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### PARTNERSHIP FOR REFORM IN SCIENCE AND MATHEMATICS (PRISM)

#### 1. VISION, GOALS, AND OUTCOMES

**Vision:** Increase science and mathematics (SM) achievement for all P-12 students in order to improve their readiness for post-secondary education and careers by enhancing teacher quality, raising expectations for all stakeholders, and closing the achievement gaps through the collaboration of P-16 partners.

In order to increase student achievement, changes in practices are needed in SM teacher preparation, professional development, and in P-12 SM courses and curricula, with extra support provided for students who need it to reach the higher expectations. The problems are circular—SM practices in P-12 schools affect higher education and vice versa, requiring pre-school through college (P-16) solutions that change in fundamental ways how P-12 schools and higher education SM faculties work together. Sustainable solutions require higher education SM faculties to engage more fully with P-12 partners through mutual learning about the necessary points of intersection among research-based knowledge (as conducted by SM higher education faculty), pedagogical content knowledge (as taught in colleges of education) and teacher “craft” knowledge (as learned and practiced by P-12 teachers teaching SM in schools), and to change practices to conform to the new learning. Sustaining the solutions also requires policy changes at the state level to ensure that policies are in place to “stretch” the magnitude of changes in practices adopted locally and to provide necessary support so local reforms get traction. The two most important leverage points for changing practices and policies needed to increase student achievement are: 1) improving teaching quality (Darling-Hammond, 1997), and 2) increasing the number of challenging SM courses P-12 students successfully complete ([www.edtrust.org](http://www.edtrust.org)). Both are emphasized in PRISM: locally through four existing regional Pre-School-College (P-16) Councils (P-12 schools, college, and university partnerships) in Georgia, and at the state level through the University System of Georgia (USG), Georgia Department of Education (DOE), and the Education Coordinating Council (ECC), the State P-16 Council—the appropriate forum for addressing policy issues that cut across P-12 and higher education. Combined strategies at regional and state levels will result in all P-12 students in the PRISM regions having high quality SM teachers and being prepared for success in challenging SM courses and curricula. These strategies will lead to increased P-12 student achievement in SM; they will contribute to knowledge about teaching and learning SM; and they will create models for scaling-up the innovations statewide.

**Goal 1:** Raise expectations and achievement in SM in P-12 schools, while closing achievement gaps among demographic groups by:

- a) Providing challenging SM curricula and materials for all students.
- b) Raising the awareness of students, parents, and the community of the need for all P-12 students to complete challenging courses and curricula in SM.

**Goal 2:** Raise student achievement in SM in P-12 schools through increasing and sustaining the number, quality, and diversity of P-12 teachers teaching SM by:

- a) Providing high quality professional development to current P-12 teachers who teach SM.
- b) Strengthening the content and pedagogy in SM for pre-service teachers.
- c) Ensuring a sufficient pipeline of highly qualified and diverse SM teachers to meet demand.
- d) Providing incentives for teacher assignment and retention to ensure access to highly qualified and experienced SM teachers by students who need them most.

**Goal 3:** Raise student achievement in SM in P-12 schools through increasing the responsiveness of higher education to the needs of P-12 schools by:

- a) Increasing the participation of SM faculty in teacher preparation and professional development.
- b) Providing incentives for SM faculty members to engage in research with P-12 schools on effective practices in science and mathematics.

**Projected Quantitative Outcomes:** Student achievement is at the apex of all PRISM goals, with outcomes and annual benchmarks to monitor improvement connected to Goal 1. Outcomes and annual benchmarks are listed below for Goal 1. Only outcomes are listed for Goals 2 and 3 with annual benchmarks in Appendix 2.

#### Outcomes and Benchmarks for Goal 1

1. Student achievement in SM will increase at all grade levels.
  - Percent of students taking challenging SM courses increases.
  - Percent of students meeting or exceeding standards on the state’s criterion referenced competency tests (CRCTs) in SM increases for all demographic groups.

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- Percent of students passing the high school graduation test in SM increases for all demographic groups.
- 2. Achievement gaps in SM will decrease among all demographic groups of P-12 students.
  - Gaps decrease among demographic groups as to percent completing (with grade C, or better) challenging SM courses.
  - Gaps decrease among demographic groups as to percent meeting or exceeding standards on SM CRCTs.
  - Gaps decrease among demographic groups as to percent passing the high school graduation test in SM.
- 3. College readiness in SM of high school graduates will increase for all demographic groups.
  - Percent of students completing Algebra I in 8<sup>th</sup> grade (with grade C, or better) increases for all demographic groups.
  - Percent completing the SM college preparatory curriculum increases for all demographic groups.
  - Percent of students requiring Learning Support in college decreases for all demographic groups.

### Outcomes for Goals 2 and 3

4. The SM content knowledge of in-service P-8 teachers will increase.
5. The pedagogical skills of in-service teachers teaching SM will improve.
6. The SM content knowledge of pre-service P-8 teachers will increase.
7. The pedagogical skills of pre-service teachers aspiring to teach SM will improve.
8. The number and diversity of P-12 teachers prepared to teach SM will increase.
9. The number of qualified and experienced SM P-12 teachers assigned and retained in hard-to-staff (urban and remote rural) schools will increase.
10. The numbers of SM faculty members working in teacher preparation will increase.
11. The numbers of SM faculty members working in the schools will increase.
12. The numbers of SM faculties working in the schools that receive promotion or tenure will increase.
13. The amount of collaborative research between higher education and P-12 SM faculties will increase, contributing to the teaching and learning knowledge in SM.

**Self-Assessment Process Used to Develop Vision, Goals, and Projected Outcomes:** PRISM is an initiative of the ECC, which includes the Governor and CEOs and Board chairs of Georgia's public education agencies. An ECC Lead Staff Team coordinates P-16 work in Georgia; Jan Kettlewell, PRISM PI, represents the USG on this team. Following a presentation of key data elements in SM to the ECC by the USG Chancellor, the ECC asked the ECC Lead Staff, under the leadership of Jan Kettlewell (Associate Vice Chancellor of P-16 Initiatives for USG,) to develop and implement a plan to improve SM student achievement. Data elements include:

- P-12 student and teacher baseline data (see next section, page 3).
- Teacher needs assessments in four regions.
- Results of an external evaluation of Georgia's P-12 curriculum in SM (Quality Core Curriculum).
- Number of college freshmen receiving grades of "D, W, or F" in college algebra, (pre-requisite to the mathematics sequence required by the USG for elementary teachers and middle grades teachers concentrating in SM), and the corresponding decreases in the number of college students choosing to major in these fields.
- Lessons learned from the state's Teacher Quality Plan (1999) (a successful example of P-16 work) and from issue papers on teacher quality from the Governor's Education Reform Commission (2000) showing:
  - The impact of teacher work environment and salary on decisions to select teaching as a career choice and to accept and remain in teaching positions in hard-to-staff (urban and remote rural schools).
  - Teacher certification standards that require no SM for elementary teachers and that permit middle grades and high school teachers to teach out-of-field for a minor portion of the day.
- *Principles for the Preparation of Educators for the Schools* (Board of Regents, 1998) (USG teacher preparation policy) that requires four mathematics courses for elementary teachers but only the core curriculum in science.

The ECC Lead Staff team invited four existing regional P-16 councils, each with a track record of collaboration in the preparation of new teachers, and each with active participation in state-level P-16 work (see accomplishments on pp.17-18) to plan and implement the Partnership for Reform In Science and Mathematics (PRISM). During fall 2002, representatives from the four regional P-16 councils (existing regional P-16 coordinator; regional PRISM Co-PIs, one from each of the core partner higher education institutions; P-12 teachers; staff development coordinators; and higher education SM and education faculty members) and members of the USG P-16 staff finalized the vision, goals and outcomes for PRISM. The data confirmed common deficiencies in SM student achievement and a need to improve the quality of SM teaching across regions, and the necessity for some unique regional strategies because of

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different contexts. Georgia's PRISM partners came to agreement on a vision, goals and outcomes and finalized regional and state plans. The core (C) and supporting (S) partners in the four PRISM regions are:

- Metropolitan Atlanta:
  - Atlanta Public Schools—largest urban region in Georgia (C).
  - Georgia State University—urban research university that is the top producer of African American teachers; 3<sup>rd</sup> largest producer of teachers in Georgia (C).
  - Center for Education Integrating Science, Mathematics, and Computing—outreach center for K-12 education at the Georgia Institute of Technology (S).
- Northeast Georgia:
  - Clarke, Jackson, and Oconee County School Systems—small urban and rural school systems (C).
  - University of Georgia—largest research university and the largest producer of teachers in Georgia (C).
  - Georgia Perimeter College—largest two-year college with high number of pre-education majors (S).
- East Central Georgia:
  - Bulloch, Evans, Screven, and Effingham County School Systems—remote rural school systems (C).
  - Georgia Southern University—a regional university; 6<sup>th</sup> largest producer of teachers in Georgia (C).
- Southeast Georgia:
  - Chatham County School System (Savannah)—2<sup>nd</sup> largest urban region in Georgia (C).
  - Bryan, Camden, Liberty, and Glynn County School Systems—small urban and rural school systems (C).
  - Armstrong Atlantic State University—the 8<sup>th</sup> largest producer of teachers in Georgia and provides most of the teachers to the greater Savannah and surrounding areas (C).
  - Coastal Georgia Community College—two-year college with exceptional school outreach programs (S).

**Baseline Student and Teacher Data: Baseline Student and Teacher Data:** Georgia is a diverse state with a large minority student population. In 2001-2002, the ethnic breakdown of Georgia's P-12 students was: Asian 2%; African American, 38%; Hispanic, 5%; White, 53%; Multiracial, 2% ([www.ga-oea.org](http://www.ga-oea.org)). The 13 core partner school districts in the four PRISM regions mirror the state's distribution. Low P-12 student achievement in SM has been a persistent problem throughout Georgia and in the four PRISM regions (specific regional and state student achievement data in Appendix 1). The state pass rate, in the 70% and 80% range for most SM state tests, masks the race/ethnicity and regional gaps. For example, in 8<sup>th</sup> grade mathematics, 87% of the White, but only 52% of the African Americans and 54% of the Hispanics, met or exceeded standards. The percent of students meeting or exceeding standards in mathematics decreases from grade 1 through 8, statewide and in the four PRISM regions. Among the 13 core partner school districts in PRISM, the achievement gap between African American and White students in mathematics ranges from 4% to 40% for grades 1-8; in science it approximates 20% at each grade level. On the High School Graduation Test in the 13 core partner school districts, the average score in mathematics for African American students is 14% lower than for White students, and 33% lower in science. The under preparation of P-12 students creates problems for colleges when students have completed the college preparatory curriculum and still require remediation. (Percent for each system requiring Learning Support is in Appendix 1). 20% of the students who graduated in 2001 and attended a USG institution in the four PRISM regions required remediation.

A major contributor to the low achievement in SM is the shortage of qualified teachers. In 2000-2001, USG institutions prepared 212 mathematics and mathematics education majors. (Not all were preparing to become teachers). The number of new mathematics teachers hired that year was 613. Georgia currently relies heavily on other states for its mathematics teachers. The same is true for science. There is a need for highly qualified teachers at all levels to improve SM student learning. As a companion to PRISM, the USG has just launched a major Teacher Preparation Recruitment Initiative (referenced in Strategies 2, 6). A concerted effort is needed to increase and retain the number of P-12 teachers prepared to teach SM in order to turn around SM student learning in Georgia.

**Challenges and Opportunities in Higher Education Core Partners:** The University System of Georgia (USG) includes 34 colleges and universities (associate, and all public baccalaureate, master's and doctoral degree granting institutions in the state). The primary focus for USG collaboration with the P-12 public schools has been teacher preparation. In 1998 the USG adopted the *Regents' Principles for the Preparation of Educators for the Schools* (Board of Regents, 1998). These *Principles* strengthen significantly the content and pedagogical preparation of all P-12 teachers prepared in the USG, and they changed the governance of teacher preparation from the college of education to a collaborative unit of arts and science, education, and school faculty. SM faculty members in the core partner universities have been active participants in the shared governance of teacher preparation since 1999. A network of partner schools is also in place for each USG institution that prepares teachers, with all core partner school districts as members. The capacity and readiness of SM faculty members to engage more fully in improving

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SM in P-12 schools is evident by their recent response to the request to form higher education consortia in SM: 95 faculty members (including active lab scientists) committed to work with core partner school districts in teacher professional development (summary of participants in Appendix 3). Further examples of SM faculty involvement in P-12 schools are included below in Section 2, Results from Prior NSF Funding; Section 3, Strategy 8, Revision of SM Student-learning Standards and Curriculum; and Section 5, Accomplishments at the Regional Level. All of the core higher education partners have the capacity to increase the number of SM teachers they prepare (data by institution in Appendix 1). A reward system that honors the collaborative work of SM faculty with P-12 colleagues will be instituted in order to sustain their increased participation (PRISM Strategy 10).

**Impact:** PRISM will reach all 9,642 elementary and middle school teachers and 490 SM high school teachers in the 13 partner school districts. This will impact the 170,172 P-12 students in the core partner school districts, with great potential eventually to impact the 1.4 million P-12 students in Georgia. In addition, the core partner higher education institutions prepare 44% of all teachers prepared within the USG (all public teacher preparation institutions), which will impact pre-service elementary, middle, and high school teachers preparing to teach SM.

**Relationship of Vision, Goals, and Projected Outcomes to MSP Key Features and to State and National Programs:** PRISM focuses directly on increasing P-12 student learning and achievement in SM through improving SM teaching quality; increasing the number of challenging SM courses P-12 students successfully complete; and contributing evidence-based knowledge to teaching and learning SM. PRISM draws upon and integrates national best practices from 1) research and 2) Pre-School-College (P-16) Initiatives.

PRISM is informed by national best practices from research such as those suggested in *Adding It Up* (National Research Council, 2001) and *Inquiry and the National Science Education Standards* (National Research Council, 2000). In order to achieve the vision, goals, and projected outcomes, P-12 students and aspiring teachers must have direct experiences with methods and processes of inquiry in SM courses. They must have opportunities to engage with a mathematical or scientific question, event, or concept before formal presentation; investigate alternative models; and involve fundamental concepts.

PRISM is also informed by best P-16 practices such as those developed by the Education Trust, National Association of System Heads, State Higher Education Executive Officers, Education Commission of the States, and Standards-Based Teacher Education Project (Council for Basic Education/American Association of Colleges for Teacher Preparation). All of these national organizations have recommended Pre-School-College (P-16) partnerships (each including arts and sciences, education, and school faculties) as a necessary strategy for meaningful P-12 reform. The Education Trust and others (see for example, Kettlewell, 2000) have also documented the importance of pursuing P-16 goals concurrently at the local and state levels—local levels to build or strengthen collaborative relationships among arts and sciences, education, and P-12 faculties that are focused on increasing student learning and achievement, and that are supported and shared when successful; and state level to create the needed policies, incentives, support, and visibility that make it possible to sustain the reforms once implemented.

## 2. RESULTS FROM PRIOR NSF FUNDING

**The Georgia Initiative in Mathematics and Science (GIMS):** Principal Investigator: Michael Padilla, University of Georgia; Dates: 1992–1997: GIMS created: 1) the *Georgia Framework for Learning Mathematics and Science*, used in the revision of the state’s Quality Core Curriculum (QCC) objectives at that time; 2) a framework for training teachers for diverse classrooms (over 500 teachers received training); and 3) *Principles of Educating Teachers*, used by 94% of the state’s teacher preparation institutions. GIMS studies speak to its positive effect on student achievement. Lessons Learned that Inform PRISM: While Georgia’s QCC was informed by GIMS, student-learning standards were not aligned with expectations for college admission, leaving large gaps in college readiness for many high school graduates. In addition, GIMS had no positional authority to influence state policy on requiring more rigorous SM curricula for all P-12 students or on teacher preparation. PRISM benefits from these lessons: 1) the Georgia Department of Education (DOE) is an active partner in PRISM, which was not the case for GIMS; 2) SM student-learning standards will be set pre-school through two years of college (P-14); 3) a public awareness campaign led jointly by DOE and USG will help the public understand the importance of all P-12 students having access to and being prepared for rigorous SM curricula; and 4) members of the PRISM Leadership Team have authority to change policy in teacher preparation and development, thus broadening its impact.

**Atlanta Initiative in Mathematics and Science (AIMS):** Principal Investigator: Beverly Hall, Atlanta Public Schools; Dates: 1998–2003: AIMS focused on teacher professional development in SM to support a standards-based approach to teaching and learning in P-12 SM classrooms. Lessons Learned that Inform PRISM: Teacher

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knowledge and skills in teaching in a standards-based classroom will support the outcomes of PRISM. Two challenges AIMS experienced: 1) the curriculum standards used to frame the teacher professional development have since been judged by an external audit as less than rigorous (through PRISM Strategy 8 new curricular standards are under development); and 2) despite successes in teacher professional development, the high teacher attrition rate limits its lasting effect. (Through PRISM Strategy 6 new policies will be developed to provide teachers with incentives for teaching shortage fields, like SM, and in hard-to-staff schools, like the Atlanta Public Schools).

**GK-12: The Bio-Bus Project:** Principal Investigator: Barbara Baumstark, Georgia State University; Dates: 2002—2004: The Bio-Bus, a mobile instructional laboratory with state-of-the-art science equipment, provides equipment and supplies to schools where such items are not usually available, and a summer teacher workshop in biotechnology. Within two years, the two buses served 16,153 students (202 trips) in 137 schools within 20 school districts. Assessment of the project is ongoing; however, despite a lack of advertising (other than word-of-mouth), the Bio-Bus has generated great interest among teachers and school children. Lessons Learned that Inform PRISM: The Bio-Bus provides P-12 students with opportunities for more inquiry-based science. Inquiry-based instruction is a central feature of the PRISM design for pre-service and in-service SM teachers.

**Elementary Science Education Partners (ESEP):** Principal Investigator: Robert Dehaan, Emory University Medical School; Dates—1996-2001: ESEP created a consortium (Emory University, the Atlanta University Center, Georgia State University and Atlanta Public Schools) for institutes to train lead teachers, the organization and direction of workshops for the training of teachers, and all aspects of the science-partners program. The elementary science kit based program and inquiry-based professional development were sustained and expanded by Atlanta Public Schools. Lessons Learned that Inform PRISM: The emphasis on inquiry-based instruction in PRISM is an extension of ESEP.

**Cooperative Learning in Undergraduate Mathematics Education (CLUME): Developing a Comprehensive Program for College Faculty:** Principal Investigator: Ed Dubinsky, Georgia State University; Dates:1997—1998: CLUME trained college mathematics faculty members to use cooperative learning methods in their classes that included students preparing to be teachers. The program featured a series of summer workshops in which faculty members implemented cooperative learning in one or more classes. Overwhelmingly, participants reported successful use of the methods and consequent improvement in mathematics learning. One impediment noted was the long-term experience of most instructors using more traditional methods (e.g., lecturing and individual work assignments). Lessons Learned that Inform PRISM: CLUME included no mechanisms for faculty to sustain their focus on teaching and learning beyond the workshops. PRISM creates an Institute on the Teaching and Learning of SM that includes training on changing how SM are taught in higher education to aspiring teachers as well as ongoing discipline-based professional networks, in which faculty observe and assess their own teaching practices, apply findings to improve their teaching, and share successes and failures with colleagues.

### 3. ACTION PLAN

**Best Practices from Research on Teaching and Learning SM Upon Which PRISM is Built:** Research findings suggest that students at all levels build new knowledge and understanding on what they already know and believe. Particularly in science, many students have preconceptions that are inconsistent with accepted, extant science knowledge. Students often hold on tenaciously to these ideas, which can be resistant to change, particularly when conventional teaching strategies are used (Wandersee et al., 1994). Students change their ideas when they discover alternatives that seem plausible and appear to be more useful (Hewson and Thorley, 1989). Learning can be enhanced when students have opportunities to articulate their ideas to others, challenge each others' ideas, and, in doing so, reconstruct their ideas (Rosebery, et al., 1992). Effective learning requires students to take control of their own learning. Thus, opportunities for self-assessment need to be provided so that students can understand the main purposes of their learning and thereby grasp what they need to do to achieve (Black and William, 1998).

The Education Trust describes completion of challenging courses as one of two key leverage points for increasing student achievement ([www.edtrust.org](http://www.edtrust.org)). In order for P-12 students to experience challenging curricula, expert teachers are required (Darling-Hammond and Post, 2000). Students in high minority schools have less than a 50% chance of getting a licensed SM teacher with a degree in the field in which he or she is teaching (Darling-Hammond and Post, 2000). "Recent studies have found that the difference in teacher quality may represent the single most important school resource differential between minority and white children and that it explains at least as much of the variance in student achievement as socioeconomic status" (Darling-Hammond and Post, 2000, p. 128).

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Research findings suggest that mathematical proficiency is developed through five interdependent strands: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (National Research Council, 2001). Effective programs of teacher preparation and professional development help teachers understand the mathematics they teach, how their students learn that mathematics, and how to facilitate that learning. Teachers adapt what they are learning to deal with problems that arise in their own teaching. Mathematics understanding is facilitated best when students have direct experience with methods and processes of inquiry. Tasks are central to students' learning – students learn best when they are presented with academically challenging work that focuses on sense making and problem solving as well as skill building.

It is well established that teachers' deep understanding of SM content has a significant impact on what P-12 students learn (See, for example, National Research Council, 2002a, and Darling-Hammond and Post, 2000). Yet, preparing teachers as SM majors does not necessarily prepare them to be effective teachers – the correlation between number of content courses and teacher effectiveness is unclear (Wilson, et al., 2001). A difficult challenge is the concordance among the teaching methods and strategies used in content courses, those used in pedagogy courses, and those that teacher candidates are taught to use to teach content to their P-12 pupils.

Similar challenges hold for teacher professional development. To be effective such development must be tied to student learning content standards and classroom instruction; sustained over time; connected with higher education; and be a part of a larger effort to improve instruction (*No Child Left Behind Act*, 2001). Professional development must also be intentional, ongoing, and systemic (Guskey, 2000). To sustain reforms, teachers need to be engaged in inquiry and receive systemic support by committed leadership (National Research Council, 2001).

Many SM faculty members are not prepared for teaching in ways that will allow students to develop deep understanding. Faculty members teach the way they were taught, without the same level of insightful questioning and collaborative efforts that characterize their research. An example of a successful change strategy is the Reformed Teaching Observation Protocol (RTOP) based on principles of effective teaching (AAAS, 1989). The Arizona Collaborative for Excellence in the Preparation of Teachers developed RTOP, a NSF-sponsored program to improve undergraduate SM instruction (Sawada, 1999, Sawada et al., 2000a, 2000b). Teachers trained in use of principles of effective teaching had higher RTOP scores than those who were not trained. High school pupils taught by teachers with higher RTOP scores demonstrated significantly higher achievement in scientific reasoning, nature of science understanding, and understanding of scientific (biological) concepts than pupils from a control group of teachers who had not been trained in RTOP (Adamson et al., 2002).

Another potentially powerful change strategy is Peer-Led Team Learning (PLTL) - a model that integrates student-led workshops into a course (Gosser et al., 1996). Its concept is to use more advanced peers to lead small group learning, with one leader for each group of six to eight students. Success of PLTL has been measured to date by the success of the percentage of students earning higher grades (A, B, C) than their non-workshop counterparts (Gafney, 2001, Tien, et al., 2002). In addition, performance of former workshop leaders in ACS General Chemistry examinations is higher than non-leaders even though the latter had taken more advanced chemistry courses (Blake, 2001). Use of PLTL has at least two potentially positive outcomes: 1) Experience of peer leaders naturally leads to an interest in the teaching/learning process. Peer leaders are successful students of science. Thus, there is in a pool of peer leaders a place to recruit students into programs that can lead to P-12 teaching. 2) PLTL allows large-sized sections to be broken into small groups that can then be taught using inquiry-based methods.

The challenge is to modify and/or develop courses in which current and aspiring P-12 teachers of SM are taught using methods that follow sound research findings. Since understanding science is more than knowing facts and mathematical proficiency is more than mastering a skill to carry out procedures accurately, teacher candidates need learning environments that facilitate proficiency and understanding. (National Research Council, 1999B, 2001). In all SM courses for aspiring and in-service P-12 teachers of SM, SM faculties should model best teaching practices.

The National Research Council (1999a) suggests four strategies that administrators could use to encourage faculty to learn new effective approaches to teaching and then apply them: 1) Provide faculty with the resources required to consult with colleagues and education experts; 2) establish a centralized fund for educational improvement in the dean's office that can send a powerful message regarding a change in departmental values; 3) favor in promotion, tenure, and salary deliberations, faculty work that engages students in innovative courses; and 4) advocate for the use of innovative design and assessment of courses and research focused on teaching and learning the discipline as evidence of a faculty member's productivity as a teacher-scholar.

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**Strategic Actions that Integrate Key Features of MSP, Result in Evidence-Based Outcomes, and Further Inform the Teaching and Learning Knowledge Base:** Improved student achievement in SM in the 13 core partner school districts is at the apex of the PRISM vision. To achieve this central tenet, changes are proposed in local practice and state policies to improve teaching quality in SM; to ensure increased numbers of P-12 students have access to, are prepared for, and succeed in, challenging SM curricula; and to provide incentives for sustained involvement of higher education SM faculty to contribute to further understanding about teaching and learning SM and to participate in the implementation to improve P-12 student achievement in SM. All strategies emanate from a combination of the research base for PRISM and from the self-assessment.

**Teaching Quality--Teacher professional development** of P-12 teachers teaching SM is featured in PRISM to develop inquiry-based strategies, deepen content knowledge, and on-going P-16 research collaboration that provides practitioner-tested improvements of best practices. Inquiry approaches will be cemented in the core partner school districts through sustained teacher professional development and participation of SM teachers in Learning Communities, established in the four regions to engage higher education and P-12 faculty. These discipline-based, school-university Learning Communities will provide a forum to convert practitioner knowledge into professional knowledge, for SM school and college faculty to refine and experiment toward a set of best practices on the teaching and learning of SM, and for best practices to be used to inform practice, pre-school through college. Progress of students taught by participating SM teachers will be closely monitored to provide feedback on the modifications employed. These progress results will inform the ongoing professional development of P-12 teachers teaching SM, including the academic concentrations in SM being developed for current P-8 teachers. Many of these recommendations will be submitted to refereed journals to add to the SM teaching and learning knowledge base.

**Teacher preparation** in the use of inquiry-based approaches: Since future teachers are influenced by the way they are taught, a key leverage is to change the way they are taught in SM courses by using inquiry-based approaches in the core introductory SM courses and in upper level SM courses. Further, parts of modified upper level SM courses can be used as modules for teacher professional development. An Institute on the Teaching and Learning of Science and Mathematics will be established for higher education SM faculty and administrators to learn why and how to adopt their courses to an inquiry-based approach and to provide them with opportunities to participate in discipline-based professional networks with their colleagues across the four PRISM regions and in Learning Communities with their P-12 colleagues. Best practices will also be integrated into the ongoing refinements of the Institute.

**Teacher quality policies:** Concurrently, policy changes at the state level and increased public awareness of the issues statewide wrap-around the work in the four PRISM regions to deepen and sustain the reforms underway. Policy changes will: 1) Provide incentives (through a teaching certificate endorsement in SM) for in-service P-8 teachers to complete inquiry-based content courses; 2) Increase the science content knowledge of aspiring elementary teachers prepared in the USG through policy changes in the *Regents' Principles for the Preparation of Educators for the Schools*; and 3) Provide incentives to attract and retain increased numbers and diversity of highly qualified P-12 teachers prepared to teach SM, through the introduction of new policies to the ECC.

**P-12 SM Courses and Curricula:** Georgia's P-12 SM curriculum will be revised to raise expectations for all students and to align student-learning standards and curricula in P-12 with expectations for college. A public awareness campaign will be launched to raise educational aspirations and public understanding as to the need for all students to complete a rigorous SM curriculum. Previous NSF initiatives (Georgia Systemic Initiative—GIMS—and the Urban Systemic Initiative—AIMS) speak to the need for higher SM student-learning standards and curricula in P-12 schools. According to a recent audit of Georgia's P-12 SM curricula: "The Quality Core Curriculum Standards are unclear, fail to clearly articulate across grade levels, do not always align with national standards, and lack rigor" (PDK Audit, p. 16). The Georgia QCC was given a grade of B in mathematics and an F in science in its *State of the State Standards, 2000* report card ([www.fordhamfoundation.org](http://www.fordhamfoundation.org)). Moreover, PRISM will emphasize the needed connections between raising student-learning standards and teacher professional development: Teachers will develop deep understanding of SM content and pedagogical knowledge needed to bring P-12 students to new student-learning standards and to complete rigorous SM curricula. Increased public understanding as to the benefits of universal challenging SM curricula for P-12 students, along with two companions to PRISM underway in Georgia (Leadership Institute for School Improvement, that provides professional development for school administrators and changes in the preparation of school counselors) will support the efforts of the four PRISM regions to increase enrollment in and successful completion of challenging SM curricula by all P-12 students. PRISM regions will be given priority for participation in the Leadership Institute providing principals and superintendents with strategies for increasing student participation and success in challenging courses.

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**Incentives for higher education faculty to invest in P-12 reform:** A small group of administrators and SM faculty leaders from the four PRISM regions will recommend incentives for sustained involvement of SM faculties in improving teaching and learning of SM in P-12 schools. Innovative design and assessment of SM courses as well as research focused on teaching and learning in the schools will be considered as evidence of a faculty member's productivity as a teacher-scholar. Resources will include those required for consultation, including time for regular interaction with colleagues around common problems of practice, and involvement through the discipline-based professional networks and in the Learning Communities with their P-12 colleagues.

**Why Georgia?** Georgia is an established leader in P-16 partnerships, the first state with a state P-16 council and a statewide system of regional P-16 councils (See accomplishments on pp. 17-18). Georgia P-16 work is based upon and has helped to shape the national P-16 agenda (evidenced by the PRISM PI receiving a national award from the Education Trust in 2001 for outstanding leadership in K-16 reform). The PRISM action plan is situated in a P-16 context locally, within four existing regional P-16 councils, and at the state level through the ECC, the appropriate forum for policy change that spans P-12 and higher education. The P-16 Network of all 15 regional P-16 councils in Georgia is also in place that meets regularly to share lessons learned across regions. The P-16 strategy affords an opportunity for regional P-16 groups to experiment with adaptation of SM best practices and then to inform and refine best practices within their partner regions. Georgia's existing P-16 infrastructure increases the prospects for scaling up innovations and lessons learned from the four regional PRISM partnerships to all 15 regional P-16 councils in Georgia. The established leadership roles of the PRISM PI, Co-PIs, and project directors in national networks increase the potential for impact of PRISM beyond Georgia.

### PRISM LEVERAGE POINT 1: STRENGTHENING TEACHING QUALITY

**Strategy 1. Regional Level: Provide high quality professional development to P-12 teachers teaching SM.** Teacher professional development is the top priority of all four PRISM regions to improve SM student achievement. Teaching quality will not improve without high student learning-standards and strategies and supports for teachers to help all students reach the standards. The following needs were identified during the planning phase:

- Organizing instruction around standards rather than around textbooks, units, or themes.
- Customizing instruction in ways that recognize differences in cultural backgrounds, learning styles, special needs of students so as to bring all students to high student-learning standards.
- Utilizing inquiry-based instruction.
- Using self-assessments and performance-based assessments of students in relation to the standards.
- Providing SM content for P-8 teachers.
- Getting students ready for key transition points – 1<sup>st</sup> grade, 3<sup>rd</sup> grade, middle school, high school, and college.

PRISM professional development integrates content instruction and best practices with the needs of individual teachers within the context of the specific student populations they teach. It will be customized to the needs of the individual teacher and school, collaboratively designed and delivered within each PRISM region to address the preceding list of identified needs, and include completion of four-course sequences in science and/or mathematics for P-8 teachers (as needed), as described below in Strategy 2. Regional District PRISM Coordinators in partnership with the Regional PRISM Co-PI will share responsibility for developing the structure and implementation for PRISM professional development locally. All 10,132 P-12 teachers of SM in the four PRISM regions will receive stipends, organizational support, and released time for participation in professional development. Professional development in PRISM will be supplemented through participation in two ancillary activities: 1) Participation of PRISM teachers will be given priority in Summer Institutes offered through the Center for Proficiency in Learning and Teaching Mathematics (an NSF funded Center at the University of Georgia), and 2) USG has committed 50% of its Teacher Quality (former Eisenhower) funds for professional development in the areas of SM with preference given to the four PRISM regions (These grants must be used to address the above identified needs of SM teachers and can address the implementation of Georgia's new student-learning standards, described in Strategy 8).

**Step 1:** In Year 1, regional PRISM leaders will organize P-12 teachers of SM into study groups focused on building a knowledge base on the important trends and issues in their field. Study groups will read articles; study national, state, and local SM content standards; map standards with curriculum to find the strengths and gaps; and learn to use action research. The study groups will conclude with the development of an individual professional development plan for each teacher involved in PRISM. Lead PRISM teachers at each participating school will lead the study sessions and develop consensus as to the expected the outcomes of each session.

**Step 2:** In years 1-5, all 10,132 teachers in the four regions will receive stipends to participate in summer academies and yearlong professional development designed to address the knowledge and skills for teaching in standards-based

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classrooms. Regional PRISM consultants (college SM faculty and teacher leaders) will collaborate in the delivery of needed professional development. Monthly study sessions will continue during years 2-5 for ongoing support and sharing. During the study sessions in Years 2-5, teachers will analyze—the percent of students (all demographic groups) taking challenging SM courses, student performance data, and course outcomes—building improvement plans, and designing ways to provide individual assistance to students. Increases in students taking challenging SM courses and in student achievement (all demographic groups) will constitute the primary evidence of impact.

**Step 3:** A web-based community within each region and across the regions will be used for sharing successes and struggles. Regional participants will present research projects, lessons learned and best practices at Regional Coordinating Committee meeting, annual P-16 Network meetings, Georgia Staff Development Council meetings, and other conferences as invited.

**Strategy 2. State Level: Provide academic concentrations in SM for current P-8 Teachers through two new USG faculty consortia.** To support the regional work described in Strategy 1, academic SM concentrations for current elementary and middle grades teachers will be offered by two USG higher education consortia, one in mathematics and one in the sciences. Each consortium is developing an inquiry-based four-course sequence that integrates academic content knowledge, evidence-based pedagogical knowledge, and teacher craft knowledge to enable current elementary and middle grades teachers to deepen children's understanding of SM.

**Step 1 (completed):** Appoint the USG Mathematics Consortium and the USG Science Consortium to include faculty members from each of the following sciences: biology, physics, chemistry, and geology annually (total 95). A list of SM higher education faculty serving on the consortia is summarized in the Appendix 3.

**Step 2:** During Year 1, in retreat format (one for each consortium) frameworks for the course sequences will be developed and an Executive Committee from each consortium will be appointed to draft the four-course SM sequences. (Lessons from the Middle Grades Mathematics and Science Initiative, a component of Georgia's Teacher Quality Plan (1999) and other models from individual institutions will be featured as points of departure.) The executive committees will reach preliminary agreement on the course sequences and then present them to the full consortia. The two consortia (in retreat format) will refine the SM course sequences and prepare to present them for critique to P-12 teachers of SM in the four PRISM regions. The P-12 Lead Teacher Advisory Committee (Lead teacher from each school in four PRISM regions) will first meet to formulate their reactions to the draft course sequences. The P-12 Lead Teacher Advisory Committee and the two consortia will then meet together (in retreat) to finalize the SM course sequences, integrating content knowledge, research on teaching SM, and teacher craft knowledge on best practices. The consortia and P-12 Lead Teacher Advisory Committee will agree on desirable delivery models that facilitate meeting the specified learning outcomes and also accommodate teachers' schedules.

**Step 3:** The creation of endorsements in SM will be recommended to the Professional Standards Commission, providing teachers the opportunity to have an endorsement in S or M added to their teaching certificates.

**Step 4:** The two endorsements will be marketed statewide through the new Teacher Career Center, a component of the USG Teacher Preparation Recruitment Initiative, a companion to PRISM (funded through the US Department of Education): A P-16 partnership among the University System Office and seven regional P-16 councils.

**Step 5:** Annually in years 2-5, in each of the four regions 50 teachers will complete the science endorsement and 50 will complete the mathematics endorsement, greatly reducing out-of-field teaching in elementary and middle school; 16 faculty members from the two consortia will receive partial released time to offer the SM endorsements. The PRISM regions will provide stipends and other incentives for P-8 teachers to complete the endorsements and determine which incentives result in the highest numbers of P-8 teachers successfully completing them.

**Step 6:** Based upon lessons learned in the four PRISM regions, new policies and strategies will be recommended to the Department of Education for adoption statewide.

**Strategy 3. Regional Level: Engage higher education and P-12 faculty in learning communities.** In traditional models, professional knowledge building is the province of researchers, with the application knowledge left to practitioners. These models have often left chasms between research and implementation because while traditional research-based knowledge has generalizability and is of a trustworthy (scientific) character, it has been difficult for teachers to use it to improve their practice. Teachers' "craft" knowledge, on the other hand, is characterized more by its concreteness and contextual richness than by its generalizability and context independence (Hiebert, et al., 2002). Shulman (1986) describes many kinds of teacher professional knowledge – content knowledge, pedagogical knowledge, and pedagogical content knowledge, plus knowledge of students - what they know and how they learn. In teacher craft knowledge, all of these types of knowledge are intertwined, organized not according to type but according to the problem the knowledge is intended to address. Collaboration becomes essential for the development of professional knowledge; it must also be created with the intent of public examination, with the goal of making it shareable among P-12 teachers and higher education faculty, open for discussion, verification, and refutation or

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modification. Locally developed practitioner knowledge has not achieved much credibility in the past due to a perceived potential lack of quality. However, observation and replication across multiple trials in various Learning Communities can produce tests of quality that are as rigorous as experimental, comparative methods that rely on controlling and isolating variables.

PRISM will establish discipline-based, school-university Learning Communities in which practitioner knowledge is converted into professional knowledge through SM school and college faculties experimenting and refining a set of best practices on the teaching and learning of SM, and then using the best practices to inform their practice.

**Step 1:** The Institute on the Teaching and Learning of SM (described in Strategy 4) will train regional Co-PIs in successful strategies for leading Learning Communities and faculty on how to participate effectively in them.

**Step 2:** Regional Co-PIs will establish discipline-based regional Learning Communities in SM from among the P-16 partners described in strategy 1. Annually, 50 SM faculty members and teachers per region will participate from the core partner school districts and higher education institutions. Through the Learning Communities, collaboration will ensure that what is discovered will be communicable because it is discovered in the context of group discussion.

**Step 3:** Teachers will share their practices in teaching a given concept and examining alternative best practices. Through group discussion, a refined model will be determined and tried out in the classroom. Student success data will be monitored to establish refined best practices. Best practices identified will further inform work in Strategy 1.

**Step 4:** Best practices in the teaching and learning of SM will be identified through collaborative research and shared on an annual basis across Learning Communities within each of the four PRISM regions.

**Step 5:** Collections of best practices that contribute evidence-based outcomes to SM learning and teaching will be developed and shared statewide through the P-16 Network and nationally through the MSP Learning Network.

**Strategy 4. Regional Level: Influence the quality of teacher preparation through changing how SM are taught to future P-12 teachers.** An Institute on the Teaching and Learning of SM will be established for higher education SM faculty and administrators. Participants will learn why and how to adopt their courses to an inquiry-based approach, and what are the current best practices in SM teaching and learning.

Two groups of SM courses taken by aspiring teachers will be targeted: Introductory SM courses where all teacher candidates, especially those in elementary and middle school education, obtain their knowledge of the major themes, big ideas, and organizing concepts of a field (Henry, 2000) and upper division courses, in which aspiring teachers need to experience links among content and pedagogy and assessment strategies for a particular discipline.

The Institute will also establish and support five professional networks (one per discipline) across the four regions. Faculty will also meet regularly throughout the year in study groups on their own campuses. There will be a close connection between the Institute and the Learning Communities described in Strategy 3. The Institute will be used to train the leaders of the learning communities. Recommendations of best practices for course modules emanating from the Learning Communities will be integrated into the Institute.

**Step 1:** Annually, there will be a one-day joint meeting for 100 SM faculty members and administrators from across the four PRISM regions, followed by a two-day meeting for faculty. This meeting will emphasize: 1) An Overview of PRISM – why standards-based learning in courses for aspiring teachers; why change how SM are taught to aspiring teachers; research that supports an inquiry-based approach; learning outcomes, assessments, and assignments; and 2) Developing learning outcomes.

**Step 2:** 80 SM faculty members from across the four PRISM regions will be invited to participate in the Institute in two additional one-day meetings annually. These sessions will be organized by SM disciplines, led by experienced critical friends (disciplinary faculty from non-PRISM institutions). These meetings will emphasize “new learning” in: alignment of assignments with learning outcomes for a course; development of rubrics for assignments that are aligned with standards; translating learning outcomes into effective teaching and learning in the classroom; Reformed Teaching Observation Protocol training in principles of effective teaching (described on p. 6); Peer Led Team Learning training (described on p. 6); self-assessment; learning communities; and best practices.

**Step 3:** These same 80 faculty members will be invited to participate in five professional networks (four in the sciences one in mathematics) across the four regions to support higher education SM faculty who are in process of changing their teaching practice in courses taken by future P-12 teachers of SM. In the professional networks, faculty members will be able to observe and assess effects in their own classrooms, apply findings to improve their teaching practices, and share their successes and failures with colleagues. The professional networks will each meet four times annually. They will result in the development of evidence-based outcomes that contribute understanding to the teaching and learning of SM and to their implementation in SM courses taken by aspiring teachers. Lessons learned will be shared statewide through the P-16 Network and nationally through the MSP Learning Network.

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**Strategy 5. State Level: Revise the Regents' Principles for the Preparation of Educators for the Schools to include a 12- semester hour integrated science sequence for elementary teachers.** In 1998, the USG adopted a new policy for teacher preparation requiring future elementary teachers to complete a four-course sequence in mathematics, in addition to the freshman level mathematics course required of all college students (Board of Regents, 1998). This policy requires no such sequence in science. (Aspiring elementary teachers complete only the two-course science sequence required of all college freshmen.)

**Step 1:** In Year 2, the USG Science Consortium, described previously, will draft recommendations for an integrated science sequence for aspiring elementary teachers, drawing from their work in Strategy 2 (six meetings anticipated).

**Step 2:** These recommendations will then be advanced through existing governance processes and to the Board of Regents for policy adoption that will affect all public teacher preparation institutions in Georgia.

**Strategy 6. State Level: Initiate new policies that provide incentives and improved working conditions for teaching SM in P-12 schools.** From the self-assessment, solutions to five problems were targeted in order to increase teacher recruitment, assignment, and retention in SM (Governor's Education Reform Commission, 2000):

1. Low production of SM teachers in Georgia's colleges and universities, particularly from minority groups and from individuals interested in teaching in hard-to-staff (urban and in remote rural) schools in Georgia.
2. Low yield of SM teachers prepared for entry into the profession.
3. Most school administrators are not prepared (and do not know how) to lead teachers toward achieving the State's accountability expectations, leaving teachers highly frustrated and vulnerable.
4. Teacher preparation and professional development have not resulted in school improvement.
5. There is a direct correlation between teacher work environments and teacher shortages, declining teacher applicant pools, low teacher morale, and high teacher attrition rates, particularly in hard-to-staff schools.

PRISM focuses directly on recommendations #2, #4, and #5 and indirectly on #1. More focused work on increasing teacher production (#1) in SM is underway through the USG Teacher Preparation Recruitment Initiative (referenced in Strategy 2) and professional development programs for school administrators (#3) are underway through Georgia's Leadership Institute for School Improvement, a companion to PRISM (launched in October 2002, to change teachers' working conditions through professional development for their superintendents and principals).

New state policies are needed 1) to make teaching SM competitive with private sector positions in these fields that require comparable education, and 2) to provide incentives for teaching SM in hard-to-staff schools so as to attract more SM teacher candidates from minority groups so that greater numbers of minority teachers choose to work in urban schools (which are hard-to-staff) where there are proportional numbers of minority students (Governor's Education Reform Commission, 2000). These policy recommendations called for sufficient incentives for SM teachers to accept teaching positions in hard-to-staff schools so as to end the disparity in teacher qualifications between schools in general and those that are hard-to-staff. Promotional opportunities are also needed as incentives to keep quality P-12 teachers of SM in the classroom, thus reducing out-of-field teaching. A tiered teacher certification system, that includes promotion opportunities for teachers in leadership roles, is under development.

**Step 1:** In Year 1, PRISM Co-Directors will analyze the salary disparities between P-12 science teachers and other careers requiring comparable education in the sciences. A similar analysis in mathematics has been completed.

**Step 2:** In Year 1, PRISM Co-Directors will hold 16 teacher focus groups, four per PRISM region, to gather teacher input into development of promising strategies for teacher incentives in SM.

**Step 3:** In Year 1, PRISM Co-Directors will appoint and coordinate a Teacher Incentives Forum (50 teachers) to develop possible "incentive" packages for pilot implementation in the four PRISM regions. The four PRISM regions will then pilot the various models developed, to include salary add-ons 1) for teaching SM (designated shortage fields), 2) for accepting assignments in hard-to-staff schools, 3) for remaining in hard-to staff schools more than three years, and 4) for qualifying as mentor or master teachers, through the tiered-certification process.

**Step 4:** During Years 2-3, the models developed will be piloted and the Teacher Incentives Forum will recommend policy ideas to the PRISM Leadership Team, which will then develop coherent policy recommendations to the ECC.

**Strategy 7. Regional Level: Implement regional strategies to recruit SM teachers.**

a) Through the Georgia Teacher Quality Plan, Georgia State University (and three other institutions) piloted the implementation of an Advanced Academy for Future Teachers for academically talented high school students in an effort to attract these students into teacher preparation programs. The external evaluator reported promise for the model but recommended that it should be collaboratively planned, operated, and targeted toward the needs of specific school systems. Within the Metro Atlanta PRISM region, the Advanced Academy for Future Teachers will be refined to focus on recruiting students to become teachers in SM for Atlanta Public Schools.

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**Step 1:** The Regional Co-PI, Georgia State University, and Regional District Coordinator for PRISM, Atlanta Public Schools will implement recruitment plans to recruit 30 high school SM students annually into the Academy.

**Step 2:** Beginning in Year 3, a Freshman Learning Community (FLC) will be implemented at Georgia State University to continue to provide support for students who complete the Academy and begin study to become SM teachers (1st year retention rates for students in FLCs are five percentage points higher than for non-FLC students.)

**Step 3:** Lessons learned will be shared with the other three regions through the PRISM Leadership Team.

**Step 4:** Through annual meetings of the P-16 Network, Metro Atlanta will share best practices from the Advanced Academies for Future Teachers and Freshman Learning Communities with the other PRISM regions.

b) Northeast Georgia PRISM Region: Northeast Georgia will target undecided arts and sciences majors already attending the University of Georgia and Georgia Perimeter College and second career individuals wishing to become teachers. The program will draw from lessons learned through a pilot program in Georgia's Teacher Quality Plan.

**Step 1:** During Year 1, the Regional Coordinating Committee will develop and implement recruitment and marketing materials; hire and train pre-education advisors; train arts and sciences advisors about SM teaching degrees; begin development of first years seminars relating to teaching as a career and development of pre-teaching community experiences for individuals to experience life in communities of students they will be teaching.

**Step 2:** During Year 2, all programs will be implemented with a goal to provide seminars for 50 students annually.

**Step 3:** In Years 3-5, lessons learned will be shared with the other 3 regions through the PRISM leadership team.

**Step 4:** Best practices will be shared statewide through P-16 Network meetings during Years 3-5.

### PRISM LEVERAGE POINT 2: HIGHER EXPECTATIONS FOR SM CURRICULA IN SCHOOLS

**Strategy 8. State Level: Raise and align SM student-learning standards and curriculum, pre-school-two years of college (P-14).** The Quality Core Curriculum (QCC) is Georgia's P-12 curriculum. It includes specific course-by-course and grade-by-grade objectives for teachers. School districts must use the QCC unless they demonstrate that they have higher standards. Most school districts use the QCC. The external audit of the QCC (summarized on page 7) makes clear that school districts will have difficulty increasing student achievement in SM when the curriculum, instruction, and current teacher professional development is guided by inadequate student-learning standards. Under the leadership of two PRISM senior personnel, new state SM student-learning standards will be developed and the QCC will be revised to correspond with the new standards. The student-learning standards will be developed, Pre-K through two years of college (P-14) with a goal for a more rigorous curriculum in SM aligned with expectations for college. The new standards will provide the continuity and rigor—aligned with the National Council of Teachers of Mathematics (NCTM) standards and the National Science Education Standards (NSES)—necessary to develop specific grade and course-level objectives in the P-12 SM curriculum (NCTM, 1996, National Research Council, 1996). As a companion to PRISM, DOE will develop new P-12 assessments, aligned with the new standards and curriculum. PRISM will draw upon the existing Post-Secondary Readiness Enrichment Program (PREP), a supplemental USG program to increase the support toward college readiness of 7<sup>th</sup>-12<sup>th</sup> graders who need extra help to meet the higher expectations. PREP is a companion to PRISM.

**Step 1 (completed):** A P-16 Curriculum Revision Leadership Team, chaired by one of the PRISM senior personnel, is guiding the development of P-14 student-learning standards and revisions of the SM QCC (includes PRISM PI and one PRISM Co-Director). In fall 2002, P-12 curriculum directors, SM coordinators, SM and SM education faculty members from eight different USG institutions drafted SM student-learning standards, vertically aligned for P-14, at key benchmark levels (K, 3, 5, 8, 12 and 14), and horizontally aligned within grade level. USG SM academic advisory committees are currently reviewing the draft standards (membership summarized in Appendix 3).

**Step 2:** In Year 1 (summer 2003), Georgia's SM QCC will be revised, under the leadership of a member of the PRISM senior personnel. Ninety P-12 teachers who teach SM will participate in a five-day workshop, in which they develop for all P-12 grades and all SM courses specific objectives that emphasize advanced skills and higher level thinking, horizontal alignment across SM, and vertical alignment within SM. The USG Science and Mathematics Consortia (described in Strategy 2) will then meet with these teachers to provide feedback on the specific grade and course-level objectives in SM (SM faculty serving on consortia are summarized in Appendix 3).

**Step 3:** In Year 2, using the "Train the Trainer Model" a member of the PRISM senior personnel will prepare 100 Regional Education Service Agency (RESA) curriculum specialists on the new standards and curricula. As a companion to PRISM, RESAs will then lead professional development on the new standards and curriculum for the 10,132 SM teachers participating in PRISM. Lessons learned from teacher professional development described in PRISM Strategies 1-3 will be used to inform this effort, and, conversely, the new student-learning standards and revised QCC in SM will inform the continuing professional development within the PRISM regions and the development of the integrated science sequence for aspiring teachers, described in Strategy 5).

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**Strategy 9. State Level: Conduct a public awareness campaign of the need for all P-12 students to have access to, to be prepared for, and to succeed in challenging courses and curricula in SM.** One of the reasons Georgia's SM QCC has not conformed to NCTM and NSES standards is the relatively low level of educational aspirations and limited understanding of the consequences of low-level curricula in many parts of Georgia (a lesson learned through previous P-16 work). To raise aspirations, PRISM will include a public awareness campaign to garner community support for all P-12 students to complete challenging SM curricula. The campaign will target: Parents, P-14 students, guidance counselors, P-12 teachers, principals, superintendents, and college SM faculty. It will emphasize: 1) The benefits of: Students meeting high P-14 student learning standards at grades K, 3, 5, 8, 12 and 14 in SM in order to be promoted to the next grade level, to graduate from high school, and to complete two-years of college; students being "college ready" when they meet the Level 12 standards; requiring all middle and high school students to complete challenging SM curricula so that they will be adequately prepared for college success; having support systems in place and providing extra time to students who need them to reach the high P-14 student learning standards; providing every student (beginning in 4<sup>th</sup> grade) with a "school to career" plan that includes college exploration and post-secondary planning activities and programs in SM; and information on college admissions tests, registration dates, how to prepare for, and how test scores are used. 2) The consequences of: Curricular tracking in SM that results in a disproportionate number of low-income and minority students placed into low-end courses in high school, ability groups in elementary school, and special education; assigning less prepared and the newest SM teachers to the P-12 students who need them most; and assigning teachers to teach SM who are not prepared in those fields.

**Step 1:** During Year 1, a public awareness campaign administrator will be recruited to manage outside vendors and the on-going daily activities associated with the administration of a broad-based campaign; bids from prospective campaign vendors will be solicited and a vendor team selected. The vendor team will conduct benchmark-marketing research as to current perceptions/attitudes and behaviors to develop thematic messages and program elements. Collaterals/messages will be pilot tested statewide. Advertising and marketing partners will be formalized to support and participate in the campaign (e.g., civic group leaders, technology-driven corporations, Boys and Girls Clubs of America). The statewide integrated marketing plan and measurement protocol will be finalized.

**Step 2:** During Year 2, the public awareness campaign will be launched via radio, television, billboards, magazines, brochures, publicity/media coverage, special events, public forums, etc., with a goal of impacting the behavior and perception of key audiences regarding P-12 students' access to and preparation for challenging SM courses.

**Step 3:** During Year 3, all campaign efforts will be maintained, assessed for effectiveness, and refined.

**Step 4:** During Year 4, partnerships will be solidified with a goal of institutionalizing the most successful strategies.

**Step 5:** During Year 5, the effectiveness of the campaign will be measured and plans devised for sustaining it.

### PRISM LEVERAGE POINT 3: INCENTIVES TO INCREASE RESPONSIVENESS OF HIGHER EDUCATION

Higher education SM and SM education faculties will be involved in the following PRISM strategies that have already been described: #1) collaborative design and delivery of teacher professional development within each PRISM region; #2) design and delivery of SM endorsements for current P-8 teachers; #3) participation in SM Learning Communities with P-12 colleagues; #4) participation in the Institute on the Teaching and Learning of SM for higher education faculty members; #5) development of an integrated science sequence for aspiring elementary teachers for inclusion in the *Regents' Principles*; #7) participation in regional recruitment strategies to attract increased numbers and diversity of high quality P-12 teachers prepared to teach SM; and #8) development of P-14 student-learning standards in SM and the corresponding P-12 curricula that will raise expectations and requirements for all students in SM.

**Strategy 10. State Level: Provide a reward structure in universities to encourage faculty members to sustain involvement in improving SM teaching and learning in P-12 schools.** In order to sustain the involvement of SM faculty members in improving teaching and learning of SM in P-12 schools, changes in the faculty reward system will be needed.

**Step 1:** During Year 1, a small group of higher education administrators and SM faculty leaders from the four PRISM regions will be appointed to develop recommendations for incentives for sustained involvement of SM faculty in improving teaching and learning in SM in P-12 schools, using the NRC recommendations (1999a) as a point of departure for discussion. The Committee will be chaired by a member of the PRISM senior personnel and it will include: two vice presidents for academic affairs, one dean, one department chair, two college-level chairs of promotion and tenure committees, one SM faculty member, a cultural anthropologist to study and document the process, and a faculty member in organization development to advise on strategies for changing processes of faculty rewards (the cultural anthropologist and organizational development faculty members will participate in all steps).

**Step 2:** During Year 2, 100 SM faculty members from the PRISM regions will come together in a retreat to consider the Committee's recommendations and reach consensus on incentives for sustained involvement of higher education

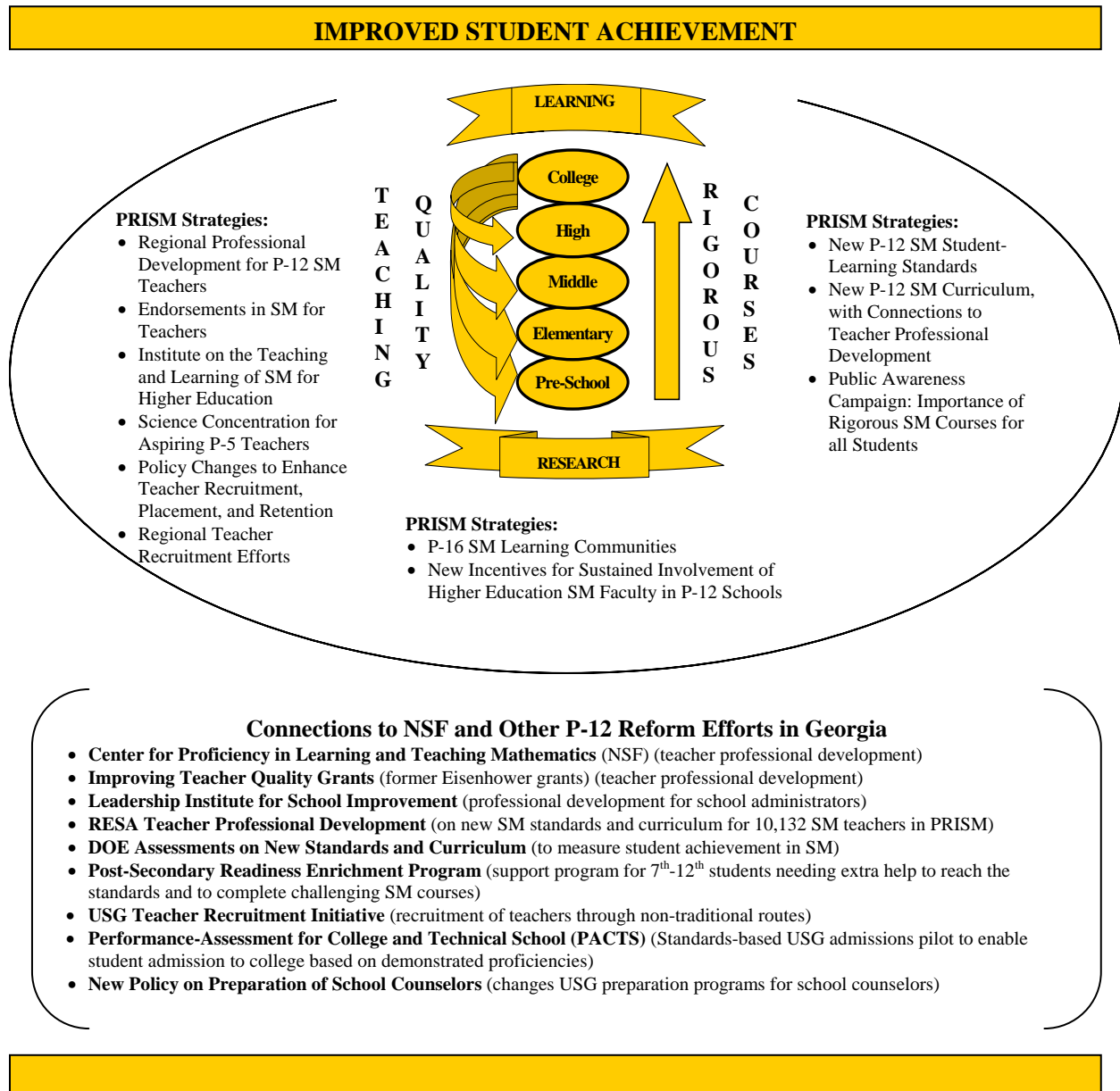
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SM faculties in improving teaching and learning SM in P-12 schools, including: what is needed to appropriately recognize faculty for their participation in the schools and definitions of evidence for promotion and tenure. The recommendations will then be implemented and refined in the PRISM core higher education partner institutions.

**Step 3:** During Year 3, the USG Administrative Committee on Academic Affairs will formally consider the recommendations. The recommendations, as approved, will become policy, which all USG institutions must meet.

**Step 4:** In Years 4-5, members of the committee (step 1) will write for publication the process and lessons learned in changing faculty reward systems, a contribution to increased national understanding of what it takes to increase and sustain the involvement of higher education SM faculty in improving SM teaching and learning in P-12 schools.

### Summary of PRISM Strategies and Connections with other P-12 Reform Initiatives in Georgia:



**Timeline and Relation to Outcomes:** Each strategy in the action plan includes implementation steps and timelines. The table below lists each strategy, identifies the first year the strategy is implemented, and makes explicit its relationship to the annual benchmarks and quantitative outcomes of PRISM.

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Strategy	Yr	Contribution to Annual Benchmarks and Quantitative Outcomes
#1 Teacher professional development	1	<ol style="list-style-type: none"> <li>1. Percent of teachers using inquiry-based instruction and teaching to standards increases</li> <li>2. Percent (all demographic groups) completing challenging SM courses increases</li> <li>3. Percent of students meeting standards on state assessments increases</li> <li>4. Gaps among demographic groups decrease on percent of students meeting standards</li> </ol>
#2 Academic concentrations in SM to P-8 teachers	2	<ol style="list-style-type: none"> <li>1. 800 teachers complete academic concentration in S</li> <li>2. 800 teachers complete academic concentration in M</li> <li>3. Percent of middle grades teachers teaching SM out-of-field decreases</li> <li>4. Percent (all demographic groups) completing challenging SM courses increases</li> <li>5. Percent of students meeting or exceeding standards on state assessments increases</li> <li>6. Gaps among demographic groups decrease on percent of students meeting standards</li> </ol>
#3 Higher education SM faculty and P-12 teachers engaged in learning communities	1	<ol style="list-style-type: none"> <li>1. 1000 P-12 &amp; higher education SM faculty members participate in Learning Communities</li> <li>2. Collaborative research among higher education and P-12 faculties increases</li> <li>3. Evidence-based outcomes that contribute to understanding teaching and learning SM are identified, quantified, and disseminated</li> <li>4. Best practices in teaching SM are implemented</li> <li>5. Percent (all demographic groups) completing challenging SM courses increases</li> <li>6. Percent of students meeting or exceeding standards on state assessments increases</li> <li>7. Gaps among demographic groups decrease on percent of students meeting standards</li> </ol>
#4 Institute on the Teaching and Learning of SM	1	<ol style="list-style-type: none"> <li>1. 80 SM higher education faculty, annually, participate in biannual meetings and professional networks in the Institute</li> <li>2. Percent of SM faculty using inquiry-based &amp; standards-based instruction increases</li> <li>3. Evidence-based outcomes that contribute to understanding teaching and learning SM are identified, quantified, and disseminated</li> <li>4. Best practices in teaching SM are implemented</li> <li>5. Number of new P-12 SM teachers increases</li> <li>6. PRAXIS II pass rates in SM increase</li> <li>7. New SM P-12 teachers are proficient in content, use of inquiry-based instruction, and teacher craft knowledge</li> </ol>
#5 Integrated science for new P-5 teachers	3	<ol style="list-style-type: none"> <li>1. New policy is implemented throughout USG</li> <li>2. PRAXIS II pass rates in science increase for P-5 teachers</li> <li>3. Out-of-field teaching science in elementary classrooms decreases</li> </ol>
#6 Incentives for SM teacher recruitment, assignment, and retention	2	<ol style="list-style-type: none"> <li>1. New policies in place</li> <li>2. Number of P-12 teachers prepared to teach SM increases</li> <li>3. Number of SM teachers hired and retained in hard-to-staff schools increases</li> <li>4. Number of P-12 SM teachers retained increases</li> <li>5. Out-of-field teaching in SM decreases, P-12</li> </ol>
#7 Programs for SM teacher recruitment	2	<ol style="list-style-type: none"> <li>1. 80 aspiring SM teachers participate annually in targeted regional programs</li> <li>2. Number of P-12 teachers prepared to teach SM increases</li> </ol>
#8 New SM standards and curricula developed and implemented	2	<ol style="list-style-type: none"> <li>1. P-14 SM student-learning standards approved (that reflect NCTM and NSES standards)</li> <li>2. P-12 SM curriculum revised to require more challenging SM courses</li> <li>3. P-12 teachers complete professional development on new SM standards and curricula</li> <li>4. Percent (all demographic groups) completing challenging SM courses increases</li> <li>5. Percent of students meeting standards on state assessments increases</li> <li>6. Gaps among demographic groups decrease on percent of students meeting standards</li> </ol>
#9 Public awareness campaign on importance of challenging SM courses for all students	2	<ol style="list-style-type: none"> <li>1. Public understanding increases as to benefits of challenging SM curricula for all students</li> <li>2. Public understanding increases as to the consequences of SM curricular tracking</li> <li>3. Public aspirations increase as to importance of greater numbers of students majoring in SM in college</li> <li>4. Percent (all demographic groups) completing challenging SM courses increases</li> <li>5. Percent of students meeting or exceeding standards on state assessments increases</li> <li>6. Gaps among demographic groups decrease on percent of students meeting standards</li> </ol>

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Strategy	Yr	Contribution to Annual Benchmarks and Quantitative Outcomes
#10 Incentives to sustain increased involvement of SM higher education faculty P-12	3	1. New policy on faculty reward system in place 2. Number of SM faculty involved in teacher preparation increases 3. Number of SM faculty working in schools increases 4. Number of SM faculty working with P-12 schools and teacher preparation who receive promotion and tenure increases 5. Number of papers and publications collaboratively developed with P-12 SM teachers increases

### 4. EVALUATION PLAN

The evaluation of PRISM will be conducted by an internal evaluator, Judy Monsaas, Director of P-16 Evaluation and Assessment, and an external evaluator, David Payne, retired professor of educational assessment and evaluation and Director of Test Scoring and Reporting Services at the University of Georgia. Dr. Payne is a noted expert in program evaluation having written evaluation textbooks and conducted evaluations at the local, state and national levels. Monitoring changes in teacher production and student achievement in SM using large scale databases and changes in policy will be the role of the internal evaluator, who has access to large scale databases through participating state agencies. The formative and summative evaluation of regional strategies and state level initiatives will be conducted by the external evaluator. The external evaluator will also serve as an advisor to the internal evaluator on all accountability and evaluation activities.

**Accountability.** Regional partners will provide disaggregated data on participation in PRISM strategies for P-12 SM students and teachers and higher education faculty members to the internal evaluator to monitor program participation rates. SM teacher recruitment, preparation and production data and SM higher education faculty participating in teacher preparation will be obtained from the regional partners as well. Disaggregated SM student achievement data will be obtained from the Office of Education Accountability for the regional partners and the state. Data will be obtained from the following sources for both the regional partners and the state to monitor progress towards meeting benchmarks and outcomes for Goals 1 and 2. (See the data reported in Appendix 1 for baseline data and examples of the types of data provided.)

Agency	Data	Benchmarks
Office of Education Accountability	<ul style="list-style-type: none"> <li>• Criterion-referenced Competency Tests (grades 1-8)</li> <li>• High School Graduation Tests (to be replaced with End-of-Course Tests)</li> <li>• Other standardized test scores</li> </ul>	Goal 1: Outcome 1, 2, 3
USG, Office of Strategic Research and Analysis	<ul style="list-style-type: none"> <li>• Learning support (remediation) rates</li> <li>• Quantitative Literacy test pass rates (under development)</li> <li>• SM course success rates</li> <li>• Number of SM teachers prepared</li> <li>• Praxis I and II pass rates</li> </ul>	Goal 1: Outcome 3 Goal 2: Outcome 6, 7, 8
Georgia Department of Education	<ul style="list-style-type: none"> <li>• SM high school course taking patterns in SM</li> <li>• SM teacher placement and retention</li> </ul>	Goal 1 Outcome 3 Goal 2: Outcome 9
Georgia Professional Standards Commission	<ul style="list-style-type: none"> <li>• Praxis I and II pass rates</li> <li>• MS teachers teaching out of field</li> <li>• Number of teachers obtaining SM endorsements.</li> </ul>	Goal 2: Outcome 4, 5, 6, 8, 9

Participation data will be collected biannually from the regional partners. Data from state agencies will be obtained annually. Biannual reports on progress toward meeting the benchmarks by program, region, and state (as relevant) will be provided to the PRISM Leadership Team to be used as formative data to make strategy changes and program modifications. **These data will be used to monitor performance on the PRISM goals, outcomes and benchmarks.** These data will also be presented in annual summative reports to the four core partner higher education institutions, 13 core partner school districts, DOE, USG, and the ECC.

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**Formative and Summative Evaluation.** The external evaluator will conduct both formative and summative evaluations of the regional strategies and selected state strategies. For the PRISM strategies, the external evaluator will meet with the core regional and state partners to develop mutually acceptable evaluation plans. These plans will include three components (1) major research/evaluation questions (tied to the PRISM outcomes), (2) evaluation design and sources of evidence (Payne, 1994), and (3) benchmark outcomes. Evaluation designs will answer the following two questions: What is happening? Is there a systematic effect? (National Research Council, 2002b) To answer the first question, multiple sources of data will be used including interviews, surveys (paper and online), performance assessments and focus groups. Experimental and quasi-experimental designs will be used to answer the second question. Following are the strategies that will be evaluated by the external evaluator:

- Strategy 1. (Regional) Provide professional development in SM to in-service teachers. *Separate regional evaluation plans* will be developed with common data elements included across all evaluations. This combination of separate and common data gathering will allow the regional core partners to make mid-course corrections in their plans and yet allow for comparisons across regions.
- Strategy 2. (State) Provide academic concentrations in SM for current P-8 teachers. *One evaluation plan for entire state.*
- Strategy 3. (Regional) Engage higher education and P-12 faculty in learning communities. *One evaluation plan for all four regions.*
- Strategy 4. (Regional) Implement Institute on the Teaching and Learning of Science and Mathematics for higher education faculty and administrators. *One evaluation plan for all four regions.*
- Strategy 7. (Regional) Implement strategies to recruit SM teachers. *Separate regional evaluation plans* with common data elements.
- Strategy 10. (State) Provide a reward structure for SM faculty to conduct research in P-12 schools. *One evaluation plan for all four regions.*

Strategies 5 and 6 are policy objectives and the internal evaluator will monitor their implementation. The internal evaluator will also monitor implementation of Strategy 8; student course taking patterns and state level student achievement data will be used to analyze its impact. Under the direction of the internal evaluator, a consulting firm will be contracted to evaluate Strategy 9, the public awareness campaign (independent of the agency that conducts the campaign). Student course taking patterns and student achievement data will also be used to gauge impact.

The internal and external evaluators will provide mid-year progress reports to the PRISM Leadership Team on the progress of the evaluation activities and on the formative evaluation results. Annual written reports will be provided as well. Following is an overview of the evaluation responsibilities of the internal and external evaluators.

<b>Evaluation</b>	<b>Sample Questions Asked</b>	<b>Responsible Evaluator</b>
Implementation Evaluation	How many participants are there? How many completed the program?	Internal evaluator
	How is the program being implemented? Does it match the goals and strategies of PRISM?	External evaluator
Formative Evaluation	What is the impact of the program on the participants? Which program activities are most/least effective?	External evaluator
Summative Evaluation	Was the program successful?	External evaluator
	Were the benchmarks and outcomes met?	Internal evaluator

### 5. PARTNERSHIP MANAGEMENT/GOVERNANCE PLAN

**Capacity and Readiness of Partners to Collaborate Toward Project Vision and Goals:** PRISM is situated in Georgia's P-16 work at the state and regional levels. State level P-16 accomplishments to date include:

- Development of draft P-14 student-learning standards in SM for PRISM (initial work underway in Strategy 8).
- Creation of the SM higher education consortia to support in-service teachers development of deeper content knowledge, a component of PRISM (initial work underway in Strategy 2).
- Development and implementation of the Post-Secondary Readiness Enrichment Program (PREP) a USG supplemental program to provide 7<sup>th</sup>-12<sup>th</sup> grade students in at-risk situations with the extra help they need to be ready for college. Approximately 15,000 students are served annually in over 400 middle and high schools in Georgia. Sheila Jones, PRISM Co-Director, leads PREP (supports Strategy 8 and outcomes for Goal 1).

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- Performance Assessment for College and Technical Schools (PACTS) has involved the development of “college readiness standards,” performance assessments, student work collections to show evidence of proficiency on the standards, and an alternative college admission system in four regions of Georgia. As a college admission system, PACTS will be piloted in 2003. PACTS is led by Judy Monsaas, internal evaluator for PRISM (foundation for Strategy 8 and supports outcomes for Goal 1).
- Standards-Based Teacher Education Project, a national project of the Council for Basic Education and the American Association of Colleges for Teacher Education, was piloted as a P-16 Initiative in Georgia. All four universities in PRISM participated in STEP, which resulted in an analysis of the arts and sciences and education components of teacher preparation and increased collaboration between the two colleges. Jan Kettlewell (PRISM PI) and Dorothy Zinsmeister (PRISM Co- Director) led STEP (foundation for outcomes of Goal 3).
- Georgia’s Teacher Quality Plan, a P-16 initiative that resulted in the USG *Principles for the Preparation of Teachers*, pilot work on academies for future teachers, targeting of educational leadership for changes in preparation and development as a necessary to improve conditions for practice of teachers. Jan Kettlewell (PRISM PI) led the Teacher Quality Plan (foundation for Strategies 1-7 and to outcomes for Goal 2).
- The Georgia Leadership Institute for School Improvement, a professional development center for principals and superintendents featuring strategies to improve teacher working conditions, a charter preparation program for aspiring leaders, and an advocacy center for policy changes in educational leadership. Jan Kettlewell (PRISM PI) led the development of the Leadership Institute (supports Strategy 6 and outcomes of Goal 2).
- The USG Teacher Preparation Recruitment Initiative, targeting high-need school systems in Georgia in partnership with seven USG institutions. Trish Paterson, a member of the USG P-16 staff, leads the Recruitment Initiative (foundation for Strategy 6 and outcomes of Goal 2).

**Accomplishments at the Regional Level Include:** Regional P-16 councils are based at USG institutions that prepare teachers and they include P-12 school districts and other colleges in the region. The four PRISM regions have active P-16 councils in place that have focused primarily on teacher preparation. Accomplishments include:

- **Partner Schools:** Development of a network of partner schools within each region to work on teacher preparation. Longer-term goals of the partnership include: Teacher professional development, research on improving schools and teacher preparation programs, and support for P-12 student learning in the school.
- **Strengthening Content Preparation of New Teachers:** The core university partners in PRISM have developed and implemented: 12 semester hour concentrations in mathematics for teacher candidates preparing to teach at the elementary level; two 12 semester-hour concentrations from among English, mathematics, science, and social studies for middle grades teacher candidates (will teach grades 4-8); and requirements for an academic major in the discipline (beginning with the junior class in the fall of 2002, a BS or BA degree in the discipline is required) for high school teacher candidates.
- **Governance:** The core university partners have changed governance structures for teacher preparation, moving it from the exclusive prerogative of colleges of education to shared governance systems that include colleges of arts and sciences, education, and school partners.
- **Accountability:** The core university partners in PRISM have put into practice the “University System of Georgia Guarantee” that ensures the teachers they prepare are accomplished in bringing diverse P-12 students to high levels of learning. They provide support, assistance, and professional development to all graduates during their first two years of teaching and provide any teacher they prepare with additional training at no cost to the graduate or to the school system if the latter finds the new teacher lacking.

**Rationale for Lead Partner:** PRISM is an initiative of the ECC. The ECC asked the USG to be lead partner for PRISM, because of the solid record of P-16 accomplishments under the direction of the USG P-16 staff. These staff members are national leaders in P-16 work and under their leadership university-school partnerships within the four PRISM regions are well established. USG includes associate, and all public baccalaureate and graduate programs in Georgia, increasing the prospects of bringing to scale the best practices from the core higher education partners.

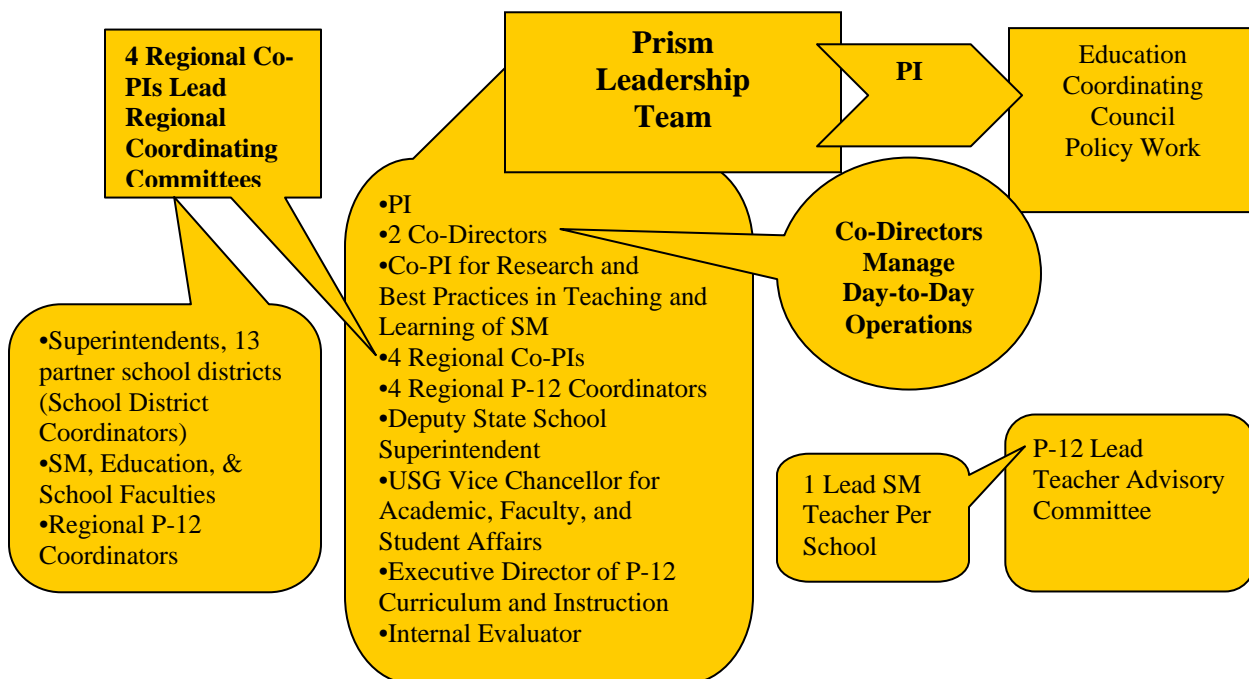
**Management Strategies to Ensure PRISM Reaches Vision, Goals, and Outcomes:** PRISM will be managed through a combination of a state level Leadership Team and Regional Coordinating Committees (RCCs), a strategy that has worked successfully through the P-16 initiatives described previously. At the state level, the PRISM Leadership Team will meet monthly to keep work at regional and state levels integrated and focused on goals and outcomes. At alternating meetings the internal evaluator will give the Leadership Team interim reports of progress. Discussions will focus on adjustments needed in the work plan to keep PRISM focused and on track.

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Regionally based Co-PIs will also hold monthly meetings of the RCCs to keep the work focused and on track across the core partner school districts and universities. The two Co-Directors will each serve as liaisons with two of the four RCCs. They will attend RCC meetings and serve to unify work between the regions and the state level. The Co-Directors will invite the internal evaluator to periodic meetings of the RCCs to provide feedback on work underway. The external evaluator will evaluate all program components of PRISM.

The PRISM Leadership Team, RCCs, Lead Teacher Advisory Committee (1 teacher per building), and the external evaluator will meet together annually in retreat format to review progress reports from the internal and external evaluator and to make corrections in the work plans necessary to meet the goals and outcomes of PRISM.

**Membership, Roles, and Responsibilities of the PRISM Leadership Team:** The PRISM PI will chair the Leadership Team. It includes PRISM Co-Directors: Sheila Jones (mathematician) and Dorothy Zinsmeister (biologist); Co-PI for Research and Best Practices in Teaching and Learning SM, Ron Henry (physicist), Georgia State University; 4 regional Co-PIs: Mike Padilla (science educator), University of Georgia, Nydia Hanna (science educator), Georgia State University, Mark Kostin (science educator), Georgia Southern University, and Chris Schuberth (geologist), Armstrong Atlantic State University; 4 regional P-12 Coordinators: Dava Coleman (Clarke County Schools), Adrian Epps (Atlanta Public Schools), Nancy Marsh (Bulloch County Schools), and Rex Demers (Chatham County Schools); Deputy State School Superintendent, Stuart Bennett; USG Vice Chancellor for Academic, Faculty and Student Affairs, Frank Butler (physicist); coordinator of the P-12 standards and curriculum revision, Pam Adamson; and internal evaluator, Judy Monsaas (total 16). A parallel structure is in place within each region, with the regional Co-PIs providing the leadership, and the RCCs representing SM and education faculties from higher education and SM teachers; regional P-12 coordinators; and the school superintendents serving as P-12 coordinators for the 13 districts (membership in Appendix 3). The Co-Directors will direct the day-to-day operation of PRISM. Jan Kettlewell (PI) will represent PRISM on the ECC Lead Staff Team ensuring collaboration with other state partners in development of policies needed to achieve the vision, goals, and outcomes, and fostering connections between PRISM and other P-12 educational reform work in Georgia. Specific responsibilities of PRISM Leadership Team are in Appendix 3. A diagram of the PRISM management structure follows:



**Participation of Scientists and Mathematicians in PRISM:** Scientists and mathematicians participate in both the management and implementation of the action plan strategies. Participation in the state and regional management structures has already been described. Participation in PRISM strategies includes: 34 scientists and 26 mathematicians (in addition to science education and mathematics education faculty members) serving on the Science and Mathematics Consortia that are focused on PRISM Strategies 2 and 5; additional scientists and

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mathematicians will be participating in teacher professional development within the four PRISM regions (Strategy 1); 80 scientists and mathematicians will be invited to participate in the Institute on the Teaching and Learning of SM (Strategy 4), in SM learning communities with their P-12 colleagues (Strategy 3), and in showcasing best practices through the Georgia P-16 Network; 13 SM faculty members are participating in development of P-14 student-learning SM standards and in the revision of the P-12 SM curriculum (Strategy 8), with 136 additional SM faculty members serving in a review capacity for Strategy 8; and seven SM faculty members will undertake a study on incentives needed to change the faculty reward system (Strategy 10). SM participants summarized in Appendix 3.

### 6. INSTITUTIONAL CHANGE AND SUSTAINABILITY

PRISM includes built-in structures and supports to ensure sustainability of proposed innovations toward increasing SM student achievement. At the state level, key DOE and USG leaders serve on the PRISM Leadership Team with positional authority to develop needed policy changes in P-12 standards and curriculum, teacher preparation, and professional development. Policy changes that cut across P-12 and higher education are decided by the ECC. Since PRISM is an initiative of the ECC, with Jan Kettlewell (PI) designated as lead, she is a position to collaborate with other members of the ECC lead staff team in development of cross-sector educational policies needed to support and sustain PRISM and to ensure that PRISM is connected to other P-12 educational reform initiatives in Georgia. The set of policy changes advocated through PRISM will provide support for changes in practice within the four PRISM regions. Additionally, the public awareness campaign (Strategy 9) will increase awareness throughout Georgia as to the consequences of some of the present practices in P-12 schools, those that lead to under-achievement in SM; to under-representation of SM majors and future teachers in higher education, particularly among poor and minority students; and to under-representation of SM college graduates prepared for graduate school and careers in SM to meet the needs of today's economy. Increased public awareness brings higher expectations for the schools, which will support further changes in policy and in practice to increase student achievement in SM.

Through its existing P-16 structure, Georgia brings a history of successful school-university collaboration resulting in sustainable change that is foundational to PRISM (described on pp. 17-18); mechanisms are in place for sustaining and scaling-up best practices. Within each of the PRISM regions there is an existing P-16 council. These regional P-16 councils provide an already established forum for sharing PRISM best practices in the teaching and learning of SM with all school systems and higher education institutions within each region. At the state level, the existence of the P-16 Network provides an established vehicle for sharing best practices in the teaching and learning of SM among all 15 regional P-16 councils in Georgia, and for codifying them for national presentations and publications. The combination of changed policies, built-in vehicles for sharing best practices within Georgia, and support for SM faculty to refine and experiment with teaching and learning strategies in SM will contribute to changed practices and to their contributions to the teaching and learning knowledge of SM that leads to improved student achievement in SM in P-12 schools. Georgia's participation in the MSP Learning Network will enhance the probability that best practices elsewhere will be implemented in Georgia and that Georgia will contribute evidence-based outcomes that advance the nation's understanding of teaching and learning of SM in P-12 schools.

Ten letters of substantive commitment from core partners are in Appendix 4 (remaining letters on file with the PI). Partners will redirect the following resources toward achievement of the PRISM vision, goals, and outcomes:

- University System: Will commit 25% of PI's time; 10% time of the Vice Chancellor for Academic, Faculty, and Student Affairs to coordinate USG policy development and implementation in support of PRISM; former Eisenhower funds for teacher professional development within the PRISM regions; funding for additional meetings of the P-16 Network, for the PREP supplemental support program for 7<sup>th</sup>-12<sup>th</sup> grade students in PRISM regions, and for teacher preparation recruitment; and sustained support for the SM Consortia and for participation of higher education SM faculty in the learning communities beyond the granting period.
- Georgia Department of Education: Will commit 10% time of the Deputy State School Superintendent for External Affairs and Policy, to coordinate policy development and implementation to support teacher professional development in SM; 50% time of the Executive Director for Curriculum and Instruction to coordinate P-12 standards development and curricular revisions in SM; half of the funding for the curricular revision process and full funding for teacher professional development that ensures full teacher understanding of the expectations of the revised curriculum.
- Over five years, collectively the core higher education and public school partners will commit over \$3 million annually through a combination of direct and in-kind contributions to support and sustain the reforms that have been implemented (breakdown in sub award budgets).