

Project description: The Mathematics Science Partnership in New York City (MSPinNYC)

A. BRIEF OVERVIEW AND PLANNING HISTORY

New York City's (NYC) more than 8,000,000 people, and its diverse cultures, large businesses, complicated politics, transportation and health systems, and vast media result in complex influences on its two major educational systems-- the NYC Public School System made up of 1290 schools, 1,052,056 students, and 89,322 teachers spread through five boroughs, and the City University of New York (CUNY), with its 210,000 students, ten senior colleges, six community colleges, the CUNY Law School, and the CUNY Graduate Center. The two systems are inextricably intertwined; CUNY is the largest provider of teachers for the NYC Public Schools and 61 percent of CUNY's first-time freshmen are graduates of NYC high schools. Although there is great wealth in NYC, more than 68% of public school students meet the criteria for free and reduced lunch. Nearly 126,000 students speak languages other than English as their first language.

Under new leadership and organizational structures, the PreK-12 system has recently embarked upon new directions that must be taken account of in the design of any reform effort. The Mayor is now a major player in the operation of the schools; 32 local school districts have given way to ten school regions (13 PreK-12 schools are on CUNY campuses); high schools are now organized within the regions rather than as one separate district (see Supplementary Documents page 1, Figure 1); the Board of Education no longer exists (replaced by an Advisory Panel) and the new Regional Superintendents have responsibilities that differ significantly from those of the old community school district superintendents. Data collection systems must be reconfigured to reflect the new regions. City-wide curricula and textbooks in mathematics have been mandated for the first time in all grades and a new city-wide science curriculum will soon follow. The New York State Regents examinations, which used to be optional are required for high school graduation for all students. Through funding from the Bill and Melinda Gates Foundation, ten new high schools designed to provide access to college for students will open on CUNY campuses during the next five years. (MSPinNYC will work with the Gates leadership to develop collaborative areas and develop mathematics and science courses for these schools.)

In 2003, CUNY's University Dean for Teacher Education convened a working group of faculty from education and the sciences at CUNY's senior colleges and community colleges, representatives from the city schools, including mathematics and science coordinators, and the superintendents' offices of Regions 3 (Queens) and 9 (Manhattan and the South Bronx) to discuss mutual concerns and issues related to mathematics and science education in the city. He also held meetings with Regional Superintendents, with Joel Klein, the Chancellor of the NYC Schools, and with Richard Mills, the New York State Commissioner of Education.

The working group met on a regular basis through early December, to exchange ideas, examine data, and identify persistent concerns that include: (1) shortages of mathematics and science teachers, especially experienced teachers in schools characterized by poverty and by students historically underrepresented in mathematics and science; (2) extremely low retention rates among teachers; (3) high failure rates among students who take the 8th grade mathematics exam and required-for-graduation state mathematics and science Regents examinations; (4) lack of preparedness of high school graduates for college level work; (5) a high drop-out rate among college students; and (6) schisms and poor communication between schools, (some) university campuses, and between science and education faculties. Despite many reforms, including those funded by the National Science Foundation (NSF), and the infusion of federal and private funds into the PreK-12 system, widespread problems remain that impact negatively on the effective teaching and learning of mathematics and science.

The Strategy and the Parts

MSPinNYC planners made the decision that the most efficient and productive way to address these concerns is to concentrate efforts on developing meaningful and sustainable partnerships between PreK-12 and CUNY, and between scientists and educators. The MSPinNYC will address changes in the cultures of the two systems needed to make the partnerships work while developing academic student support programs, research-based teacher education programs, and programs to recruit mathematics and science teachers to the New York City schools.

Partnerships develop best when those involved are engaged in solving problems each of the players considers important, and when the benefits that accrue are shared. Planning meeting results, teacher interviews, and data analysis helped identify secondary school mathematics and science as the primary problem to address. NYC and the NYS Department of Education (NYSED) are facing significant challenges related to the poor performance of high school students on the Regents exams, exit exams now required state-wide of all high school students. Over

50% of NYC students who took the Math A Regents exam in June 2003 failed it, even after scores were recalibrated; the same figure, about 50%, characterizes failure on the chemistry Regent exam over a 5-year period. A review panel recommended that NYSED and higher education strengthen their partnerships to ensure strong teacher education programs, both pre-service and in-service, that will improve the performance of students. (NYSED, 2003).

MSPinNYC proposes to address developing partnerships, changing cultures, and improving aspects of secondary school mathematics and science teaching and learning through the use of a micro/macro strategy. The micro level will focus on the following **OUTCOMES**:

- Twelve research-based Mathematics and Science Hub Schools (Hubs);
- Summer and academic year professional development for 84 teachers at the Hubs, at other secondary schools, and at new Gates-sponsored CUNY high schools;
- Introduction of teacher-research methodology into daily practice of the teachers;
- A revised student teaching model for science and mathematics;
- Summer camps for 5860 students who have failed science and mathematics courses and/or regents exams;
- Mechanisms to institutionalize the programs as part of academic year school programs;
- Initial partnerships among college faculty and secondary school teachers;
- Cadet's Mathematics and Science Corps (Cadets) of 240 high school students; and
- Student and teacher systems to provide disaggregated data that informs learning, teaching, and assessment in rapid fashion.

At the macro level we will work to develop connections among many programs and to ferret out what works. The approach makes good use of the city's intellectual capital and helps to develop its operational capability, capability not apparent from its separate parts. Mechanisms will be developed to ensure that what is learned at the micro level is sustained and institutionalized; that the city's many resources are brought to bear on the entirety of its two major educational systems; and that scale up and dissemination will occur broadly within the two systems. Formative evaluation data will be used to determine and address issues such as: (1) fundamental alterations in the cultures and practices of both systems; (2) alignments between high school courses, New York State Regents Examinations, graduation requirements, college admissions, and prerequisite knowledge and skills for introductory college science and mathematics courses; (3) dissemination of policies and practices to other NYC school regions and CUNY institutions; and (4) human and financial resource reallocations. Macro level mechanisms (page 9) include

- A Council for Mathematics, Science, and Education (Council)
- Monthly seminars and public forums
- Action Meetings of "Job-Alike" groups
- Mathematics and science related doctoral seminars

The micro/macro strategy permits concentration on a manageable number of activities and experiments of affordable size and complexity, while simultaneously engaging the larger community in policy, practice, and research issues that affect and are affected by micro level reforms. At both the micro and macro levels we will research, pilot, analyze, and revise reforms and activities. This two-level strategy assures that NSF's five key features are addressed—the work is partnership driven; there is an emphasis on teacher quality, quantity, and diversity, and on challenging courses and curricula, evidence-based design and outcomes, and institutional change and sustainability--while focusing on critical crosscutting issues such as professionalism, culture change, scaling up, and research-embeddedness in decision-making, implementation, assessment and evaluation. Moreover, employment of teacher-researcher strategies (Doerr 2000; Czarnocha, 2002; Fosnot, 2001) already developed at Bronx Community College and Hostos Community College, will introduce the use of integrative processes between educational research and classroom practice, a major condition for success in mathematics education (National Research Council, 1999).

Partners and Capacity

Membership in the MSPinNYC partnership was determined by interest and commitment displayed during planning meetings; follow-up sub-group meetings; analysis of feeder patterns among the public schools, community colleges, and senior colleges; analyses of student and teacher data; history of cooperative efforts among prospective partners; and readiness for the kinds of transformations targeted in the proposal. The core partnership includes three senior colleges, Hunter, Lehman, and Queens, three Community Colleges, Bronx, Hostos, and Queensborough, and School Regions 3 and 9. The colleges have a long history of school-based partnerships with the public schools in these two

regions. Region 3, located in Queens, has almost 126,000 students and Region 9, located in Manhattan and the Bronx, has 107,672 students. Together there are more than 137 secondary schools in the two regions.

Hunter is the lead institution because of its strong college-wide commitment to urban education as indicated by practice and by its vision statement which champions social justice; and which has a particularly strong focus on secondary mathematics and science; and because of its history of cooperative efforts between education, mathematics and science faculty. A chemistry program developed and piloted at Hunter will be the basis for the MSPinNYC's professional development and student support programs. Hunter's President, Jennifer J. Rabb, established a Mathematics Center for Learning and Teaching (in addition to and different from the Dolciani Center which focuses on Hunter students) to help promote the mathematics competency of PreK-12 children. The Center grew out of a partnership between mathematics and mathematics education faculty united by the belief that teachers must be viewed as both learners and practitioners. Hunter participates in the Teacher Scholars program in cooperation with The After School Corporation and in "College Now," a comprehensive CUNY/Public Schools initiative that fosters active involvement of all CUNY colleges in promoting and supporting higher standards for all NYC high school students. "College Now" is a collaborative relationship between education and programs such as the federally funded GEAR UP.

Collaborative programs already developed between Bronx Community College and Bronx high schools, many in Region 9, and between Hostos Community College and Lehman College, help set the stage for development of system-wide partnerships. Hostos, in cooperation with Lehman, is in the final stages of developing an associate degree in Mathematics and Mathematics Education. The role of language, particularly Spanish, and culture in learning mathematics is a major focus of the degree, and is already being addressed through a Teacher Research group at Hostos Community College. Hostos developed the initial teacher-researcher program influenced by the work of Lee Shulman (Shulman, 1993) and Lev Vygotsky (Vygotsky, 1986). Hostos is host to a Center for Teaching and Learning, a joint CUNY/Hostos engineering major, and several access programs.

CUNY-wide participation is assured through the Office of the Vice Chancellor for Academic Affairs which includes the University Dean for Teacher Education. The Vice Chancellor will chair the MSPinNYC's Policy Committee (page 12) and team with the University Dean for Teacher Education to coordinate science and education activities.

B. VISION, GOALS, AND OUTCOMES

The vision of MSPinNYC includes two large and interdependent systems that have learned to work as partners, function in unison, share resources, tolerate each others' weaknesses and appreciate each others' strengths and accomplishments. It includes seamless passage from one educational level to the next, from kindergarten through graduate school. Policies and resources support practices, and qualified mathematics and science teachers are recruited, effectively educated, and retained for significant periods of time. Decisions are evidence-based, rooted in examination of relevant data, and open to honest inquiry. Science faculty at institutions of higher education (IHE) regard educational research with the same high regard as their own research, and education faculty are rewarded equally for doing it well. Research pervades classrooms from high school through graduate school. For teachers, the goals of doing research include helping students understand and solve problems in their classrooms, recognizing the importance of evidence for decision making, and developing the ability to see things critically. For students, pre-research and research efforts provide a deeper understanding of content. Faculties pursue research into their own practices as a way of strengthening them.

The MSPinNYC advocates making teaching more public and infusing research into the practice of teaching as a means of rendering it more scholarly (Shulman, 1993; Ball, 2000). Most important, at the end of the road are the students who have developed a deep and useful understanding of mathematics and science content, coupled with a belief that they can all succeed, irrespective of background or economic status. MSPinNYC's activities and approaches will move the NYC public schools and CUNY closer to realizing the vision. **GOALS**, consistent with this vision, include:

- Developing partnerships and changing cultures among a number of CUNY's senior colleges, community colleges, and two of ten Regions within the New York City public school system.
- Creating, implementing, scaling-up, and field testing student support, teacher recruitment, and professional development programs.
- Improving student understanding of content and performance on examinations.
- Ensuring that research results and practice permeate every aspect of the project.

- Institutionalizing and sustaining project outcomes.

Obstacles to Reform: Conditions noted on page 1, including size and complexity of both systems, and newness of reorganization efforts, create obstacles to reform. Owing to realignment of school districts, an important first-year component is reconfiguration of data to provide disaggregated information quickly and accurately (Supplementary Documents, page 1). The need to operate within the framework of the School Chancellor's and Mayor's initiatives puts a premium on research into and diagnosis of what works, in what settings, for whom, and why. The many funded projects already in the system, some working against each other, some in spite of each other, can also impede reform. Research has shown that a multiplicity of projects within a system conspires to make reform more difficult. Other obstacles that face all schools, especially those in urban settings, include recognition that a system's entropy is always greater than its internal energy; that large numbers of children live in poverty without belief in themselves or in their own future; that schools have many inexperienced and unqualified teachers; and that IHE culture is built on the power of the professoriate, more interested in and rewarded by research than teaching or working with teachers.

C. ACTION PLAN: THE MICRO LEVEL

MSPinNYC has designed an innovative model for professional development, called the Collaborative Teaching Laboratory (CTL), rooted in scholarship, research, public teaching, and partnerships. It grew from a need to provide support for the many high school students failing New York state science and mathematics Regents exams and, as a result, likely to fail to graduate from high school. (In 2003, fewer than 50% of the NYC students passed the Math A, chemistry, or physics Regents exams). Passing rates on the Regents in living environments and earth science hovered around 60%, particularly alarming since students are required to pass the Math A and two science Regents exams to graduate. The MSPinNYC also recognized that a significant number of mathematics and science teachers, particularly new teachers and those teaching out-of-license, need support to better understand important content.

The CTL partners IHE mathematics and science faculty, recognized as outstanding teachers, with experienced and novice high school teachers to create instructional teams that will act to 1) develop and cement partnerships among faculty at the colleges and at the high schools, 2) evaluate and share innovative pedagogical strategies that work with particular students in particular situations; 3) infuse a teacher-researcher model among all members of the instructional staff, and 4) provide opportunities for the teachers to deepen their content knowledge through the process of co-teaching and reflecting with college mathematics and science faculty. The CTL includes creation of research-based mathematics and science hub schools (Hubs), and summer and school year professional development.

The Hub schools become centers of reform for this project. They are schools that, because of the activities of the MSPinNYC, will be transformed from schools with student performance below city-wide averages and few students taking advanced mathematics and science courses to exemplars of mathematics and science education without any concomitant change in the demographics of a primarily minority student population. Students in Hub schools will take more advanced courses in high school and college. (College Now, a CUNY-wide program, will waive tuition for eligible high school students from Hub schools who take college courses.). As exemplars of mathematics and science education, Hubs will play significant roles in teacher education recruitment strategies and programs. Hubs, having undergone substantial cultural and practical changes, will be integral to spreading reform by partnering with nearby schools and serving as "hubs" of reform activity in their regions. Hubs will also serve as host visits for schools wishing to adopt practices throughout New York City.

The CUNY campuses will partner with twelve schools to develop Hubs. The partnerships will result in (1) improved approaches to teacher recruitment, preparation, and retention, (2) practices for increasing students' success rates in secondary school mathematics, earth sciences, biology, chemistry and physics, especially among historically underrepresented and economically deprived students, (3) research-driven reform, and (4) IHE/high school teaching partnerships. MSPinNYC staff recognizes that establishment of collegial relationships between IHE and secondary school faculty working together on specific objectives, in a concrete non-political setting, is essential to the success of the project. These collegial relationships are viewed as an initial stage in a long, difficult, sensitive journey that should result in important culture changes in PreK-12 and IHE. Project leadership will insist upon a "principle of mutuality", where every partner brings strengths and weaknesses to the partnership and every partner can benefit from it.

A committee to select Hub schools will be composed of partnership members and chaired by Lucy West, Deputy Superintendent of Region 9. Flyers and application forms will be prepared and circulated throughout the Regions,

and the Selection Committee will visit schools wishing to become hubs. Two Hub schools from Region 9 will be selected in Year 1 and four in Year 2. Six schools from Region 3 will enter the partnership in year 3, and the Region 3 Deputy Superintendent will assume Chair of the Selection Committee. Elements of the program will be introduced at 36 other schools in Regions 3 and 9 in years four and five by TRTs trained during the first two years. The Hubs will host visits from leadership and teachers from the 8 other NYC Regions and NYS school districts interested in adopting/adapting the CTL model and Regents' support programs. An initial list of conditions for selection, agreed upon by IHEs and School Regions, include:

- Principal and Assistant Principal interested in substantial change demonstrated by willingness to provide release time, block schedules across Hub schools within a district; and detailed, disaggregated student and teacher data;
- below average student performance on state-wide exams coupled with good attendance;
- a cadre of dedicated and concerned mathematics and science teachers.

The transformation process of Hubs will result professional development that involves intensive summer team teaching experiences followed by academic year support. Multi-year support is built directly into the partnership, reflecting the need for long-term practices to effect real change.

Professional Development Model: The CTL Summer Program: Implementing the CTL begins with an intensive summer camp for students who have failed the relevant state-wide Regents exam the prior June. This program enables the instructional staff to develop mutual trust necessary for the partnerships between IHE and second school teacher. Summer success, particularly with *failing* students, is extremely uplifting and provides impetus to institute reform during the school year. One of the hypotheses to be tested in the summer program is that the best environment to improve teaching skills is on-the-job teaching in the presence of a supportive instructional staff. However, the focus is on more than teaching. The summer camp is a mechanism for high school teachers to also strengthen their content knowledge. Thus, our second hypothesis is that significant amounts of content can be learned by teachers informally rather than through formal courses. Similar hypotheses have been validated elsewhere (Korthagen and Kessels, 1999). Both hypotheses will be tested during the course of this project.

The instructional staff, referred to as Teacher-Researcher Teams (TRTs), includes college faculty expert in the content with credentials as outstanding classroom teachers (but not necessarily at the secondary school level), experienced high school teachers well-versed in creating active learning environments, novice teachers (fewer than five years teaching) and undergraduate science students considering careers in teaching. A teacher-researcher is defined here as a professional who is equally at home teaching in the classroom and as a researcher familiar with the various methodologies of classroom-based research (Doerr, 2000). Teacher-researchers are able to investigate student learning while in the process of teaching.

The TRT model is the outgrowth of a pilot program in chemistry, designed and implemented by three chemistry professors at Hunter College in Summer 2003. It provided an intensive five and a half week summer experience for 24 students designed to prepare high school students for the Chemistry Regents exam; improve attitudes towards science; and develop better critical reasoning skills. The TRT included three Hunter College chemistry faculty, 3 high school teachers, and five undergraduates. The success of the summer program, in which *100% who failed the June Regents chemistry exam passed in August*, coupled with the positive evaluation reports, demonstrated that the TRT could construct an educational environment in which students *both* enjoyed learning science and achieved success on the state-mandated exams.

The 5 ½ week summer camp involved four days each week of intensive (6 hour) instruction divided into three segments: student lab projects intended to be interesting and meaningful and make chemistry relevant, such as analyzing the walls and floors of Hunter College for lead content; classroom instruction taught by teachers and faculty, and problem-solving sessions led by undergraduate science students (interns) who expressed interest in teaching (part recruitment strategy). TRTs met to plan the problem-solving sessions during lunch. The teachers and faculty reflected on the day's activities and plan for the next set of activities during the problem solving sessions. Instructional responsibility was shared among all team members. The evaluator of the pilot reported that the program was successful for TRTs and students. Teachers said that it helped fill content gaps and encouraged them to try out new pedagogical strategies. Students said: "I think I will do better in school because I learned how to do homework and study." "We learned to slow down and think things through, rather than rushing to get the answer." Although these students had just failed the Chemistry Regents in June, seventy percent expressed interest in taking more science courses. All the students believed they were better science students because of the program.

The MSPinNYC proposes to scale up the pilot chemistry program to include additional grade levels (8-12), disciplines (mathematics, physics, biology, earth science), and sites. New sites will include Lehman College, Bronx Community College and Hostos Community College in Years 2, 3 and 4; and Queens College and Queensborough Community College in years three and four. In addition, part of the development of a sustainable model, beginning in year 3, includes situation of courses at the Hubs and the beginning of a process to replace traditional NYC summer offerings with the new courses. TRTs will be composed of 1 IHE faculty, 3 teachers, and 5 undergraduate interns. During Years 1 and 2, additional faculty will be present in the classrooms as part of their training process and will participate on the teaching teams. Details of the scale-up of the summer program at the colleges only are shown in the figure below:

“Scale-Up” of Summer Courses at IHEs and Number of Students Directly Impacted

	Manhattan		Bronx		Queens	
	# Courses	# Students	# Courses	# Students	# Courses	# Students
Year 1	4	100	0	0	0	
Year 2	8	300	4	100	0	
Year 3	8	600	8	200	8	200
Year 4	4	100	4	100	8	200
Total	24	1100	16	400	16	400

Development and implementation of the model in new settings and different content areas is designed to control for variables such as class size, content focus, and TRT membership. Variables will be teased out and put to the test by TRTs and members of the Evaluation Team. As modified models are moved to the Hubs in Years 4 and 5 (see Scale-Up – Summer Camps below), the Regions will assume the cost of implementing them, costs that replace those entailed in running traditional summer schools for failing students. The Deputy Superintendent of Region 9 has suggested employing the model for literacy classes as well as science and mathematics. A Council (described on page. 9) and Formative Evaluation Team (page 11) will analyze the program as it is implemented and scaled up, and will provide rapid feedback to help the MSPinNYC leadership team make adjustments and changes in process.

“Scale-Up” of Summer Camps at High Schools and Number of Students Directly Impacted

	Manhattan		Bronx		Queens	
	# Courses	# Students	# Courses	# Students	# Courses	# Students
Year 3	12	360	0	0	0	
Year 4	24	720	12	360	0	
Year 5	36	1080	24	720	24	720
Total	72	2160	36	1080	24	720

The underlying framework of the CTL is a public team-teaching model utilizing classroom-based research. The informal, introductory approach to the teacher research utilized in the pilot program emphasized reflection and the power of collaboration, and provided “context for joining teacher learning with learning about teaching,” (Ball, 1992; Ball and Rundquist, 1993). The approach builds on the “scholarship of teaching” model advocated by Lee Shulman (Shulman,1993) as an important tool for elevating and enlivening the practice of teaching. It stresses teaching as a public enterprise subject to critique and analysis, and the importance of multiple collaborators.

The teacher-researcher methodology will be expanded into a formal component of the CTL model. Previous work done under an NSF grant by faculty at Hostos and Bronx Community Colleges on teacher-research methodology will support development of techniques to integrate classroom practice with research results, important tools for bringing about successful reform in mathematics and science education (Rittle-Johnson, et. al., 2002).

Questioning the Model—in the process of implementation: Programs are developed at particular times, in particular places and, generally, for particular audiences, and are often implemented under unique circumstances by more or less well-informed implementers. Good programs are somewhat complex and school reform is played out amidst many variables, some very difficult to control. The TRT model worked in the summer of 2003; it accomplished its goals and enabled 100% of its small number of students to pass a chemistry Regent’s exam. The MSPinNYC leadership wants to know if it will work again, and under what conditions? For what disciplines? What

factors contributed most to its success? What factors proved to be necessary? Sufficient? Formative evaluation will employ cyclic teacher research methodology where, after each period, there is analysis of the results, redesign of the approach, and introduction of new or modified practices.

School Year Model: Pedagogical Rotations and Seminars: The summer program is strengthened during the school year using a Pedagogical Rotations Model similar to both medical school rounds and grand rounds, and to Japanese Lesson Study (Watanabe, 2002). TRTs meet in August to identify particular curriculum components and content areas each needs to improve. Brainstorming sessions ensue, informed by experience, readings, and data, about how to best approach specific content that is part of the day’s lessons -- a process TRTs have already experienced the previous summer.

TRTs, including the IHE faculty, will convene -- armed with a short list of targeted questions – four times each semester in the classroom of a particular team member to observe her or his class. TRTs will meet in the afternoons for reflective discussions about what they witnessed in the morning and how successful a similar presentation was in their own classrooms. Over the course of each semester, all team members will have their classes observed at least once by the team and once by another colleague who participated in the summer program. In addition, all TRTs will attend a two-credit seminar that addresses content, pedagogy, and assessment. The number of teachers and students impacted by the Pedagogical Rotations are shown in the table below.

“Scale-Up” of Pedagogical Rotations and Students Directly Impacted

	Manhattan		Bronx		Queens	
	# College Faculty	# Students	# College Faculty	# Students	# College Faculty	# Students
Year 1	4	120	0	0	0	
Year 2	8	240	4	120	0	
Year 3*	8	240	8	240	8	240
Year 4*	4	600	4	240	8	240
Year 5*	0	600	0	600	4	600
Total	8	1800	8	1200	8	1180

*In Year 3 Pedagogical Rotations begin in neighboring schools led by Hub teachers (see Supplementary Documents, Benchmarks).

Filling the content gaps many teachers have will be an objective of the CTL. Content gaps held by mathematics and science teachers, particularly for novice teachers and those teaching out-of-license, are substantial. For example, more than 50% of the science teachers in Hunter’s teacher education programs hold the same misconceptions about fundamental scientific concepts as high school students. This is not surprising because undergraduates hold many misconceptions and misconceptions are notoriously difficult to change (Dykstra, 1992; Nakhleh, 1992; Smith, 1993). A focus on the misconception literature as well as reflection on one’s understanding of the subject will serve as the mechanism to address content knowledge formally in the seminar course and informally in the summer camps and pedagogical rotations. Mathematical content will focus on the strands selected from the NYS Standards: mathematical reasoning, numbers and numeration, operations, modeling/multiple representation, measurement, probability and patterns and functions. Science content will focus on topics selected from the Regents curricula. The focus on mathematics and science as investigative processes will form the basis for presenting content to the students and will be a significant part of the conversations taking place during the Pedagogical Rotations. Misconceptions about meanings of terms initially will be addressed by having teachers explain concepts without the use of any mathematical or scientific jargon. Students will maintain a "Journal of Inductive Inquiry" to develop mathematical and scientific intuition by cultivating the ability to think through writing. In the process teachers are able to witness the growth of their own understanding, and, as researchers, learn more about the acquisition of mathematical and/or scientific knowledge.

IHE Faculty in Secondary School Classrooms: On-site professional education of teachers includes participation of an IHE content specialist who spends at least eight full days in the schools each semester. The faculty member observes and, when appropriate, participates in teaching the secondary school class. Again, the goal is to reinforce connections between schools and colleges; practice teaching in public; provide content and pedagogical support to the schools; and provide IHE faculty members with new insights into teaching and learning. These experiences

might even provide necessary challenges for altering university teaching and content selection. The school meetings have the potential to change both the teacher who is observed and the TRT members who do the observing, as well as the institutions in which they dwell. In addition to pedagogical rounds and participation of IHE faculty in the Hubs, time will be arranged for on line communications among members of the TRT teams as well as with an additional number of designated experts. The use of other technologies, such as blackboard software, will also permit team members to communicate between scheduled meetings.

Pathways to the Profession: *The Cadet's Mathematics and Science Corps (Cadets):* NSF-funded peer tutoring programs in mathematics and science, developed at Fresno Unified and Long Island University (LIU), have been successfully employed to help students learn and to recruit others into teaching careers. Both Fresno and LIU will share information, admissions and evaluation forms, and publicity flyers with the MSPinNYC where a corps of mathematically and scientifically talented high school students from Regions 3 and 9 will be selected and educated to serve as mathematics and science peer tutors for other high school students. The Cadet Corps will work under the direction of the TRTs. Prospective Cadets, including a large number of members from historically underrepresented groups, will be sophomores or juniors at the time of application with a minimum grade point average of 3.0 in mathematics and/or science, interest in one or both disciplines, sensitivity to others, and good communication skills. An MSPinNYC Committee will make the final selections from among candidates nominated by teachers, principals, and community leaders.

One hundred and eighty cadets (20 in Year 2, 40 in Year 3, 60 each in Years 4 and 5) each receive 30 hours of educational preparation during the summer and the academic year. Preparation will include: (1) strengthening content knowledge and knowledge of the appropriate curriculum; (2) questioning and mediation techniques; (3) approaches for working with English language learners; (4) diagnosing problems and assessing learning; and (5) school visits and practice tutoring. In addition to formal training, cadets will meet on a monthly basis to discuss their experiences, broaden their knowledge, and learn more about teaching careers. They will have access to IHE faculty on-line on a regular basis. On-line communication will permit the cadets to join a larger group of students involved in the same enterprise both in the United States and abroad, such as Fresno and LIU tutors.

Tutoring experience can be used by Cadets to fulfill the high schools' community service requirements; conversations underway suggest that the program will also generate credit for an undergraduate education course. In addition, some will be invited to participate in the summer programs and in Pedagogical Rotations and colloquia focused on teaching and learning. Strategies to recruit Cadets as prospective teachers include the availability of tuition scholarships for Cadets wishing to pursue careers in mathematics and science teaching. Additional efforts to recruit the Cadets as future teachers will be addressed directly and indirectly. Hubs will use existing space for Drop-in Tutoring Centers to facilitate the Cadets work. Centers will be open one hour before classes start through 6:00 pm.

Micro Level Impacts: *Creating a Climate for Change -- infecting schools with a sense of professionalism:* Teachers interviewed by faculty involved in the proposed MSPinNYC indicated the "factors that might drive them out of the city system" are overwhelmingly related to a lack of "professionalism" in their work lives. School climate, as opposed to salary or student behavior was the major concern. Those with advanced degrees looked for opportunities to learn more science and build a community of teachers among their peers. Research findings support this and make it clear that what is most important is a working environment in which teachers are part of a team of educators (NEA, 1996).

The potential for TRTs to create a climate conducive to change and developing professionalism in the schools is great. Members of TRTs discover, in process, that it is natural and appropriate to share knowledge, acknowledge and fill content gaps, and talk with each other about problems encountered while teaching. Connections formed between master teachers and novice teachers in the summer will be further developed and nurtured during the school year, and will enable informal mentoring. In addition, because mathematics, biology, earth science, chemistry, and physics teachers at the same schools are involved, a critical mass needed to drive and sustain reform is created. College faculty, present in the secondary school classrooms to help develop content knowledge and analyze teaching and learning, will themselves learn more about the practice of teaching, and will also come to recognize the many research opportunities embedded in work with schools. They will, like faculty at Hostos and Bronx Community Colleges who participated in the teacher-researcher program, come to value educational research as much as scientific research, and put the same effort into it. Such collaborations tend to lead to publication.

IHE Mathematics and Science Departments: Because it is axiomatic that teachers teach how they were taught, it is imperative that pedagogical approaches used at the IHEs to teach mathematics and science content reflect successful teaching practices secondary school teachers need to know about and use. The process of exposing IHE faculty to successful teaching practices employed in secondary schools begins with partnerships developed as part of the TRTs and Pedagogical Rotations (page 7). Many mathematics and science courses offered in the CUNY system still rely on the traditional lecture and recitation model, irrespective of content, class size, or objectives. MSPinNYC will develop awareness of how students learn, how different cultures react to particular content and teaching styles, knowledge of varying pedagogical strategies, and alternative assessment strategies among IHE faculty through seminars, forums, participation in the secondary schools, and at regularly scheduled meetings between IHE and secondary school faculty (page 10). By engaging faculty and secondary school teachers in discussions about what knowledge is necessary for all students as opposed to majors and researchers the staff hopes to bridge a chasm and inject new thinking into seemingly intransigent problems.

Teacher Education Programs: Several aspects of existing teacher education programs, as well as science and mathematics courses, will be altered, first at the institutions directly involved in MSPinNYC, and then at other CUNY institutions.

- Hubs will serve as clinical sites for the colleges, enabling them to incorporate the CTL model in their pre-service programs.
- Student teaching will be based on the CTL model. Multiple student teachers will frequently be assigned to the same classrooms so that each can benefit from diverse and varied experiences and insights. Each group will design and carry out research projects useful to the teacher and classroom(s) in which they work.
- Educating teacher researchers will become a required component of teacher education programs, beginning with introducing research into science content and science education courses, and culminating with a cadre of teachers who approach teaching as researchers approach problems to be solved.
- Selected science, mathematics, and education courses will be redesigned and/or developed.
- Some Hub teachers will be hired as “clinical faculty” at the colleges.

ACTION PLAN: THE MACRO LEVEL

The macro level has been designed as a cost effective and realistic approach to addressing issues and policies that go beyond specific college campuses and school regions involved in the micro program. Macro activities will involve and develop commitment from experts who are available across CUNY institutions and within the NYC School System, as well as provide a transparent, often public, mode for questioning, analyzing, researching, and making available rapid responses to issues and problems that emerge from implementations at the micro level. A series of vehicles such as a Mathematics and Science Council, seminars and public forums, “job-alike” meetings, and doctoral seminars are introduced to help address citywide policies and develop partnerships and change cultures. The MSPinNYC’s Management Team is responsible for analyzing and reacting to advice, suggestions, issues, and research needs that come from these groups. The PI and a Co-PI, both research chemists with extensive administrative experience and reputations as outstanding teachers, enhance possibilities to bring about IHE reform.

Council for Mathematics, Science, and Education (Council): The fifteen member Council brings scholars from mathematics, science, public policy, cognitive and developmental psychology, learning and teaching, anthropology, communications arts, and professional education together with practitioners, administrators, politicians, and cultural leaders from within the city to address the larger and more intransigent issues that plague educational reform and that arise out of the daily work of the micro level. It operates as a semi-autonomous body whose deliberations can be set into motion by its members or by the project’s Management Team. Its membership brings a range of resources to problems, plans, and events that reside outside the scope of any one person or group of persons. Experts from different areas and disciplines confront issues and problems that no one person, group, or organization can solve. As the Council works and deliberates, it models partnership building, a major MSPinNYC goal.

The Council will serve in multiple capacities, as a whole and in sub groups, as: (1) academic review boards or visiting committees; (2) analysts, (3) provocateurs, (4) researchers and identifiers of research areas, and (5) brokers. The goal of developing meaningful and lasting partnerships among groups who do not often or naturally work together or respect each other motivates all Council activities, especially those at the macro level. Because this is a difficult goal to realize, decisions will be made in process regarding when to probe, when to bring matters to the surface, and when to “attack” in another fashion altogether. Although Council membership will be composed almost exclusively of those who live and work in NYC, a small number of external consultants will serve ex-officio. The Council will meet twice a year in addition to more frequent sub group meetings, formal and informal e-mail

conversations, and scheduled visits to IHE colleges and secondary schools. Examples of issues and problems the Council will address include:

- Relationships and alignments between particular NYS Regents Exams, related high school curricula, graduation requirements, and IHE requirements;
- Alignment between high school graduation requirements and entrance requirements for community colleges, senior colleges, graduate programs, and teacher certification;
- Reward structures for IHE faculty and secondary school teachers;
- Teacher and student beliefs about teaching and learning;
- Institutional change and sustainability;
- Programmatic and “intellectual” scale up;
- Knowledge that is of most worth: literacy vs. mastery; researchers vs. teachers;
- Controversies that affect the teaching and learning of mathematics and science;
- MSPinNYC impacts

Monthly Seminars and Public Forums: Seminars and forums provide an additional vehicle to bring project participants together in settings conducive to building partnerships. These events will involve participants from institutions involved at the micro level and will address major concerns related to implementation areas such as developing partnerships, recruiting teachers, educating and retaining teachers; developing challenging courses and curricula and preparing students to meet these challenges; and developing evidence-based programs and outcomes. Seminar and public forum leaders will be recruited from across the nation as well as from NYC. Lee Shulman, President of the Carnegie Foundation and a major proponent of the Scholarship of Teaching, is an appropriate person to lead a seminar focused on teaching as a respected intellectual/scholarly activity, while a discussion of what subject should be taught first in high school science would be wise to involve Leon Lederman (Physics First). An investigation of how to help narrow the learning gap between historically underrepresented groups and others might include Bob Moses (The Algebra Project) or Bill Velez (Department of Mathematics, University of Arizona). A seminar dealing with the role of scientists and mathematicians in education might involve Hyman Bass (University of Michigan). Seminar and forum topics can be suggested by participants and/or Council members. The Director of the Macro Component has responsibility for implementing these events. The public forums will be held at the CUNY Graduate Center; a seminar at any of the participating institutions.

Meetings of Job-Alike Groups: Changing the culture at IHEs, developing scholarly and respectful relationships between Schools of Education and Science and Mathematics Departments, and bringing about similar sorts of relationships between IHEs and the NYC Public Schools are daunting tasks, especially at institutions as large, complex, and traditional as CUNY and the NYC Schools. The effectiveness of the strategy suggested below -- characterized by lots of conversation over long periods of time about real issues affecting real students, and with people who possess the power and authority to change policies and practices-- might not be obvious. Much of what is suggested has not happened before, especially on the scale suggested. The meetings and conversations have been designed to: develop understanding, among different groups and organizations, of conditions, existing capacities, and needs in the field, and provide forums for analyzing and responding to them. The meetings are expected to lead to action and to produce results.

- **Vice Chancellor for Academic Affairs, College Presidents, NYC Schools Chancellor, and the NYS Commissioner of Education** will meet twice yearly to review policy issues and ways that their the offices can work together productively to solve educational problems across the state. This group considers recommendations arising from Council deliberations, other faculty and administrative groups, and the project’s management team. It facilitates policy and practice changes and alternative strategies. These meetings will sometimes occur as part of the Presidents’ Council, composed of CUNY’s college presidents
- **CUNY Science and Education Deans, Deans of Arts and Sciences, and Regional Superintendents** meet twice a semester to examine effects of project implementation on courses, programs, resources, facilities, and requirements. On another level, they meet to begin the process of sharing cultures, ideas, problems, and solutions among three very different groups.
- **IHE Department Chairs and Regional Assistant Principals (APs) for Mathematics and Science** Department Chairs, called APs in NYC, meet four times a year to gain a better understanding of each others’ perspectives, scholarship, research and address content-related issues.
- **IHE Faculty and Mathematics and Science Teachers** will meet monthly to discuss content and pedagogy. The partnerships developed in the MSPinNYC should have the largest impact on this group as those involved learn to

understand each others prejudices, biases, strengths, and styles; to respect and share in each others' expertise; and to alter how they learn and teach.

Doctoral Research and Seminars: CUNY doctoral students in education, the sciences and social sciences will be part of the MSPinNYC's Formative Evaluation Team. They will observe at job-alike meetings, pedagogical rotations, and summer camps; interview, collect and analyze data; and help design studies and carry out research projects. Faculty advisers will work with the MSPinNYC leadership and these students to help develop close ties between thesis topics and the work done on this project. Two or three students will help develop a project history (annotated chronology) and case study. All the graduate students involved in the MSPinNYC will come together at least twice yearly to discuss implications of findings and emerging issues new ideas.

D. EVALUATION

Evaluation of the MSPinNYC reflects the project's working philosophy of acting publicly and transparently within a climate of openness. Its purpose is to produce information that permits the project to self-correct in the process of implementing (formative evaluation); to determine project effectiveness as the project nears completion (summative evaluation); and to consider applications and extensions of the approach in other settings (dissemination). The design makes it possible to respond regularly and virtually instantaneously to data, events, and strategies. Members of the formative team will be present as listeners and critical friends at all meetings described on pages 9-11 and meetings of the project's Management Team. The evaluators will help participants reflect on what has been said and implied and on action steps that follow.

Different evaluation teams will be responsible for formative and summative evaluation. Both groups will continuously ask why, under what circumstances, and under what conditions activities, strategies and approaches work best. The evaluation will address the work and performance carried out by key stakeholders who include: project leadership, students enrolled in mathematics and science courses, Cadets, education, mathematics, and science faculty, secondary mathematics and science teachers, and CUNY, NYC Schools, and NYSED leadership. Both teams will cooperate with relevant NSF-funded MSP Research, Evaluation, and Technical Assistance projects by sharing information, tools, and strategies and attending relevant meetings. Key components to be evaluated include:

- disjunctions and convergences between the project's vision and reality;
- design strategies (micro/macro, the Council, seminars and forums, job-alike meetings);
- partnerships and culture changes (reward systems, district priorities and policies; IHE priorities and policies; new and revised science courses, lines and kinds of communication, informal procedures, reward systems, teaching styles and classroom organizations; participation by CUNY, NYCDoE, and NYSED);
- teacher education (CTL model, TRT classrooms, altered student teaching experiences, new and revised courses, scholarships awarded, quantity and quality of new recruits to teaching);
- student success (scores on Regents, Regents results compared with results on nationally normed tests, content interviews, college going rate, teacher recruitment and retention content-realignment);
- research efforts (kinds of research, publications, responses to school problems; and
- leadership, institutionalization, and dissemination (new proposal directions, changes in Regents Exams, scholarships and fellowships, role of graduate students, doctoral requirements, and resource allocations)

Data will be analyzed, utilized, and, when appropriate, disseminated. Tools used to conduct the evaluation include interviews, focus groups, observations (classrooms, formal and informal meetings, workshops) surveys, case study, and tests. Some tools already exist; others will be developed within the project's first year. To help test the hypothesis that substantial content can be learned in informal settings (page 5), exams must be developed to determine, as closely as possible, what teachers have learned in informal settings. Very little is actually known about bringing about culture change within IHEs and between IHEs and PreK-12 educational systems. To this end interview protocols, indicators of change, and feedback loops must be developed. A "content interview", one-on-one or in small groups, will be designed to determine how students attack particular problems, depth and mastery of concepts they learn, and how learning difficulties are manifested. The content interview, coupled with a classroom observation instrument, will be used to help produce new approaches for dealing with resistance to closing learning gaps in NYC among historically underrepresented students.

The Formative Evaluation Team is headed by Leo Gafney, an evaluator who has considerable experience with NSF and NIH projects. His team will concentrate on continuous analysis, assessment, and critique of the project's

progress in meeting critical benchmarks. It will analyze and use the data collected by the IHEs and NYC School Regions to assess progress; frame information and action producing research questions; and develop the sense of partnership and cultural change fundamental to this project. It will also be responsible for assessing -- and supporting--the health of the Partnership and reporting on its strengths and weaknesses. The team will meet with the MSPinNYC Management Team bi-monthly to report its findings and facilitate discussion about implications of the findings for the conduct of the project.

Members of the Education and Human Resource Directorate of the American Association for the Advancement of Science, headed by Yolanda George, will serve as the Summative Evaluation Team. This team will assess the matured project's outcomes and impact, using a process that includes review and "certification" of data, analysis of written reports and other documents, and conducting focus groups and informal interviews. It will analyze the design strategy, goals, structure, leadership, outcomes, scale up, dissemination efforts, and productivity of the partnership as well. It will develop a tool to assess partnerships and culture change and write a case study that illustrates the growth of partnerships and culture changes at CUNY campuses and secondary schools. The Summative Evaluation Team makes yearly site visits through Year 3, and increases the frequency to two visits in Years 4 and 5. It also meets with the Formative Evaluation Team.

The Summative Evaluation Team is responsible for preparing yearly reports and the project's Final Report. Among the questions this team and MSPinNYC will address are the following:

- To what extent did the project meet its goals?
- Did the micro/macro strategy work? What did it accomplish? Would it be useful in other settings?
- What factors are most critical for establishing collaborative, evidence-based cultures among IHEs and PreK-12 systems? To what extent have solutions been institutionalized as the result of MSPinNYC?
- Has collaboration encouraged engagement between research scientists and mathematicians, mathematics and science educators, and secondary school teachers?
- What unintended but significant results has this project produced?
- What steps have been taken to institutionalize successful project results at CUNY and in the Regions?
- What are the affects of the summer Regents program on academic year course content and methodology?
- How have faculty teaching styles changed for the good? Selection of content? Course requirements?

E. PARTNERSHIP MANAGEMENT/GOVERNANCE PLAN

The MSPinNYC governance/management structure includes a management team, project director and coordinators, and specific committees (See Supplementary Documents for Figure 2). The Management Team represents the sciences, education, and the public schools. It includes the PI, a Professor of Chemistry at Hunter and a researcher who has also worked with science education majors and public schools for eight years. She designed and implemented the Chemistry Summer Camp together with another Co-Pi, also a Chemistry Professor and researcher. Experience among the two includes Chemistry Department Chair, President of the Faculty Senate, and more than 7 NSF, NIH and other research awards. The other Co-PIs include a Mathematics Education Professor from Hunter's College of Education, a Mathematics Professor from a community college, and the Director of Mathematics and Science for the NYC Public Schools. Also on the Management Team is the Dean of Education from Queens College (a biologist) and the Math and Science specialists from Regions 3 and 9. (See Supplementary Documents for detailed job descriptions.) The Management Team, through the PI, reports outcomes and policy suggestions to CUNY's University Dean for Teacher Education who, in turn, reports to CUNY's Vice Chancellor for Academic Affairs. The PI also reports to an MSPinNYC Policy Committee chaired by the VP for Academic Affairs. Ten of fourteen faculty (PI, Co-PI, and Senior Personnel) are scientists and mathematicians. The Management Team, meeting regularly, is responsible for all grant operations, and monitoring and facilitating partnerships established as a result of this project.

The Policy Committee is composed of heads of units involved in public education in New York. The Committee addresses major ideas and programs resulting from this project, policy issues throughout the CUNY and NYC systems, and institutionalization and sustainability. It provides a critical mechanism for disseminating MSPinNYC outcomes to other units throughout NYC. In addition Louise Mirrer, Vice Chancellor for Academic Affairs and Nicholas Michelli, University Dean for Teacher Education, Richard Mills, NYS Commissioner of Education, Diana Lam, Deputy Chancellor for the New York City Department of Education, and the Superintendents from Regions 3 and 9 have agreed to serve on the committee.

The Project Director (PD) oversees day-to-day operations of the MSPinNYC and is responsible for working with **Program Coordinators from the schools and the IHE**. The PD will organize all components of the MICRO. The PD has a PhD in physics and became a high school teacher of mathematics and physics through CUNY's alternative certification program for mathematics and science teachers. **The Schools Coordinator** is selected by the Department of Education and is responsible for ensuring the selection of all hub schools, coordination of the Pedagogical Rotations, and any other activities requiring a liaison between MSPinNYC and the schools. In the first year, this coordinator will work directly with the formative evaluation team to collect the necessary data from the schools. The Coordinator reports to the Project Director. **The IHE Program Coordinator** is responsible for the details of the running of the summer programs and the seminar series as well as any other activities run at the college campuses. This Coordinator also reports to the Project Director and interacts with and supports the **Policy Coordinator**.

The Macro Director is responsible for management of all macro activities, including conducting the Council, designing seminars and forums and recruiting the speakers, and planning and participating in the Jobs-Alike meetings. The Macro Director reports to and works with the PI of the MSP. She/he will have extensive experience with the NYC IHEs as well as public school system either as a faculty member, Dean, or School Administrator.

The primary features of the Micro project involve six colleges running courses and organizing Pedagogical Rotations. A community college and senior college are paired in the management of the courses and rotations: Hunter and BCC, Hostos and Lehman, and Queens and Queensborough. **Local Management Teams** for each pairing, are composed of Deans of Education and Arts and Sciences, members of the TRTs, (faculty and teachers), Assistant Principals and other representatives from the Regions' Hubs, and undergraduates and Cadets will meet periodically to address implementation and obstacles that arise. These local management teams are constructed to ensure that all constituents are represented.

F. INSTITUTIONALIZATION AND SUSTAINABILITY

Embedded in the design of the MSP are mechanisms for institutionalizing the programs and creating sustainable reform, mechanisms that include the macro structure, the Council, and the Policy Committee. Features of the proposal that can be readily incorporated into the schools and IHE are:

- The summer schools. The MSPinNYC model requires 24 hours of teaching time per week vs 20 hours using the standard model. The slight increase in cost will be offset by significant increases in student passing rates expected under the new model.
- Inclusion of the teacher-researcher model in teacher education programs. Most of the faculty involved in the MSPinNYC are also involved in science and mathematics teacher education at the six participating colleges. It is expected that the teacher-researcher model will be incorporated in the teacher education curriculum.
- Modification of student teaching practices. A public teacher-researcher model will be developed and will replace current practices in the teacher education programs.
- Twelve partner schools. The twelve hub schools will serve as clinical sites for the teacher education programs thereby sustaining the partnerships developed over the course of the MSPinNYC.
- Culture change. Changing the culture of IHEs to include scholarship of teaching should encourage more mathematics and science faculty to engage in teaching-related activities as part of normal professional activities and these changes help sustain partnerships developed which, in turn, contribute to sustaining the reforms. Culture changes in the schools (summer schools, professional development programs) resulting in enhanced student success should remain years after the grant is concluded.
- New and enhanced partnerships among the senior and community colleges and the NYC Schools and between schools of education and the sciences and IHE faculty and secondary school teachers.
- Policy changes that support the institutionalization of the reforms.

G. DISSEMINATION

Dissemination has been built into the design of the project. At the micro level, CTL program components, Cadets, and Regents support programs are disseminated to eight NYC School Regions, 3 Senior Colleges, and 4 Community Colleges. The macro level contains strategies--a Policy Group, Council, public forums, seminars, and job-alike meetings--to involve all CUNY campuses and NYC Public School Regions in content, policy, resource allocation, K-20 alignment, and student success issues. Participation of the NYS Education Commissioner, Richard Mills, on the Policy Group assures that policy issues and program components will be brought to the state level. Publications are likely to result from the research focus built into the project, both in terms of how teachers are educated and how the project is managed and evaluated. In addition, many of the senior personnel are research faculty committed to

sharing outcomes and results through published papers, presentations at professional conferences, department meetings, and other formal and informal venues. A case study about developing IHE and school district partnerships, part of the evaluation, will be shared broadly. High school students will naturally disseminate their tutoring experiences through e-mail and other electronic communications to similar local, national, and international groups.

H. PRIOR SUPPORT

NSF DUE #9453606 (F. Gardella, co-PI on sub award to Hunter College) The NYC Collaborative for Excellence in Teacher Preparation operated from August 1995 to July 2001. Partnerships developed at Hunter as a consequence of the collaborative laid the groundwork for this MSP. The MA programs for training secondary school teachers in science (biology, chemistry, earth science, and physics) and mathematics MA program were revitalized and created collaboratively with faculty from the School of Education and Arts and Sciences. As a result of the growth of these MA programs, joint positions between the School of Education and the sciences were created. Faculty now regularly “cross teach” courses in science education and science and mathematics education and mathematics.

DUE-0202848, (P. Mills and W. Sweeney). Funding to develop new BA/MA programs in science and education to prepare effective science teachers and develop new recruitment strategies. The BA/MA programs will be the only route for traditionally certified science teachers. (The MA programs are alternative certification pathways.) The chemistry BA/MA program now accepts students, and biology and physics will begin accepting students in fall 2004. New recruitment strategies have been implemented. The summer pilot project in chemistry was funded in part through this grant. Collaborations between School of Education faculty and science faculty have deepened and resulted in “cluster courses” offered this fall as part of the MA teacher education program.

ROLE # 0126141 (B. Czarnocha, PI, V. Prabhu, co-PI) The project, in its second year, utilizes a teacher-researcher methodology to identify particular aspects of calculus with which students have difficulties. Two instructional innovations have resulted from this approach both relating to the concept of the limit in calculus (Czarnocha, B, Prabhu, V, 2002). These innovations help students understand and remember the rules of integration. Student work is being analyzed to assist in developing a calculus-algebra support module for the calculus course at Hostos and Bronx Community Colleges.

I. TIMETABLE

Project Activities – Micro

Yr 1 Sp 04	<ul style="list-style-type: none"> • selection of 2 Manhattan hub schools and 12 teachers
Summer 2004	<ul style="list-style-type: none"> • Construct 4 TRT Teams in Chemistry, Living Environments, Math 8 and MATH A. • Teach 4 courses at Hunter College. • Faculty from BCC/Hostos/Lehman trained in the public teacher-researcher model.
Academic Yr 2004-2005	<ul style="list-style-type: none"> • Monthly Rotations in 2 Hub schools (4 disciplines, 4 TRTs) • IHE content specialist in residence at 2 schools weekly; specific discipline selected by Hubs • TRT content/pedagogy course at Hunter developed in Fall; offered Spring semester • TRT student teaching model piloted at 2 hub schools.
Yr 2 Summer 2005	<ul style="list-style-type: none"> • Construct 12 TRT Teams in all six disciplines. • Year 1 teachers return (12) and 24 new teachers selected • Teach 8 courses at Hunter and 4 at BCC/Hostos/Lehman. Specific courses chosen Hubs. • 4 faculty from Queens/QCC trained in public teacher-researcher model
Academic Yr 2005-2006	<ul style="list-style-type: none"> • Monthly Rotations in 6 hub schools (6 disciplines, 36 TRTs). • IHE content specialist in residence at 6 schools weekly; specific discipline selected by Hubs • 2nd offering of TRT course - Hunter, 1st offering of TRT course - Hostos/BCC/Lehman • Cadet Corps at 1st 2 Manhattan hubs created • Select 2 additional hubs from Bronx, Region 9, 4 hubs from Queens, Region 3 • Student teaching model continues
Yr 3 Summer 2006	<ul style="list-style-type: none"> • Construct 24 TRT Teams in all disciplines. • Yr 1 teachers (12) finished, Yr 2 teachers (24) return, 48 new teachers • Teach courses -- 8 at Hunter, 8 at BCC/Hostos/Lehman, and 8 at Queens/QCC. • First year of summer school (6-12 courses) taught at 1st 2 hub schools by Yr 1 teachers

Academic Yr 2006-2007	<ul style="list-style-type: none"> • Monthly Rotations in 12 hub schools (6 disciplines, 24 TRTs). • IHE content specialist in residence at 12 schools weekly. • 1st offering of TRT course at Queens/QCC, continued offering at other campuses • Cadet Corps at 1st 2 Manhattan hubs continues, Cadet Corps at 2 Bronx schools created • Student teaching model integrated into teacher education program
Yr 4 Summer 2007	<ul style="list-style-type: none"> • Construct 16 TRT Teams in all disciplines. • Yr 1 and 2 teachers finished (36), Yr 3 teachers (48) continue • Teach courses -- 4 at Hunter, 4 at BCC/Hostos/Lehman, and 8 at Queens/QCC. • Summer school taught at hubs by Yrs 1 & 2 teachers (36), 24-30 courses
Academic Yr 2007-2008	<ul style="list-style-type: none"> • Monthly Rotations in 12 hub schools (6 disciplines, 16 TRTs). • IHE content specialist in residence at 12 schools weekly • TRT course at all campuses offered and integrated into teacher education programs • Cadet Corps at 2 Queens hub schools created; CCorps in Manhattan & Bronx continues
Yr 5 Summer 2008	<ul style="list-style-type: none"> • All teachers finished (84) completed professional development program • Summer school taught at 12 hubs by teachers
Academic Yr 2008-2009	<ul style="list-style-type: none"> • TRT course at all campuses offered and integrated into teacher education programs • Cadet Corps at 2 Queens hub schools created; CCorps in Manhattan & Bronx continues

Project Activities – Macro

Yr 1 Summer 2004	<ul style="list-style-type: none"> • Seminar series I planned • Council constructed and initial meeting for Fall scheduled
Academic Yr 2004-2005	<ul style="list-style-type: none"> • Seminar series I • Initial council meeting and specific topic identified • Policy committee convenes • Jobs-alike meetings begin
Yrs 2-5	
Summer	<ul style="list-style-type: none"> • Seminar series planned
Academic Yr	<ul style="list-style-type: none"> • Seminars series II • Council meets, council activities coordinated • Policy committee convenes • Jobs-alike meetings

Project Activities – Evaluation

Yr 1 Summer 2004	<ul style="list-style-type: none"> • Management Team meets with Formative and Summative Evaluation Teams • Ongoing meetings of TRT, Management Team and Formative Eval Team • Data collection from NYC schools begins • NYC summer test results collected to compare with the summer program
Academic Yr 2004-2005	<ul style="list-style-type: none"> • Ongoing participating by Form. Eval Team, graduate students begin Case Study • Fall 2004 disaggregated data from NYC schools by Region collected • Annual meeting with SET • Evaluation of first summer program used to inform planning for Yr 2
Yr 2 Summer 2005	<ul style="list-style-type: none"> • Ongoing meetings of TRT, Management Team and Formative Eval Team, data collection continues
Academic Yr 2005-2006	<ul style="list-style-type: none"> • Ongoing participating by Form. Eval Team • Disaggregated data from NYCDOE continues • Annual meeting with SET • Evaluation of Yr 2 program used to inform planning for Yr 3
Years 3-5	<ul style="list-style-type: none"> • Continued work with Form. Eval. Team, Sum. Eval. Team meets twice yearly through Yr 5