faculty Fellows attended cohort conferences and summer workshops.	PD, TQQD	X					Senior faculty fellow attended. Faculty Fellow in astronomy presented at 2006 Summer Institute.
	Forum for MCPS and UMBC faculty and the other UMBC MSP	PD, TQQD, ICS	X					New activity
	Teacher Quality in Biology project participation by Senior faculty fellow and MCPS teacher	PD, TQQD	X					New activity
3.5 Develop cadre of college and university science leaders ("Maryland Science Faculty") to provide institutional and statewide leadership in undergraduate science education reform	Forum for building dialogue across and among MCPS and UMBC faculty to discuss K-16 alignment issues (along with participants of UMBC's other MSP with Baltimore County Public Schools)	PD, TQQD, ICS	X					New activity

Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.

(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check one)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Creating funding for GA or TA positions in science-based majors with a specific emphasis in inquiry based instruction.	TQQD					X	See below.
	Math TA training program (Dr. Zweck)	TQQD, CCC, ICS	X					New activity.
	Intro chemistry systemic reform (Dr. Perks) requires TA's to use inquiry instruction	TQQD, CCC, ICS	X					New activity.
	Intro biology special section on teaching and learning (Dr. Sokolove) has graduate TA	TQQD, CCC, ICS	X					
	School-based K-12 internships (partner UMBC graduate students with MCPS teachers to work	PD, TQQD	X					New Activity

	directly in the classroom to assist with inquiry-based instruction							
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	One graduate student teaching in K-12 internship program	PD, TQQD	X					New activity
	Intro biology special section on teaching and learning (Dr. Sokolove) has graduate TA	TQQD, CCC, ICS	X					
	Intro chemistry systemic reform (Dr. Perks) exposes TA's to new kinds of instruction	TQQD, CCC, EBDO, ICS	X					New activity

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.

(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching --and— 5.2 Increase the number of participating undergraduate students who consider	Partnering with MCPS to recruit and place undergraduate students with MSTs and RTs in MCPS high schools.	PD, TQQD	X					Internship program has placed 14 science undergraduates with MCPS teachers. The program included a training/orientation and "Tips for Teaching" Seminars in October and February.
	Two undergraduate student interns are also interacting with the Math TA training program (Dr. Zweck)	TQQD, CCC	X					New activity
	Create a special discussion group in BIO 100 for undergraduate students potentially interested in teaching science.	PD, TQQD, CCC, ICS	X					

science teaching as a career --and— 5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS								

Exhibit 4 b: GOAL MATRIX FOR UMBC

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
3.1 Increase the number of faculty participants who use inquiry instruction in science --and— 3.2 Increase the number of inquiry activities used by faculty participants in science instruction --and— 3.3 Improve participating faculty's understanding of inquiry teaching	Three First Year Seminars taught			X			Course approval took longer than expected
	2 ESS fellows recruited			X			Recruited 6 faculty fellows (1 from earth/space science)
	1-2 fellows added to coordinating council					X	"Coordinating council" activity eliminated.
	Westat is interviewing faculty fellows about value added to their teaching by project activities	X					New benchmark added to capture increase in amount of inquiry used in classroom.
	Baseline questionnaire to capture faculty's inquiry knowledge before involvement in project	X					New benchmark

3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Recruit 5 UMBC Faculty Fellows to partner with at least two MCPS teachers for Fall 2005 to increase to at least three for Spring 2006.	X					Benchmark exceeded (6 faculty fellows and 8 MCPS teachers) in many different projects.
	Conduct interviews with faculty to measure changes in commitment to collaborative relationships	X					New benchmark. Results are being analyzed.
	Focus groups between MCPS and faculty fellows	X					New benchmark. Results are being analyzed.

Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	10 graduate students using inquiry in their instruction	X					New benchmark. 30 graduate level Math TA's are in TA training program (Zweck); 6 chemistry TA's are trained to teach reformed course (Perks); one biology TA teaches special section on teaching and learning (Sokolove); one graduate student in K-12 internship program.
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	10 graduate students exposed to explicit training in teaching	X					New benchmark. See immediately above.
	5 graduate students exposed to K-12 teachers.	X					New benchmark. Chemistry TA's, biology TA, and K-12 intern interact with MCPS teachers.

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	Recruit at least 5 undergraduate interns for Fall 2005 and increase to at least 6 or more for Spring 2006.	X					Benchmark not met in Fall (3 interns) but far surpassed in Spring (11 interns)
	Focus group evaluation shows increased interest among students in careers in education.	X					New benchmark. Bio 100 special section students showed sustained interest in careers in education
	Pre and post surveys and focus groups for undergraduate internships are conducted to evaluate student interest	X					New benchmark; results being analyzed.

5.2 Increase the number of participating undergraduate students who consider science teaching as a career	Students' evaluations report increased interest in careers in education	X					Bio 100 students, math students and K-12 interns report sustained interest in careers in education.
	Focus group evaluation shows increased interest among students in careers in education.	X					Bio 100 students report sustained interest in careers in education.
	Pre and post surveys and focus groups for undergraduate internships are conducted to evaluate student interest	X					New benchmark; results being analyzed.
5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	At least one student hired by MCPS			X			Most programs at UMBC have just begun this year. Benchmark will be reevaluated for next year.

University of Maryland Biotechnology Institute (UMBI)

Exhibit 5 a: IMPLEMENTATION MATRIX FOR UMBI

Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
2.1 Increase the number of inquiry activities in instruction -- and -- 2.4 Conduct action research	ExPERT curriculum modification, implementation, and extension of summer research experience, including mid-year and end-of-year retreats to debug, share and model lessons	TQQD, CCC, EBDO	X					Curriculum development has included student ideas about nature of science and inquiry
-- and – 2.5 Utilize "Tuning Protocol" to steer instruction	Teacher professional learning community working meetings	PD, TQQD, CCC, EBDO	X					7 meetings and two retreats
	2006 Summer ExPERT program	PD, TQQD	X					Program expanded to include interdisciplinary science aspects of research at COMB

2.4 Conduct action research	School –year teacher professional learning communities include action research planning	PD, TQQD, CCC, EBDO	X					As part of their action research on their own inquiry teaching, teachers completed a self-assessment rubric modified from Llewelyn. See narrative for details.
2.5 Implement curriculum guides and assessments into instruction	Modify curriculum guides to reflect inquiry	TQQD, CCC	X					New activity.

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Sustaining teacher-scientist partnerships from ExPERT 2005	PD	X					New activity; added 3 new faculty mentors to mentor pool for summer 2006, including one from another institution (UMBC)

Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check one)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	Informal conversations with graduate researchers	TQQD	X					New activity

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	Career seminar for REUs	TQQD		X				Not enough applicants the first time; will try again this Fall

Exhibit 5 b: GOAL MATRIX FOR UMBI

Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
1.2 Improve percentage of correct responses to HSA type selected response items measuring science process skills and 1.3 Improve percentage of correct responses to HSA type selected response items measuring science concepts	Comparing student test scores between ExPERT teachers with "control" teachers	X					New benchmark. We collected data on county-wide final exams in June and expect to analyze it over the summer.

Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
2.1 Increase the number of inquiry activities in instruction and 2.5 Implement curriculum guides and assessments into instruction	At least 10% of curriculum modules produced or modified by ExPERT teachers during 2005-06 school year	X					ExPERT teachers have made major modifications 70%-95% of the curriculum, including changes in lab and other hands-on activities, sequence, scope, content.
	At least 5 lessons developed by ExPERT teachers implemented during 2005-06 school year	X					Number of modules developed based on ExPERT research experience content: 6
	At least 5 classroom observations recorded			X			Classroom observations were not conducted this year. They will be conducted next year on a sample of teachers from the 2004-05 and 2005-06 ExPERT teachers.
	Improvement in teacher understanding of inquiry for most teachers	X			X		Both the modified Inquiry Teaching Self-Assessment and an in-depth qualitative analysis of teachers' epistemologies showed improvement for most teachers in most areas. See narrative for details.

2.4 Conduct action research	2 self-observations per teacher	X					Teachers were trained to use the classroom observation protocol on themselves as a self-reflection tool.
	Increase in amount of time teacher spends reflecting on student thinking and behavior	X					Teachers discuss aspects of student thinking and probing to elicit productive student thinking as part of the monthly discussions and retreats.
	Increase in amount of time teacher spends reflecting on his/her own teaching practice	X					Teachers discuss aspects their own practice and reflect on increasing inquiry teaching in their classrooms as part of the monthly discussions and retreats.
2.6 Utilize "Tuning Protocol" to steer instruction	Use at least one opportunity to introduce Tuning Protocol tool to learning community					X	The Tuning Protocol was abandoned by the ExPERT community in favor of a method of instructional modification of its own design.

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.							
(a)	(b)	(c)					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
3.2 Increase the number of inquiry activities used by faculty participants in science instruction	At least one faculty to use Inquiry Teaching Survey	X					To be completed this summer by postdocs who have taught at community colleges and four-year colleges in 2005-06
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	ExPERT scientist mentors will visit classrooms and/or participate in development of inquiry lessons with ExPERT teachers from one of 3 ExPERT cohorts						4 scientists collaborated with 4 teachers to develop 1 curriculum module, 1 lesson, 1 field trip to salt marsh and lesson with mentor, 1 field trip to mentor's laboratory

University of Maryland – College Park (UMCP)

Exhibit 6 a: IMPLEMENTATION MATRIX FOR UMCP

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
3.1 Increase the number of faculty participants who use inquiry instruction in science	Continue conversations with STEM faculty members to solicit their help in achieving goal 3.1	TQQD	X					PI and GTA met with > 8 STEM faculty throughout the year on a case by case basis.
	Develop an electronic database of interested STEM faculty for dissemination of information about VIPK16.	ICS	X					An electronic database consisting of 28 STEM faculty members has been compiled.
	Identified faculty teams for the development of inquiry-based instruction (IBI) for STEM laboratory exercises	TQQD, CCC, ICS			X			Pilot program includes faculty-grad student team in chemistry working on implementing POGIL instruction; New chemistry sequence involving POGIL launched 2005-2006
	Continue conversations with	PD, TQQD	X					Fall 2005 conference was held at the ACS national meeting in DC with participation from

	Chem-REACT leadership on campus							UMCP
3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Develop 3-4 IBI laboratory exercises for lower level science courses	CCC			X			IBI/POGIL content exercises are already developed by Chemistry faculty; however, the partnership helped revise and implement the exercises
	Support the chemistry REACTS initiative on campus	PD, TQQD	X					Fall 2005 conference was held in DC with UMCP participation
	Work with STEM faculty to explore the possibility of integration of new IBI exercises into lower level science courses	TQQD, CCC, ICS	X					PI met with 6 STEM faculty during the year on a case by case basis.
3.3 Improve participating faculty's understanding of inquiry teaching practices	Develop and hold a workshop on inquiry based instruction for STEM faculty	TQQD	X					Six workshops were held for STEM faculty from three different UMCP colleges

3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Support the chemistry REACTS initiative	PD, TQQD	X					Fall 2005 conference was held in DC with UMCP participation
	Encourage attendance at the 2006 VIPK16 Summer Institute IHE days	PD, TQQD, CCC	X					PI and GA distributed information about summer institute to encourage participation and attendance.
	Support the 2005 Maryland Bioscience teachers day conference	PD, TQQD	X					Financial and in-kind support for conference, which was attended by > 100 HS teachers

Goal 4: Increase and improve inquiry, teaching practices by participating science graduate students.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Identified graduate students who will become members of the teams for the development of a inquiry-based instruction (IBI) for biology laboratory exercises	TQQD, CCC, ICS			X			Pilot program includes faculty-grad student team in chemistry working on implementing POGIL instruction; New chemistry sequence involving POGIL launched 2005-2006. Master graduate fellow in chemistry to pilot peer-observational training of chemistry TA using POGIL
	Develop an electronic data base of STEM graduate students and disseminate information about VIPK16 opportunities	TQQD, ICS	X					Used existing database to disseminate information to all STEM graduate students at university
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher	Develop and hold a workshop on inquiry based instruction	TQQD	X					The 6 workshops above (see 3.3) were open to graduate students
	Develop an electronic data base of STEM graduate students and disseminate information about VIPK16 opportunities	TQQD, ICS	X					Used existing database to disseminate information to all STEM graduate students

education sectors to encourage them to enter teaching	Provide funding to allow STEM graduate students to attend conferences with a focus on teaching or STEM education	PD, TQQD	X					Supported 8 STEM graduate students (3 of which presented) to attend Lilly East Conference.
4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	Coordinate and direct information to STEM graduate students regarding the Center for Teaching Excellence programs on teaching and learning and portfolios.	TQQD	X					Directed information to all STEM grad students via existing database; directed additional information to more than 100 graduate students who attended campus-wide TA training.
	Hold a workshop on teaching portfolios, and target STEM graduate students	TQQD	X					Two portfolio-writing workshops were presented and >4 STEM graduates student attended.

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.								
(a)	(b)	(c)	(d)					(e)
Objective	**Activity**	**MSP Key Feature**	**Progress to date (check <u>one</u>)**					**Brief explanation for changes where an activity has not been carried out as planned**
			Activity carried out as planned	Activity delayed	Activity revised	Activity eliminated	New activity substituted	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching --and— 5.2 Increase the number of participating undergraduate students who consider science teaching as a	Continue to partner with the Colleges in their presentations of sessions on careers in K12 teaching	PD, TQQD	X					Supported undergraduate career session on K12 teaching.
	Support Colleges in their efforts to connect undergraduates with HS teachers	PD, TQQD	X					GA and PI provided support for undergraduate internship program to increase the number of undergraduates working in MC HS science classrooms.
	Explore whether the various science based living-learning programs can be adapted to integrate service-learning with area HS teachers as part of the curriculum.	PD, TQQD, CCC	X					GA conducted assessment of benefits of internship program as a service and community learning project, as part of college learning experience.
	Innoworks conference	PD, TQQD	X					GA and project director designed and developed mentorship workshop for conference and provided support for teacher participants.
	Science Education Internship Program (SEIP) continued from previous years.	PD, TQQD, EBDO	X					Seven students participated in program, in which they were placed with MCPS teachers.

career --and— 5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS								

Exhibit 6 b: GOAL MATRIX FOR UMCP

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.							
(a)	(b)	©					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
3.1 Increase the number of faculty participants who use inquiry instruction in science	Have at least 5 conversations with STEM faculty members to solicit their help in achieving goal 3.1	X					Had conversations with 10 faculty
	Electronic list populated with at least 12 STEM faculty	X					Electronic List consists of 28 members
	Have 3 faculty agree to develop IBI labs	X			X		Benchmark has been revised and met—at least 3 faculty use IBI instruction, but not necessarily in new lab development
	4 faculty attend the 2006 REACTS conference	X					More than 4 IHE faculty attended the REACTS conference
3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Have 3 new IBI laboratory exercises written for Fall semester 2005	X			X		Benchmark has been revised and met— IBI instruction has been used in 3 STEM courses, not necessarily in labs
	At least 4 faculty attend the 2006 REACTS conference	X					More than 4 IHE faculty attended the REACTS conference
	Have identified specific courses and developed action plan	X					First courses identified are intro chemistry sequence; others are being identified through workshops, conversations, and pilot faculty-grad student team.

3.3 Improve participating faculty's understanding of inquiry teaching practices	At least 6 faculty attend workshops	X					8-10 faculty attended workshops over the course of the year.
	Have 3 new IBI laboratory exercises written for Fall semester 2005	X			X		Benchmark has been revised and met— IBI instruction has been used in 3 STEM courses
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	At least 4 faculty attend REACTS conference	X					More than 4 IHE faculty attended the REACTS conference
	At least 6 faculty attend the VIPK16 IHE day at Summer Institute 2006						In progress – SI has not yet occurred, and we aren't sure how many faculty will attend.
	At least 4 faculty attend the Bioscience teachers day	X					More than 6 faculty attended the Bio-Science teachers day

Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.							
(a)	(b)	©					(d)
Objective	**Benchmark**	**Level of attainment (check <u>one</u>)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Have identified 3 graduates students as part of IBI laboratory exercises writing team	X		X	X		Benchmark has been revised and met— team is working on revision and implementation rather than initial development. Identified at 1 graduate student for IBI implementation team. Master graduate fellow in chemistry to piloted peer-observational training of chemistry TA using POGIL. Begin establishment of Master Graduate Teaching Fellows Program (MGTF) who will work in new graduate students in AY 06-07, starting the year 04 and continuing into year 05
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	At least 4 STEM graduates students attend IBI related workshop	X					> 10 STEM graduate students attended IBI related workshop sponsored by CTE during AY05-06
	Database is populated by at least 6 STEM graduate students	X					Database contains > 6 graduate students
	At least two students attend a teaching conference	X					The Lilly East teaching Conference was attended by 8 STEM graduate students.

4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	At least 3 graduate students contact CTE seeking information	X					Four STEM graduates students contacted CTE regarding the winter-term portfolio writing workshop
	At least 3 graduate students attend portfolio workshop	X					Four STEM graduates students attended a teaching portfolio writing workshops this year.

Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.							
(a)	(b)	©					(d)
Objective	**Benchmark**	**Level of attainment (check one)**					**Brief explanation for changes, new benchmarks, and target dates**
		Benchmark met	Benchmark not met	Target year has been revised	Benchmark has been revised	No longer a project benchmark	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	At last 6 undergraduates attend workshop on K12 teaching careers	X					> 6 undergraduates attended a career workshop in K12 teaching offered by the College of Chemical and Life sciences
	At least four undergraduates work with area HS science teachers.	X					Nine STEM students participated in the SEIP program
	At least six students participating in Innoworks	X					> 10 students participated in Innoworks summer science teaching program

5.2 Increase the number of participating undergraduate students who consider teaching as a career	SEIP student journals and surveys show understanding and interest in teaching	X					All 9 SIEP students showed an increase in understanding and interest in teaching. SEIP survey: At least 50% of students showed increase in interest in teaching. SEIP student journals show increased understanding and interest in teaching, move to 5.2
5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS						X	UMCP's VIP programs for undergraduates do not allow for tracking students into MCPS careers. Other IHE partners are better suited for measuring this.

Section 2: Management report

Several changes have been made to the personnel administering our MSP. Most notably, one of our Co-PI's, Michael Szesze, left his position at Montgomery County Public Schools in April and is no longer part of VIP. He has been replaced as Co-PI by Gary Hedges, who continues to serve as our project manager at MCPS as well.

One of our project directors at UMBC, Mark Terranova, has changed jobs and is no longer working with VIP. Michele Wolff remains as the sole project director at UMBC, although we are looking for a replacement for Mark.

Pech Yim, a graduate student at UMCP, has been hired as a part-time project assistant for VIP K-16 at the USM office.

CASHÉ supplemental grant:

Jennifer V. Frank was hired on May 1 as the new project manager for CASHÉ at the USM office. She replaces Patricia Maloney, who is remaining as a consultant on the project.

Danielle Susskind, a graduate student at UMCP, has been hired as a part-time project assistant for CASHÉ at the USM office.

Section 3: Financial report

The financial report, including budget spreadsheets and justification for changes and carryover spending, is being sent by our AOR.

Section 4: Evaluator's Report and Project Response

Introduction

The evaluation report for Year 4 prepared by Westat has been uploaded in Fastlane as a separate document. Our project's response is below.

In general, the Evaluator's Report is accurate and complete. It is our assessment as well that while activity among the IHE partners has improved significantly, implementation and outcomes at the K-12 level have been hampered by the delays in curriculum guide production at MCPS. Still, much has been accomplished. Although the evaluation studies of many of VIP's activities speak for themselves, others deserve more specific comment from us.

Assignment of Course Modifications Undertaken by the Towson and Montgomery College Faculties

We are very pleased with the extensive report on IHE teaching practices. Both the classroom observations and the survey results show quite nicely the extent and variation of inquiry instruction being undertaken in several undergraduate science classes. Many of the moves toward increased inquiry in these classes were the intentional outcomes of the learning communities discussed elsewhere in our report. This suggests, as much existing research indicates, that designing and implementing inquiry instruction in science often requires extensive support, both in terms of extra time for modifying curriculum, and the chance to collaborate meaningfully with colleagues for an extended period.

Examination of Efforts to Engage Undergraduates in Teaching at UMBC

The VIP K-16 Fellowship program for undergraduates to intern in high school classrooms was in its first year at UMBC, and is therefore a baseline report. This, and the fact that there are many VIP initiatives being undertaken simultaneously by UMBC's project staff, may explain the low level of cohesion that is pointed out in the Evaluator's Report. As we gain useful feedback on the implementation of the Fellowship program from participants and from the Evaluator's Report itself, we expect to improve upon it in Year 5. In making changes, however, we will aim to maintain the program's apparent success at informing the undergraduate fellows about the nature of teaching science as a career.

The Matter and Energy/Earth Space Systems cohort and the Biology cohort

Westat writes:

> The pre-post surveys of ESS and M&E teachers show that teachers have made significant improvement in a few areas such as teaching the essential indicators in the curriculum

> as prescribed by MCPS and the use of assessment (e.g. BCR items, selected response items, brief constructed responses, and pre-test). However, the decrease of inquiry activities among students, and use of student presentation/projects, coupled with the overall lack of changes of instructional practice, could be somewhat troubling. Even for areas that have shown significant improvement (e.g. consulting with university faculty, conducting practitioner research, as well as the use of pretest and technical passage), there was ample opportunity for growth.

Teaching the essential indicators and using pre-assessment and formative assessment measures that mirror the State H.S.A. for biology is a very significant first step in improving student achievement. This improvement is truly extraordinary in light of the fact that the MCPS curriculum guides for Matter & Energy and Earth Space Systems are not fully implemented. The delay in the delivery of the curriculum guides could also explain the lack of change in instructional practice. The curriculum guides provide a framework for inquiry teaching, and in spite of the professional development that has occurred, especially Doug Llewellyn's sessions during the fall cohort conference, MCPS teachers are not entirely comfortable changing from a teacher-centered to a more student-centered method of instruction without the complete resource documents provided through the guides.

Westat continues:

> Comparison with the biology teachers reveals a generally slower rate of change for the ESS and M&E teachers. While both groups demonstrated comparable growth in their use of inquiry-based practices, ESS and M&E teachers are less likely than the biology teachers to use many of the assessment strategies promoted by VIP and feel less confident about different aspects of their teaching.

It is interesting that both cohorts of teachers show similar growth in their use of inquiry-based instructional practices. Biology curriculum guides were all available during the time of the biology cohort and special workshops were held to focus on the teaching strategies within the guides. ESS and M&E teachers are less likely to use assessment strategies promoted by VIP K16 and MCPS because they do not have the pressure of the Maryland H.S.A. for biology. It is surprising that M&E teachers have not more fully implemented the types of assessment items found on the H.S.A. because, most likely, M&E students will take biology as the next science course in high school. We plan to share these questions with the teachers to gain their insights.

Perceptions of Master Science Teachers (MSTs) of the VIP Program and Its Functioning

The responses of the MSTs are extremely valuable to the continued planning of the VIP project. As the project leaders on the ground, the MSTs have a unique perspective – they are aware and focused on both the goals of the grant and the particular

situations in schools and classrooms. Their perspective on project implementation and its effects on teachers has always been assessed informally in our planning meetings and in other interactions, but Westat's survey adds a more formal and comprehensive analysis that we will use for planning our Year 5 activities.

Analysis of Student Performance Data and Enrollments in Advanced Courses

Westat writes:

> Data on student science achievement and attainment show slight improvement in some cases, and flat growth in others. For example, large increases were found in student performance in the three identified skill areas (i.e., process skills, science concepts, and science reading) on the district final exam in ESS, M&E, and chemistry, while progress in biology and physics was modest. However, the gaps between disadvantaged groups, such as African Americans, Hispanics, and students receiving special services, and other students did not narrow. The improvement in student performance in ESS and M&E is somewhat inconsistent with the overall lack of changes in their teachers' survey responses. One of the explanations is that the initial level of student achievement in these two areas was much lower than other subjects.

The gaps in achievement between groups of students is not unique to science, all disciplines show similar patterns. The science curriculum office specialists have been working closely with instructional specialists in ESOL, Special Education, and Literacy to develop instructional strategies to include in curriculum guides. We now have a checklist in place for curriculum guides to be sure that instructional strategies are in place to address the needs of lower performing students.

The grant sponsored content literacy sessions for our high school science teachers in all core courses (ESS, M&E, Physics, Chemistry, and Biology) in collaboration with library media specialists. The goal of these sessions was to develop accessible text for less capable readers that addressed concepts and process skills from MCPS indicators. These teachers will continue to collaborate to provide authentic text for students to use who struggle with written material in textbooks. In addition, instructional specialists provided science teachers and library media specialists with instructional strategies from the book, "Do I Really Have to Teach Reading," by Chris Tovani. Improving literacy skills among our MCPS students was a system-wide initiative during the 2005-2006 academic year.

Social Networking Survey of VIP Participants

Although Westat's report on networking is not yet complete, it includes some promising examples of the increased networking among project participants, particularly of the ExPERT program's success at engaging teachers in mutually supportive relationships with each other and with an IHE faculty coordinator. We look forward to

seeing the final report, which we expect to show that most participants have increased the number of collaborative relationships that are so important to improving teaching practices.

On data and indicators for Goal 2: teacher practice

Westat writes:

> Data for one indicator—use of inquiry lessons, science passages, brief constructed response items, action research and the tuning protocol (Goal 2)—were not provided by Montgomery County Public Schools (MCPS) this year.

Use of inquiry lessons

Our teacher survey has been delayed until curriculum guide production is completed. Production of curriculum guides for Matter & Energy and Earth Space Systems is ongoing and will be completed during the 2006-07 academic year. The capacity to write effective guides was reduced because Matter & Energy teachers were reluctant to commit their time to writing. Our cadre of Earth Space Systems writers was reduced due to various factors, e.g., retirement, left teaching. In addition, the MCPS High School Science Instructional Specialist was directed to write materials for elementary curriculum guides, thus temporarily diverting him from high school related tasks.

We have successfully recruited chemistry and physics teachers to write curriculum materials for Matter & Energy and curriculum guide production is progressing at a satisfactory rate. In addition, curriculum guide production was delayed because of the directive to include additional instructional materials for, and review by, ESOL, Special Education, and Content Literacy. The quality of MCPS Science curriculum guides have improved as a result of this effort, but it has added to the production delays.

Use of Brief Constructed Response Items

BCR items have been incorporated into all curriculum guides as formative and summative assessment measures. BCR items are included on all semester assessments in all core courses, Matter & Energy, Earth Space Systems, Biology, Chemistry, and Physics. Teachers have received professional development in writing and scoring this type of item, but scoring reliability has not been achieved. MCPS instructional specialists worked collectively with science Resource Teachers (Department Chairs) during Leadership Week to help them to better understand how to use the Maryland Science Rubric to score student responses on the High School Assessment for Biology. The Resource Teachers are expected to conduct similar sessions at each of their schools and assist their teachers in scoring students' constructed responses. Teachers who completed the post-program survey indicated their understanding of how to reliably score BCR items improved during their cohort. See Table 42 in Westat's report.

Use of Action (Practitioner) Research

All teachers who attended the 2006 Summer Institute posted draft research topics on the project web site, scienceinquiry.org. They are expected to post additional information as they complete their research during the next school year. However, the

completion of the research is voluntary, as are all activities associated with the grant. (Attendance reports from conferences are sent to the MCPS Director of High School Instruction who forwards them to high school principals.)

Use of the Tuning Protocol

A session was provided during the 2005 summer institute for all teachers to use the tuning protocol to examine student work. In addition, biology teachers from each MCPS high school (40 participants) used a modified version of the tuning protocol to examine and evaluate intervention strategies they used to help prepare students for the Maryland H.S.A.

Section 5: Implementation Plan for Year 5

A. Narrative

In the final year of VIP K-16, most of our project activities will continue or expand as planned. These include the conferences and other professional development activities of the Physics and Chemistry Cohort, the development and implementation of additional curriculum guides and summative assessments, faculty learning communities, undergraduate teaching internships, undergraduate course reform, and K-16 partnership activities. A few notable additions or changes, as well as our strategy for planning for the future, are described below.

1. ExPERT Program

The ExPERT summer research experiences for teachers will continue to run in 2006-07. The year-round teacher learning community will continue to meet. One of the goals of the group is to complete a community-driven project to develop a multimedia curriculum module for teacher professional development. The module will compare their experiences in the laboratory with inquiry teaching and learning in the classroom. The module will also form the basis for a teacher community action research project. In addition, ExPERT teachers will be piloting inquiry lessons designed to bring systemic and comparative organismal biology back into the curriculum. Curriculum around the hornworm, zebrafish and flies will be developed, piloted and mined throughout the school year creating a continuous thread of inquiry for students. In addition, teachers will explore the possibility of creating a Living Organism Loaner Lab that will provide other teachers in the region with free access to organisms, local expertise, equipment and lessons. Curricula and multimedia resources will also be made available on a project website. An ExPERT teacher will be recruited to work full-time on curriculum and resource development and dissemination.

2. Core Chemistry reform at UMBC

During Year 5, we have an opportunity to help expand the reforms of their CHEM 101 course carried out by VIP fellow Mark Perks during Year 4 (with help from MCPS teacher partners) to the rest of the introductory sequence in chemistry. The purpose of the revision of CHEM 101 was to utilize "peer-oriented guided inquiry learning" (POGIL) in their recitation sessions and expose entering science students to a radically different kind of learning environment. This revision was seen to be necessary because the traditional instruction approach was failing to retain students and those who did continue were not having a successful experience.

Initial data collected during this pilot year suggested that the revision was having its intended impact and enrolled students showed both increased retention and enhanced performance. Based on the results of this initial work, UMBC faculty developed a plan for continuing and extending course revision to CHEM 102 and CHEM102L. The aims of this course revision are to

- Further establish POGIL as a model for active learning

- Promote Discovery learning
- Promote problem-solving skills
- Promote increased independence and responsibility in the learning process
- Integrate the learning curriculum of chemistry courses from concept to practice
- Envelop the student in a multi-faced learning environment—lecturing, discovery, tutoring
- Expand the model to related disciplines to establish a learning community among entering science students

This project includes the full participation and support of several faculty members of the Department of Chemistry and Biochemistry besides VIP fellow Mark Perks, particularly the department chair and the vice chair for undergraduate studies. We are excited about welcoming these motivated innovators further into the VIP K-16 community. The project is also supported by the college dean and the vice provost. By supporting the course revisions, we expect to learn something about how partnership grants might be used to leverage the interests and ideas that exist among many faculty members to create something that an institution's administration gains vested interest in sustaining.

3. Systemic course reform and faculty learning community at UMCP

Along the same lines as the UMBC Chemistry reform effort, VIP is working on an even larger scale, alongside UMCP's science colleges and the Dean of Undergraduate Studies, to implement a major change in undergraduate science education for non-majors. This project, described below, will involve major course reforms that prioritize inquiry and faculty learning communities. It is called *Science as Liberal Arts for the Third Millennium: An Undergraduate Studies Initiative of the University of Maryland*. In the Year 5 Implementation Targets for UMCP (in the section following this one), this program is referred to as "Inquiry-Based Instruction (IBI) in STEM courses."

Summary: The national need for understanding of science, engineering, and technology cannot be addressed only by educating future scientists. The problem is deeper, more systemic, and must extend to improved education for non-science majors. UMCP students who major in government, health, economics, the humanities, business, journalism, and education will become decision-makers on science-related issues. To that end, UMCP will develop a signature program aimed at fostering science literacy through inquiry-based coursework.

Description: UMCP will develop a set of marquee courses for non-science majors that will fulfill the lower-level CORE science requirement. The priority in these reformed courses will be on science as inquiry, rather than science as a body of already established knowledge. The central purpose will be to foster in students a scientific approach to research and problem solving (scientific argumentation, estimation, designing and testing models, framing a question, understanding the concept of scientific theory), rather than on students acquiring information. Courses will also explore topics of current interest,

such as global warming, energy policy, health issues. Implementation will depend on soliciting proposals from faculty who are committed to revising or creating new courses, and on training undergraduate teaching assistants and graduate teaching assistants (UTAs and TAs) to support the new instruction.
The project will involve with three course enhancements models:

1. Selected faculty will concurrently teach a reformed 100-level general education science course and a 300-level UTAs training course for the UTA who will lead the discussion sections of the 100-level course. This model will help to establish a new paradigm of student-student and student-faculty engagements.
2. Selected faculty members will teach a reformed 100-level general education science course and work with the graduate teaching assistants who will lead discussions to provide mentorship and guidance in integration of the new pedagogies.
3. Selected science faculty and graduate teaching assistants would collaborate with selected faculty in non-science courses (e.g. economics, government, philosophy, business, history) to create the science-related learning modules which would be integrated into the non-science courses

A Faculty Learning Community: The faculty and graduate students involved in the course and module development would meet on a regular basis to share resources, expertise and ideas and in doing so, they will establish an on-going community of practice for enhancement of teaching and improvement of student learning in the sciences.

VIP-K16 Costs: There are two costs associated with this pilot project. The first is support for the learning communities that will involve faculty and students. Faculty will receive a stipend for their participation in a VIPK16 faculty learning community (FLC) and for leading the individual learning communities (faculty plus students) involved in the various curriculum course or module development activities (models 1-3). The faculty involved in the FLC will meet regularly to share expertise, ideas and serve as peer mentors. Faculty stipends for the FLC total $42,000. The second cost is for actual course and module development estimated at $18,000 for 5 courses (models 1 and 2) and reformed science modules for 2-4 additional courses (model 3). The costs include materials, supplies and student support. Total VIPK16 support $60,000. UMCP is prepared to continue to support this initiative to change the UMCP science education infrastructure and is providing $20,000 development costs and ongoing support costs for the initial course implementations.

4. End-of-grant Retreat on Sustainability

In Spring or Summer 2007, we plan another retreat for MSTs, faculty and student fellows, project staff, and invited guests from other science education initiatives, to continue our work toward sustaining our most successful activities and solidifying the working relationships that we have found are crucial for effective K-16 partnership. The retreat's program will build on the results of last year's retreat, and the work we have

done since then, in order to create specific plans and structures. The aim will be to support, sustain, and expand the community of leadership in science education that has developed over the course of the VIP K-16 project, tentatively dubbed the "Maryland Science Faculty."

B. Matrices: Implementation Targets for Year 5

Montgomery County Public Schools (MCPS)

YEAR 5 IMPLEMENTATION TARGETS for MCPS
(10/1/06-9/30/07)

Goal 1: Improve student learning outcomes, as measured by High School Assessments.
Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.

Objective(s)	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
1.1 Participate in inquiry activities in the classroom	Develop remaining curriculum guides for Matter & Energy and Physics	Instructional specialists, Survey instrument	June, 2007	Hedges, Morse, Raue	Completed curriculum guides Survey - Westat	100% of students in targeted courses participate on one inquiry lesson sequence
1.2 Improve percentage of correct responses to HSA type selected response items measuring science process skills	Revise existing semester assessments	Item analysis (DSA)	March, 2007	Cheng, Hedges	Revised semester assessments for M&E, Chemistry, Physics, Earth Space Systems	All assessments available
	Cohort conference session focusing on assessment		April, 2007	Hedges, Morse	Sessions completed, Student assessment data	One session held; Percentage correct: Biology = 80%, M&E = 75%, ESS = 75%,

Objective(s)	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
						Chemistry = 70% Physics = 70%

1.3 Improve percentage of correct responses to HSA type selected response items measuring science concepts	Revise existing semester assessments	Item analysis (DSA)	March, 2007	Cheng, Hedges	Student assessment data; Revised semester assessments for M&E, Chemistry, Physics, Earth Space Systems	All assessments available
	Cohort conference session focusing on assessment		April, 2007	Hedges, Morse	Sessions completed, Student assessment data	Percentage correct: Biology = 80%, M&E = 75%, ESS = 75%, Chemistry = 70% Physics = 70%
1.4 Improve student skills in reading science literature	Cohort conference session focusing on content literacy	Instructional specialists	April, 2007	Hedges, Morse, Paul	Session completed	One session held
	Analyze student data from semester assessments	Assessment and instructional specialists	May, 2007 (semester A) October, 2007 (semester B)	Cheng, Hedges	Student data from assessment items related to reading science literature	Percentage correct: Biology = 70% M&E = 70%, ESS = 70%, Chemistry = 70% Physics = 70%

1.5 Improve student writing skills in science	Cohort conference session focusing on writing responses to BCR items	Training materials, student responses	April, 2007	Hedges, Morse	Session completed	One session held
	Analyze student data from semester assessments	Assessment and instructional specialists	March, 2007 (semester A) July, 2007 (semester B)	Cheng, Hedges	Student data from constructed response items	All students will demonstrate a "basic understanding" (2.0 on the Science Rubric)
1.6 Increase student participation in advanced science courses	Cohort conference session focusing on increasing student enrollment in advanced courses	Chemistry and physics teachers	April, 2007	Hedges		One session held
	Collect student data	MCPS enrollment data	June, 2007	Hedges, Wolanin	Data collected	Increase in enrollment over previous year
2.1 Increase the number of inquiry activities in instruction	See 1.1	Teacher Survey	May, 2007	Hedges, Raue, Wolanin	Survey developed, administered, data collected and analyzed	80% of teachers responding will have increased the use of inquiry activities during the grant period
2.2 Increase the number of teachers using strategies to promote reading in science	See 1.4	Teacher Survey	May, 2007	Hedges, Raue, Wolanin	Survey developed, administered, data collected and analyzed	50% of teachers responding will have increased the use of reading strategies during the grant period
2.3 Increase the number of teachers using strategies to promote writing in science	See 1.5	Teacher Survey	May, 2007	Hedges, Raue, Wolanin	Survey developed, administered, data collected and analyzed	50% of teachers responding will have increased the use of writing strategies during the grant period
2.4 Conduct action research	Seminars at each high school	Teacher Survey	May, 2007	Hedges, Raue, Wolanin	Seminars held with action research on the agenda; Survey developed, administered, data collected and analyzed	50% of teachers responding will have conducted action research during the grant period

2.5 Implement curriculum guides and assessments into instruction	See 1.1	Teacher Survey	May, 2007	Hedges, Raue, Wolanin	Survey developed, administered, data collected and analyzed	80% of teachers responding will have implemented lesson sequences from one curriculum guide during the grant period
2.6 Utilize "Tuning Protocol" to steer instruction	Tuning protocol posted on project web site	Teacher Survey	May, 2007	Hedges, Raue, Wolanin	Survey developed, administered, data collected and analyzed	50% of teachers responding will have used the Tuning Protocol to analyze a lesson

Montgomery College (MC)

YEAR 5 IMPLEMENTATION TARGETS for MONTGOMERY COLLEGE (10/1/06-9/30/07)

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.
Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.

Objective	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
3.1 Increase the number of faculty participants who use inquiry instruction in science	Recruit new faculty participants including one in Biology, Rockville Campus, and one each at Takoma Park/Silver Spring and Germantown Campuses	Salary funding for director and faculty fellows	December 2006	Campus project manager	Participants assigned compensation for spring 2007	Fellows have participated in grant activities
3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Project Director continues to provide individual professional development support to each participant	Salary funding	Ongoing through AY 2006-2007	Campus project director	Documentation of meetings; lesson plans of inquiry activities developed and used	Each faculty participant has implemented at least one new inquiry activity
	Recruit new faculty participants including one in Biology, Rockville Campus, and one each at Takoma Park/Silver Spring and Germantown Campuses	Salary funding for director and faculty fellows	December 2006	Campus project manager	Participants assigned compensation for spring 2007	Fellows have participated in grant activities
	Science Inquiry focus groups/learning community gatherings held each month, with one participant presenting a new activity each time	Facilitator stipend; survey of level of inquiry skills	Ongoing through AY 2006-2007	Campus project director	Schedule of meetings; attendance records, follow-up survey	At least 50% of participants report using one new inquiry activity
	Establish professional science inquiry library on each campus	Space made available; funding of materials purchased	Spring 2007	Campus project director	List of materials obtained and location established	Site located and at least five resources provided at each site

	Inquiry Teaching Survey (student version) given pre- and post-instruction in revised courses	Materials costs	Fall 2006 and Spring 2007	Campus project director	Surveys	Majority of students report effective use of inquiry in their classes
3.3 Improve participating faculty's understanding of inquiry teaching practices	Project Director continues to visit participants' classrooms/labs to observe and follow up with reflective discussion	Salary funding	Ongoing through AY 2006-2007	Campus project director	Documentation of meetings; lesson plans of inquiry activities developed and used	Each faculty participant self-reports increased understanding
	Science Inquiry workshop offered	Support of Center for Teaching and Learning; facilitator stipend; survey of level of inquiry skills	Fall 2006	Campus project director	Schedule of meeting; attendance records, follow-up survey	At least 50% of workshop participants report increased understanding of inquiry teaching practices
	Offer series of mini-sessions on Best Practices in Science Teaching for all STEM faculty; include inquiry as foundational best practice	Support of Center for Teaching and Learning; facilitator stipend; survey of level of inquiry skills	Fall 2006	Campus project director	Schedule of meeting; attendance records, follow-up survey	At least 50% of workshop participants report increased understanding of inquiry teaching practices
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Fellow and faculty participants attend summer institute	Faculty stipends	July 2007	Campus project manager	Attendance Records, program	At least five faculty attend the summer institute
	College Institute courses in physical science taught for high school students at two MCPS high schools	MC/MCPS partnership funding	Both fall 2006 and spring 2007 semesters	Campus project manager	Course schedules	At least one course is offered at two high schools

5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	Field experience course for potential secondary science teachers is offered and students are recruited	Faculty stipends; curriculum documents	No later than Spring 2007	Campus project manager, director of Education Institute	Course description/objectives	Sufficient students enrolled to offer the course at least once
	Recruit undergraduate students for participation in MCPS classroom observation/assistance	Student stipends, classroom teacher availability	Spring 2007	Campus project manager, MCPS science faculty	Observation reports, classroom teacher report	At least five students are recruited and complete at least one observation
5.2 Increase the number of participating undergraduate students who consider science teaching as a career	Recruit undergraduate students for participation in MCPS classroom observation/assistance	Student stipends, classroom teacher availability	Spring 2007	Campus project manager, MCPS science faculty	Observation reports, classroom teacher report	At least five students are recruited and complete at least one observation; student questionnaires show increased interest in teaching

Towson University (TU)

YEAR 5 IMPLEMENTATION TARGETS for TOWSON UNIVERSITY
(10/1/06-9/30/07)

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.
Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.
Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.

Objective(s)	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
3.1 Increase the number of faculty participants who use inquiry instruction in science	Will recruit Drs. Susannah Feldman, Phuoc Ha, and Jennifer Scott as Towson VIP Fellows	$7,000 stipends each	End of 5th year	Towson director	Participation records in faculty learning community activities and other grant activities involving other partners	Must have attended at least 80% of faculty learning community meetings and at least two grant activities involving other grant partners
	Dr. Laurence Boucher and Dr. Joseph Topping will continue in their VIP K-16 faculty learning community roles after their retirement	$7,000 stipend	End of 5th year	Towson director	Participation records in faculty learning community activities and other grant activities involving other partners	Must have attended at least 80% of faculty learning community meetings and at least two grant activities involving other grant partners
	Continuation of faculty learning community, inquiry instruction design, and participation in science inquiry workshops and other grant activities	Stipends and materials for faculty	End of 5th year	Towson director	Records	More members of learning community are implementing inquiry in their teaching

3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Continuation of faculty learning community, inquiry instruction design, and participation in science inquiry workshops and other grant activities	Stipends and materials for faculty	End of 5th year	Towson director	Records, course syllabi and lesson plans.	At least two additional modified units used in classes and laboratories
					Inquiry teaching self-survey and student survey, given pre- and post- modified instruction	Surveys show increase in total amount of inquiry instruction used by community members
					Peer classroom observations and faculty self-reporting	Show increase in amount of inquiry used by each participating faculty member
3.3 Improve participating faculty's understanding of inquiry teaching practices	Continuation of faculty learning community, inquiry instruction design, and participation in science inquiry workshops and other grant activities	Stipends and materials for faculty	End of 5th year	Towson director	Attendance records	At least 2 faculty attend inquiry workshops outside of grant
					Inquiry teaching self-survey and student survey, given pre- and post- modified instruction	Surveys show increase in a majority of faculty's understanding of inquiry instruction
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Continuation of faculty learning community, inquiry instruction design, and participation in science inquiry workshops and other grant activities	Stipends and materials for faculty	End of 5th year	Towson director	Record of participation	Faculty participate in collaborative activities at grant activities and external conferences
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Brian Wysocki and Shira Manhaim continue participation in grant activities as graduate VIP fellows	Stipends and materials	End of 5th year	Towson director	Records, teaching portfolios	At least two inquiry activities developed by each of the graduate fellows

4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	Brian Wysocki and Shira Manhaim continue participation in grant activities as graduate VIP fellows	Stipends and materials	End of 5th year	Towson director	Records, teaching portfolios	Fellows report increased exposure to science teaching careers
4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	Brian Wysocki and Shira Manhaim continue participation in grant activities as graduate VIP fellows	Stipends and materials	End of 5th year	Towson director	Records, teaching portfolios	Each fellow will maintain a teaching portfolio

5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	Recruit undergraduate science majors as VIP fellows	Stipends and materials	Fall 2006	Towson director	Records	At least one additional fellow recruited.
	Fellows will participate in grant activities	Stipends and materials	End of 5th year	Towson director	Records	Fellow(s) attend cohort conferences and summer institute
					Records	Fellows have meetings with director
					Teaching portfolios	Each undergraduate student fellow will maintain a teaching portfolio
5.2 Increase the number of participating undergraduate students who consider science teaching as a career	Recruitment and participation of undergraduate fellows (see 5.1 above)	Stipends and materials	End of 5th year	Towson director	Records, teaching portfolios	Statements and teaching portfolios show increased interest in teaching as a career
5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	Encourage undergraduate fellows to enter teaching careers in MCPS	Stipends and materials	End of 5th year	Towson director	Reports from fellows	At least one undergraduate fellow enters a teaching career in science

University of Maryland – Baltimore County (UMBC)

YEAR 5 IMPLEMENTATION TARGETS for UMBC
(10/1/06-9/30/07)

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.
Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.
Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.

Objective(s)	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
3.1 Increase the number of faculty participants who use inquiry instruction in science	Faculty Inquiry Projects (8 faculty fellows recruited)	Stipends to faculty	End of Yr 5	Shriver Center staff	Surveys/interviews	Increased the number of faculty who use inquiry instruction in science
	Revise/Create & teach 3 First Year Seminars	Stipends to faculty	End of Yr 5	Shriver Center staff	Surveys/interviews	Increased ways to promote inquiry instruction among faculty through seminars
	January Symposium for all participants	Event support	January 2007	Shriver Center staff	Survey	Surveys indicated increased opportunities for networking and collaboration among most participants
	Reform and teach Chem 102 to match inquiry-based reforms of Chem 101	Financial support for Chemistry department	End of Yr 5	Chemistry department	Interviews, classroom observations, course materials	Inquiry-based reforms established for Chem 102 course, which is taught by most faculty at some point

3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Faculty Inquiry Projects (8 faculty fellows recruited)	Stipends to faculty	End of Yr 5	Shriver Center staff	Surveys/interviews	Interviews/surveys indicated increased use of inquiry activities in instruction by most participants
	Revise/Create & teach 3 First Year Seminars	Stipends to faculty	End of Yr 5	Shriver Center staff	Surveys/interviews	Interviews/surveys indicated increased use of inquiry activities in instruction by most participants
	January Symposium for all participants	Event support	January 2007	Shriver Center staff	Survey	Surveys indicate increased networking and collaboration among most participants
	Reform and teach Chem 102 to match inquiry-based reforms of Chem 101	Financial support for Chemistry department	End of Yr 5	Chemistry department	Interviews, classroom observations, course materials	Inquiry-based reforms established for Chem 102 course, which is taught by most faculty at some point
3.3 Improve participating faculty's understanding of inquiry teaching practices	Faculty Inquiry Projects (8 faculty fellows recruited)	Stipends to faculty	End of Yr 5	Shriver Center staff	Surveys/interviews	Surveys/interviews indicate most participants have an increased understanding of inquiry
	Revise/Create & teach 3 First Year Seminars	Stipends to faculty	End of Yr 5	Shriver Center staff	Surveys/interviews	Surveys/interviews indicate most participants have an increased understanding of inquiry
	January Symposium for all participants	Event support	January 2007	Shriver Center staff	Survey	Surveys indicated increased networking and collaboration among most participants

	Incorporate Chem 102 reformers into supportive VIP community	Financial support for Chemistry department	End of Yr 5	Chem department, VIP staff	Interviews, classroom observations, course materials	Interviews indicated increased understanding of inquiry among majority of faculty or department as a whole
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Faculty Inquiry Projects (8 faculty fellows recruited) including, but not limited to:	Stipends to faculty	End of Yr 5	Shriver Center staff	Survey/Interviews	Interviews and surveys indicated increased involvement in ongoing and collaborative inquiry-based relationships with K-12 teachers among most faculty participants
	-Mark Perks Chemistry reform					
	-Mark Bulmer-Earth science project					
	-Phil Sokolove/Gale Seiler-BIOL teaching section					
	-John Zweck-Math TA training					
	Inquiry-related forum/discussion among UMBC and MCPS faculty and administrators (Host at least one forum)	Event support	Oct 2006 and June 2007	Shriver Center staff	Survey	Interviews and surveys indicated increased involvement in ongoing and collaborative inquiry-based relationships with K-12 teachers among most faculty participants
	Involve HS teachers in Chem 102 reform effort in some way	Financial support for Chemistry department	End of Yr 5	Chem department, VIP staff	Interviews, classroom observations, records	Interviews indicated new K-16 relationships
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Math TA training program (Dr. Zweck) (30 graduate students being trained in and learning inquiry in their instruction)	Stipends and project support	End Yr 5	Shriver Center staff & faculty fellows	Survey and focus groups	Surveys and focus group data indicate increased number of graduate students using inquiry instruction
	Intro Chemistry systemic reform (Dr. Perks) requires TAs to receive training in and use inquiry instruction (5 graduate students being trained in and learning inquiry)	Stipends and project support	End Yr 5	Shriver Center staff & faculty fellows	Survey and focus groups	Surveys and focus group data indicate increased number of graduate students using inquiry instruction

	Intro biology special section on teaching and learning (Dr. Sokolove and Dr. Seiler) has graduate TA (1 graduate student being trained in and learning inquiry)	Stipends and project support	End Yr 5	Shriver Center staff & faculty fellows	Survey and focus groups	Surveys and focus group data indicate increased number of graduate students using inquiry instruction
	K-12 Internships (partner graduate students with MCPS teachers to assist with inquiry instruction in the classroom) (3 graduate students being trained in and learning inquiry)	Stipends and project support	End Yr 5	Shriver Center staff	Survey and focus groups	Surveys and focus group data indicate increased number of graduate students using inquiry instruction
	Reform of Chem 102 course will require training of 4 TAs (for 25 discovery sections) for learning and teaching inquiry	Stipends and project support	End Yr 5	Chemistry department	Survey and focus groups	Survey and focus group data indicate increased number of graduate students using inquiry instruction
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	K-12 internships (3 graduate students exposed to explicit training in teaching and exposure to K-12 teachers)	Stipends and project support	End Yr 5	Shriver Center Staff	Survey & focus group	Surveys and focus group data indicate increased exposure of most graduate students to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as career
	BIOL 100 Special Section (1 graduate students exposed to explicit training in teaching)			Shriver Center staff and faculty fellows		Surveys and focus group data indicate increased exposure of most graduate students to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as career

	CHEM 101/102 reform (5 graduate students exposed to explicit training in teaching and exposure to K-12 teachers)			Shriver Center staff and faculty fellows		Surveys and focus group data indicate increased exposure of most graduate students to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as career
	Math TA training (30 graduate students exposed to explicit training in teaching)			Shriver Center staff and faculty fellows		Surveys and focus group data indicate increased exposure of most graduate students to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as career
	Reform of Chem 102 course will expose 4 TAs to explicit training to teaching	Stipends and project support	End Yr 5	Chemistry department	Survey and focus groups	Survey and focus group data indicate increased exposure of TAs to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as a career

4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	Activity eliminated					
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	K-12 Internships: Partnering with MCPS to recruit and place undergraduate students with MSTs and RTs in MCPS high schools; includes students recruited from First Year Seminars (Recruit at least 10 undergraduate interns for FA06 and 20 for SP07)	Stipends and project support	End of Yr 5	Shriver Center staff	Surveys & focus groups	Surveys and focus group data indicate increased exposure of most undergraduate students to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as career
	Math TA training: engage student interns with Math TA training program (Recruit at least 3 interns in conjunction with Math TA training)	Stipends and project support	End of Yr 5	Shriver Center staff and faculty fellow	Surveys & focus groups	Surveys and focus group data indicate increased exposure of most undergraduate students to teaching and perspectives on K-16 teaching as encouragement for consideration of teaching as career
	Intro biology special section on teaching and learning		End of Yr 5	Faculty fellow	Surveys	Evaluations of course activities show increased exposure to information regarding teaching as a career

						Evaluations for all undergraduate activities show sustained or increased interest among students in careers in education
						Evaluations for all undergraduate activities show increased understanding of inquiry-based instruction
5.2 Increase the number of participating undergraduate students who consider science teaching as a career	K-12 Internships: Partnering with MCPS to recruit and place undergraduate students with MSTs and RTs in MCPS high schools; includes students recruited from First Year Seminars (Recruit at least 10 undergraduate interns for FA06 and 20 for SP07)	Stipends and project support	End of Yr 5	Shriver Center staff	Surveys & focus groups	Surveys and focus group data indicate that most undergraduate participants had sustained or increased interest in teaching as a career
	Math TA training: engage student interns with Math TA training program (Recruit at least 3 interns in conjunction with Math TA training)	Stipends and project support	End of Yr 5	Shriver Center staff and faculty fellow	Surveys & focus groups	Surveys and focus group data indicate that most undergraduate participants had sustained or increased interest in teaching as a career
	Intro biology special section on teaching and learning		End of Yr 5	Faculty fellow	Surveys	Evaluations of course activities show increased exposure to information regarding teaching as a career

						Evaluations for all undergraduate activities show sustained or increased interest among students in careers in education
5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	Follow up with program alumni to see if they have entered teaching careers (At least one student's career choice was influenced by VIP K-16)		End of Yr 5-3 to 6 months after grant period	Shriver Center staff	Interviews	Interviews indicate an increased number of participating undergraduates who entered teaching
Goal 5 in general: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.	Chem 101, 102, 102L reform effort	Financial support for Chemistry department	End Yr 5	Chemistry department	Records, test scores	students show increased retention rates and higher performance scores (final exam, passing rates) than students from previous years
					Records	students show increased attendance rates compared to students from previous years
					pre-post survey of CHEM students; additional post surveys for students as (and if) they continue through the courses series	students show increased ownership for their learning and appropriately seek supports that will make them successful
					Records	Increased number of students continue to enroll in STEM courses and/or declare a STEM major

University of Maryland Biotechnology Institute (UMBI)

YEAR 5 IMPLEMENTATION TARGETS for UMBI
(10/1/06-9/30/07)

Goal 2: Improve teacher content knowledge in the sciences by providing high quality professional development to in-service high school teachers.
Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.
Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.

Objective(s)	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
2.1 Increase the number of inquiry activities in instruction (by MCPS teachers)	ExPERT multimedia curriculum development (nature of science, scientific inquiry), piloting of curriculum, dissemination of curriculum (website development)	Stipends, supplies, classroom instructional materials; website development consultant	July 2007	S. Honda	Records including workplan, interview guide and other tools, completed module, website, supplementary materials	-One multimedia resource focusing on the nature of science and scientific inquiry completed -Website developed -Module published on website
	Teacher professional learning community working meetings	Participant supplies; instructional materials	June 2007	S.Honda	Calendar and attendance records	7 meetings; 1 retreat
	2006 Summer ExPERT program	Teacher stipends, teacher travel, mentor supplies	August 2007	S.Honda	Records of number of teachers and mentors recruited	At least 7 teachers placed with at least 4 mentors

Objective(s)	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
2.4 Conduct action research	Teacher research comparing inquiry in their laboratory experiences with inquiry in their classrooms	IRB application fee, videotapes, transcriptionist for video footage, mileage for classroom observer	July 2007	S. Honda	Records	At least 5 teachers
	Teacher research on Llewellyn rubric and classroom observation protocol		July 2007	S. Honda	Records	At least 5 teachers
3.1 Increase the number of faculty participants who use inquiry instruction in science --and-- 3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Inquiry Teaching Survey given to postdocs, staff, faculty teaching outside of UMBI					At least one postdoc, staff, faculty teaching outside of UMBI completes survey

--and-- 3.3 Improve participating faculty's understanding of inquiry teaching practices	One inquiry teaching workshop for postdocs, grad students, and faculty	Instructional materials, consultant fee	August 2007	S.Honda		Workshop completion
	Modeling of inquiry teaching practices and teaching of learning theory in grantsmanship course (part of UMBI Postdoctoral Career Development Workshop Series)		August 2007	S. Honda		Workshop completion
	2007 VIP K-16 Summer Institute	Faculty/postdoc/grad student mileage	July 2007	VIP		Invitations extended
3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	ExPERT scientist mentors will visit classrooms and/or participate in development of inquiry lessons with ExPERT teachers from one of 3 ExPERT cohorts	Mileage	June 2007	S.Honda with MCPS/ExPERT teacher		At least 4 teacher-scientist collaborations accomplished
	An earth/space science scientist (as opposed to biologist) will collaborate with an earth/space science teacher as part of the ExPERT program	Stipend	August 2007	S.Honda		Recruitment on one earth/space systems scientist completed. Recruitment on one earth/space science teacher At least one discussion session on inquiry in earth/space science will be held.

University of Maryland – College Park (UMCP)

YEAR 5 IMPLEMENTATION TARGETS for UMCP
(10/1/06-9/30/07)

Goal 3: Increase and improve inquiry teaching practices by participating college science faculty.
Goal 4: Increase and improve inquiry teaching practices by participating science graduate students.
Goal 5: Improve undergraduate student retention in the sciences and participating undergraduates' interest in pursuing careers in teaching.

Objective	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
3.1 Increase the number of faculty participants who use inquiry instruction in science	Continue conversations with STEM faculty members to solicit their help in achieving goal 3.1	Staff time and support	Oct. 2006-June 2007	Project Director and supporting GA	Number of conversations	Inquiry based instruction activities will be used in at least 4 STEM courses or laboratories
	Update the electronic database of interested STEM faculty for dissemination of information about VIPK16.	Staff time and support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of faculty in data base	
	Identified faculty for the development of a inquiry-base instruction (IBI) for STEM courses	Staff time and support, Individual faculty stipends	Oct.–Dec. 2006	Project Director and supporting GA	Have list of teams, and project titles involved in the CoP project	
	Continue conversations with Chem-REACT leadership on campus	Staff time and support	Oct. 2006-Jan. 2007	Project Director and supporting GA	Number of meetings and conversation	
	Develop and hold a workshop on inquiry based instruction	Staff time and support. Workshop support to CTE	Oct. 2006-Sept. 2007	Project Director and supporting	Attendance and feedback from Number of participants involved in the CoP project	

Objective	Specific Supporting Activities	Resources Needed to Implement Activity	Timeline for Completion	Responsible Individuals	Measures/ Assessments of Progress	Benchmarks for end of Year 5
				GA		

3.2 Increase the number of inquiry activities used by faculty participants in science instruction	Identified faculty for the development of a inquiry-base instruction (IBI) for STEM courses	Staff time and support, Individual faculty stipends	Oct.–Dec. 2006	Project Director and supporting GA	Have list of teams, and project titles involved in the CoP project	At least four new or modified inquiry based instructional activities will be used in STEM courses
	Continue conversations with Chem-REACT leadership on campus	Staff time and support	Oct. 2006-Jan. 2007	Project Director and supporting GA	Number of meetings and conversation	
	Develop a community of practice (CoP) that focuses on IBI in STEM courses	Staff time and support, individual faculty stipends	Oct. 2006-Sept. 2007	Project Director and supporting GA	Have list of teams, and project descriptions involved in the CoP project	
3.3 Improve participating faculty's understanding of inquiry teaching practices	Develop and hold a workshop on inquiry based instruction for STEM faculty	Staff time and support, workshop support to CTE	Oct. 2006-Sept. 2007	Project Director and supporting GA	Attendance and feedback from participants involved in the CoP project	Faculty's understanding of inquiry based teaching will increase as evidenced by survey response and IBI instructional products that are generated
	Identified faculty for the development of a inquiry-base instruction (IBI) for STEM courses	Staff time and support, individual faculty stipends	Oct.–Dec. 2006	Project Director and supporting GA	Have list of teams, and project description	
	Develops a community of practice (CoP) that focuses on IBI in stem course	Staff time and support, individual faculty stipends	Oct. 2006-Sept. 2007	Project Director and supporting GA	Have list of teams, and project descriptions involved in the CoP project	

3.4 Increase the number of faculty participants who are involved in ongoing collaborative relationships with K-12 teachers	Support the chemistry REACTS initiative	Staff time and support, funding for REACTS conference	Oct. 2006-Sept. 2007	Project Director and supporting GA	UMCP faculty attend the 2006 REACTS conference	At least 3 STEM faculty meet and establish conversations with STEM HS teachers
	Encourage attendance at the 2007 VIPK16 Summer institute IHE day	Staff time and support funding	June –July 2007	Project Director and supporting GA	Attendance at the 2006 VIPK16 summer institute	
	Have the IBI-CoP faculty meet with local HS-STEM faculty	Staff time and support funding faculty stipends	June –July 2007	Project Director and supporting GA	Attendance at the meetings that include HS teachers	
	Support the 2005 Maryland Bioscience teachers day conference	Staff time and support funding	Oct. 2006-Dec. 2006	Project Director and supporting GA	Attendance at the 2006 Bioscience teachers day	
4.1 Increase the number of participating graduate students who use inquiry instruction in science	Identified graduate students who partner with IHE faculty for the development of a inquiry-base instruction (IBI) for STEM courses (see 3.2 above)	Staff time and support, stipends	Oct. 2006-Sept. 2007	Project Director and supporting GA	Have list of teams, and project titles	At least three STEM graduate students will use inquiry based instruction in laboratory, workshops or classroom activities that they develop and teach
	Continue conversations with STEM graduate students to solicit their help in achieving goal 4.1	Staff time and support	Oct. 2006-June 2007	Project Director and supporting GA	Number of conversations	
	Develop a community of practice (CoP) with faculty that focuses on IBI in STEM courses (see 3.2 above)	Staff time and support, Individual faculty stipends	Oct. 2006-Sept. 2007	Project Director and supporting GA	Have list of teams, and project titles	
	Develop a community of practice (CoP) that focuses on IBI in stem course for graduate students in Master Teaching Fellowship Program **(MGTF)** to improve	Staff time and support, stipends and benefits	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of applicants for and acceptances in to the MGTF program	

	teaching and learning.					
	MGTF (CoP) develops training workshops for STEM graduate students	Staff time and support, stipends and benefits	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of workshops and nature of workshop	At least three STEM graduate students will use inquiry based instruction in laboratory, workshop or classroom modules that they develop and teach
	IBI workshops for STEM graduate students	Staff time and support, stipends and benefits	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of participants and formative assessment surveys	
	MGTF participate in the graduates course on IHE teaching and learning	Staff time and support	Jan. –May. 2007	Project Director and supporting GA	Number of STEM students who successfully complete the course (UNIV798a)	
	Update electronic data base of STEM graduate students and disseminate information about VIPK16 opportunities	Staff time and support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Tracking of number of posting to the listserv	
4.2 Increase exposure of participating graduate students to teaching in the sciences and perspectives on faculty careers both in the K-12 and higher education sectors to encourage them to enter teaching	Develop and hold a workshop on inquiry based instruction as part of the campus wide graduates teaching assistants orientation	Staff time and support, workshop support to CTE	Oct. 2006	Project Director and supporting GA	Attendance and feedback from participants	At least 40 STEM graduates student will attend workshops that focus on IHE teaching issues
	Update electronic data base of STEM graduate students and disseminate information about VIPK16 opportunities	Staff time and support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Tracking of number of posting to the listserv	
	Provide funding to allow STEM graduate students to attend conferences with a focus on teaching or STEM education	Staff time and support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of application for support	
	Give graduate course (UNVI798a) on IHE teaching and learning	Staff time and support	Jan. –May. 2007	Project Director and supporting GA	Number of STEM students who successfully UNIV798a	

4.3 Create or build upon existing graduate teaching portfolios to demonstrate knowledge, skills, and competencies gained through involvement in the project, including research on teaching and learning	Coordinate and direct information specifically to STEM graduate students regarding the Center for Teaching Excellence programs on teaching and learning and portfolios.	Staff time and support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Attendance and feedback from participants	At least three STEM graduate students will construct a teaching portfolio that demonstrate increased understanding
	Hold a workshop on teaching portfolios, and specifically target STEM graduate students	Staff time and support, Workshop support to CTE	Dec. 2006-Feb. 2007	Project Director and supporting GA	Attendance and feedback from participants	
	Have the MGTF meet with STEM HS teachers	Staff time and support funding faculty stipends	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number and attendance at the meeting	
	Support the 2005 Maryland Bioscience teachers day conference	Staff time and support funding	Oct. 2006-Dec. 2006	Project Director and supporting GA	Attendance at the 2006 Bioscience teachers day	
5.1 Increase exposure of participating undergraduate students to teaching in the sciences and perspectives on faculty careers in both the K-12 and higher education sectors to encourage them to enter teaching	Continue to partner with the Colleges in their presentations of sessions on careers in K12 teaching	GA support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Have supported at least one undergraduate career session that focuses on K12 teaching opportunities	At least six undergraduates work with area HS science teachers and report on exit surveys or in journals that the activity helped them to understand faculty careers in K-12 or higher education
	Support colleges in their efforts to connect undergraduates with HS teachers	GA support stipends for students and teachers	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of undergraduates who are working with area HS science teachers increases	

5.2 Increase the number of participating undergraduate students who consider science teaching as a career	Support Colleges in their efforts to connect undergraduates with HS teachers	GA support Stipends for students	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of undergraduates who are working with area HS science teachers	At least six undergraduates working with area HS science teachers on exit surveys or in journals report that the activity helped them to consider teaching careers in K-12 or higher education
	Continue to partner with the Colleges in their presentations of sessions on careers in K12 teaching	GA support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of meetings	
5.3 Increase the number of participating undergraduate students who enter teaching careers in MCPS	Support Colleges in their efforts to connect undergraduates with HS teachers	GA support Stipends for students and teachers	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of undergraduates who apply to work with area HS science teachers	UMCP's VIP programs for undergraduates do not allow for tracking students into MCPS careers. Other IHE partners are better suited for measuring this.
	Continue to partner with the Colleges in their presentations of sessions on careers in K12 teaching	GA support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number of meeting	
	Explore whether the various science based living-learning programs can be adapted to integrate service-learning with area HS teachers as part of the curriculum.	Staff time and support GA support	Oct. 2006-Sept. 2007	Project Director and supporting GA	Number and attendance at planning meeting	

Section 6: CASHÉ Year 2 Annual Report

In October 2004, USM received a supplemental NSF grant to engage in a three-year study of Change and Sustainability in Higher Education (CASHÉ) as part of the Math Science Partnership (MSP) initiative. NSF has designated CASHÉ as one of the MSP "Knowledge Management Dissemination" projects that are studying the five key features of these partnerships. The CASHÉ project seeks to document curriculum transformation, faculty engagement, and sustainable change among higher education institutions involved in MSP grant projects. This report summarizes major CASHÉ initiatives during the second year of the grant in the following seven areas: (1) Advisory Board, (2) Collaboration with Related Projects and Partners, (3) Curricular Drilldown Study, (4) Faculty Engagement Study, (5) Project Bibliography, (6) Knowledge Dissemination Activities, and (7) Personnel Changes.

Advisory Board

During the past year, a multidisciplinary Advisory Board was created to provide external guidance, direction, and validation for the CASHÉ project. There are three fundamental areas of inquiry that this group is helping to answer:

1. When we talk about change and sustainability in higher education resulting from MSP work, what should we be seeking? What is the evidence that change exists? What are the indicators? What literature and research should we be consulting?

2. What are we learning from MSP projects about what works, and what does not work, to engage higher education faculty in improving of STEM education across the K-16 educational sectors?

3. What can be done to foster, encourage, and even require changes in policy and practice by institutions of higher education (IHEs), disciplinary associations, and government agencies to develop changes created by MSPs into sustainable practice?

On September 22, 2005, the first CASHÉ Advisory Board meeting was held at the National Academy of Sciences in Washington, DC. Agenda items for the first meeting included the development of the group's charge, an overview of the MSP program, a presentation of promising MSP initiatives, a demonstration of the MSP Management Information System (MSP-MIS), and a discussion of components and evidence of change and sustainability. A current list of Advisory Board members is attached as an appendix to this report. A full transcript of the meeting proceedings is available in the CASHÉ project office. The Advisory Board will convene again on September 12-13, 2006, to review the preliminary findings of the curricular drilldown and faculty engagement studies and to consider broader implications and recommendations. Members of the Advisory Board will also be engaged in project work via phone and email prior to the second meeting.

Collaboration with Related Projects and Partners

During the second year of the CASHÉ grant, a primary emphasis was placed on forging connections with related projects and partners that were engaged in similar activities and initiatives. These collaborations were important to the project in building an external research network, sharing information, leveraging resources, and ensuring that CASHÉ would be well-positioned to carry out its charge.

Horizon Research Knowledge Management and Dissemination (KMD) Project: The CASHÉ project has developed and benefited from a "loosely coupled" relationship with this second NSF KMD project. Staff members attend each other's Advisory Board meetings and keep each other informed of major project developments, including areas of mutual interest and overlap. Iris Weiss, President of Horizon Research, Inc., serves as a member of the CASHÉ Advisory Board.

National Research Council (NRC): Based on a mutual agreement, the CASHÉ project team has documented evidence of sustainable change from NRC's MSP Research Evaluation and Technical Assistance (RETA) workshops among participating MSP project staff and institutions. In return, NRC has provided meeting space and services at the National Academy of Sciences for CASHÉ's annual Advisory Board meetings. The two initiatives (i.e., CASHÉ and NRC's RETA project) have also benefited from mutual consultation among staff members. Jay Labov, Senior Advisor of NRC's Center for Education, serves as a member of the CASHÉ Advisory Board.

Project Kaleidoscope (PKAL): During the second year of the grant, CASHÉ and PKAL shared a graduate assistant who worked with the CASHÉ project for 10 hours per week and PKAL for another 10 hours per week. The graduate assistant served as a link between the two initiatives by providing research assistance for both organizations, including library and Web-based research on promising programs and practices, development of research protocols, maintenance of research records, and updates on project reporting. Based on a mutual decision and divergent project goals, this collaboration will not be continued into the third year of the CASHÉ grant. Jeanne Narum, Director of PKAL, serves as a member of the CASHÉ Advisory Board.

Westat: Over the past several years, USM has enjoyed a close working relationship with Westat, which currently provides research and evaluation services for two of its major grant-funded K-16 projects, including VIP K-16. CASHÉ is working with Westat on the higher education faculty engagement case studies to dovetail with their research on the impact of faculty involvement in the MSP projects. Joy Frechtling, Vice President of Westat, serves as a member of the CASHÉ Advisory Board.

Course and Curriculum Change Study (Curricular Drilldown)

In November 2005, NSF requested that the CASHÉ project team study a subset of MSPs to analyze the nature of curricular changes within participating colleges and universities that were reported as outcomes from their involvement in the project. Twenty-one MSPs provided detailed data, including annual reports, internal and external evaluation

summaries, URLs, and other project materials. The level of analysis focused on the types of curricular change involved, the number of courses and/or programs that were developed or substantially revised, the primary audience for these changes, responsible parties (i.e., individual faculty members, faculty teams, departments), linkages with external educational standards (i.e., local, state, national, discipline-based), non-curricular and non-credit activities, and supporting evidence. A preliminary draft of this report was submitted to NSF in February 2006. A revised and expanded final version of this report dated June 2006 is attached as an appendix to this report. (Due to its length, this report is uploaded as a separate document.)

Faculty Engagement Study

In collaboration with Westat, the CASHÉ project team is planning to build a series of case studies through field work and visits with several MSP projects. The timing of these visits will occur in Fall 2006 and Spring 2007, during the third year of CASHÉ funding. These cases will concentrate on ways in which projects have developed sustainable practices to engage STEM higher education faculty in improving the quality of STEM undergraduate education, strengthening teaching practices, and expanding the scope of their work to include a K-16 perspective, including the improvement of K-12 STEM education and the preparation of future teachers. These cases will also examine the role and nature of institutional policies related to faculty roles and rewards for participation in these initiatives. A preliminary research protocol has been developed and will be reviewed with the Advisory Board during its September 2006 meeting.

Project Bibliography

In Fall 2005, project members began to develop an annotated bibliography to help build the theoretical and conceptual frameworks for the study. This bibliography is a collection of peer-reviewed articles, studies, reports, prior research, chapters, and books that are used to ground the examination of change and sustainability in higher education. Sources include library database searches, Web searches, other bibliographies, and personal recommendations from colleagues and Advisory Board members. References have been chosen according to their relevance, their significance in the field, and their originality.

Since CASHÉ focuses on curricular change, faculty engagement, sustainability, change in higher education, and K-16 partnerships, these were the general categories that were used to classify each reference. This categorization scheme was useful in helping us identify how the various components of CASHÉ fit into the larger context of related research and scholarship. After the initial set of sources was collected and categorized, an annotated summary was prepared to highlight the main thesis and findings of each work. These notes allow readers to analyze the bibliography sources more efficiently and verify their relevance to our study. While the annotated bibliography is still a work in progress, we have already collected and annotated 26 sources to date.

Knowledge Dissemination Activities

During the second year of the grant, CASHÉ project staff gave a presentation titled "Tensile Strength: Change and Sustainability in STEM Higher Education" at the Association of American Colleges and Universities (AAC&U) annual meeting in Washington, DC, from January 25-28, 2006. A similar workshop was developed and presented by project staff for Project Kaleidoscope. A proposal titled "Making Good on Our Word: STEM Faculty and K-16 Partnerships" was also recently submitted for the American Association of Colleges for Teacher Education (AACTE) annual meeting in New York, NY, from February 24-27, 2007.

Personnel Changes

On May 1, 2006, Jennifer Frank joined USM as CASHÉ's new project manager. Prior to coming to USM, she served as Director of Institutional Research at Loyola College in Maryland. Her prior management and evaluation experience with grant partnership projects at USM include VIP K-16; Project LINC (a Title II TQE project funded by the U.S. Department of Education); and Greater Expectations for Student Transfer (a FIPSE funded project sponsored by the Association of American Colleges and Universities).

Appendix

CASHÉ Advisory Board Membership (Current as of June 2006)

Mel George (Chair)
President Emeritus, University of Missouri and St. Olaf College
Patrick Callan
President, National Center for Public Policy in Higher Education
Amy Chang
Education Director, American Society of Microbiology
Margaret Cozzens
President, Colorado Institute of Technology
Penelope Earley
Professor, College of Education and Human Development, George Mason University
Russell Edgerton
Senior Fellow, Carnegie Foundation for the Advancement of Teaching
Daniel Fallon
Chair, Education Division, Carnegie Corporation of New York
Lorraine Fleming
Professor, Department of Civil Engineering, Howard University
Joy Frechtling
Vice President, WESTAT
Willis Hawley
Professor Emeritus, Department of Education Policy and Leadership, University of Maryland College Park
William Kirwan
Chancellor, University System of Maryland
Jay Labov
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Jeanne Narum
Director, Project Kaleidoscope
Judith Ramaley
President, Winona State University
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Iris Weiss
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