APPALACHIAN MATHEMATICS AND SCIENCE PARTNERSHIP (AMSP)

INTRODUCTION

The University of Kentucky (UK), Kentucky Science and Technology Corporation, 52 rural school districts, regional universities and colleges, and regional agencies have created the Appalachian Mathematics and Science Partnership (AMSP) to improve mathematics and science learning opportunities for all students and teachers in the region (complete list of all partners in Appendix 1). The partnership resources are linked with the Appalachian Rural Systemic Initiative (ARSI) to take advantage of the successful infrastructure established by ARSI with school districts during the past seven years. The "critical components" the partnership will address include (1) preservice teacher and administrator education; (2) professional development of preK-12 personnel; (3) student learning opportunities including parent/community engagement; and (4) a research component to advance the understanding of educational reform in rural school environments. AMSP will engage all levels of preservice and inservice teachers with college and university faculty members through university coursework, instructional resource development, and professional development offered at universities, regional sites, and through virtual networks.

AMSP is based on several foundational understandings:

- A critical need exists in the Appalachian region to improve mathematics and science learning opportunities from elementary through graduate school;
- Effective strategies must be designed and implemented to meet the needs of mathematics and science learners and the training needs of the teachers of these disciplines at all levels;
- No one institution, preK-12 school district, institution of higher education, or community organization can independently solve the many problems related to improving science and mathematics education in rural school environments;
- Leadership abilities and levels of understanding are diverse in all education institutions and can only be enhanced, to the extent needed, through involvement of all stakeholders;
- Predominantly rural school districts have many needs in common that require implementation of both conventional and unique strategies;
- Substantial improvements in student performance will require a coordinated and comprehensive approach, systematically addressing factors that impact the teaching and learning process.

The overall goals for the AMSP are to: (1) eliminate the "achievement gap" in science and mathematics for preK-12 students in the Central Appalachian region; and (2) build an integrated preK-12 and higher education system in this underserved region which insures the selection, development and career-long support of a diverse and high quality mathematics and science teacher workforce.

In accomplishing these goals, AMSP envisions a continuum of mathematics, science and technology teaching and learning experiences for students and teachers at all levels. AMSP participants will have meaningful, overlapping interactions. Preservice teachers are guided by university faculty to prepare them for participation and student teaching experiences with teacher leaders in rural schools. The information obtained and experiences by both the preservice teacher and teacher leader are factored back into the curriculum and instructional activities in the professors' classroom. This generates new instructional practices, materials, and courses. College faculty will implement these new materials with the assistance of preservice students and teacher leaders. The cyclic nature of the activities in the AMSP vision will be revealed as elementary and middle school students are mentored by high school students who are being mentored by preservice college students. Some of the preservice college students will partner with teachers in the development and implementation of instructional materials and lessons. Principals and school counselors will receive training in how to support the implementation of standards-based science and mathematics instruction in their schools. AMSP's effectiveness will be proportional to

the extent that all of its partners contribute and the extent to which activities, that involve partner participation across components, are utilized to maximize the contributions of individuals and partners.

I. OVERVIEW

The Regional Context. The "War on Poverty," initiated by Lyndon Johnson nearly 40 years ago, made an immediate improvement in the standard of living for thousands of working poor, but the effects have not significantly interrupted the cycle of poverty that has gripped the region for decades. Educational attainment trails other regions of the country (Children living in poverty data reference – Appendix 2). The "income gap" for this region has not been diminished. Appalachian Eastern Kentucky shows the greatest disparity with households, on average, earning less than two thirds of the national average income. Appalachian counties in Virginia, to be served by AMSP, also show marked income deficiencies relative to the national average. The per capita income of residents in the central Appalachian region, the AMSP target region, is compared to the national average in Figure 1.

Figure 1. Income Rates in Appalachia, 1997.

Geographic Regions	Per Capita Income	% of U.S. Avg.
United States	$25,288	100%
Total Appalachian Region	$20,872	82.5%
Appalachian Kentucky	$15,703	62.1%
Appalachian Tennessee	$20,545	81.2%
Appalachian Virginia	$17,922	70.9%

*Data compiled by Appalachian Region Commission from U.S. Dept. of Commerce, Economic and Statistics Administration, Bureau of Economic Analysis, Regional Economic Measurement Division (REIS 1997)

According to a report presented to the Appalachian Regional Commission in August 2000, conditions for Appalachian children had generally improved from 1989 to 1995. However, more than one-third of the children in the Central Appalachian sub-region continued to live in households with incomes significantly below the poverty level. Figure 2 shows the poverty rate for children in the three sub-regions of Appalachia, with the central region to be served by AMSP having a significantly higher rate.

Figure 2. Poverty rate for children age 0-17 years, by region within Appalachia.**

Appalachian Regions	Counties (#)	1989 SAIPE	1989 Census	1993 SAIPE	1995 SAIPE
Northern Region	144	18.6%	19.2%	22.2%	20.3%
Southern Region	177	18.3%	18.1%	21.3%	20.1%
Central Region (ARSI Districts)	85	37.6%	32.9%	37.2%	34.7%
Appalachia Average	406	20.5%	20.1%	23.3%	21.6%

**From: Recent Trends in Poverty in the Appalachian Region, A Report Presented to the Appalachian Regional Commission by The Applied Population Laboratory, University of Wisconsin, Madison. August, 2000. (SAIPE = Small Area Income and Poverty Estimates)

The PreK-12 Educational Environment. In 1995 the Appalachian Rural Systemic Initiative (ARSI) began to implement the first major systemic initiative that specifically focused on improving student achievement in science and mathematics in the poor, rural counties of this region. However, the ARSI project focused only on those rural school districts in which a minimum of 30% of the school age children resided in poverty. The proposed AMSP includes a broader range of needy school districts and will develop an elementary through graduate school mathematics and science education infrastructure to raise the level of scientific and mathematical literacy in the entire region.

The model employed by ARSI has been successful in closing the gap in student achievement and building capacity for leadership in its targeted schools. However, much remains to be done. In many cases district and school leaders do not have a vision of what constitutes quality mathematics and science programs; no policies support or promote excellence in instruction; and many schools lack a district-wide curriculum in science and mathematics aligned with state or national standards. The financial resources needed to develop and implement strong science and mathematics programs simply are not available locally.

Professional development for teachers is district based and has focused on improving classroom discipline or "generic instructional strategies," rather than on specific requirements for effective mathematics and science teaching. Many teachers do not have a functional understanding of effective pedagogy and a deep understanding of concepts that they may be expected to teach. They also may lack the needed understanding and support from parents and the community at large. As a result, student achievement in the majority of the rural AMSP districts lags well behind other schools in more affluent ones.

Specific Needs for the Partnership Region. Data from the partnership school districts, universities, state agencies and through the ARSI project provide a clear picture of the needs across the central Appalachian region and a complete set is included in Appendices 3-7.

Few students in the region served by this partnership score at the "proficiency level" in mathematics and/or science as defined by the assessment standards developed in each state (Appendix 3). Analysis of the assessment data consistently reveals lower performance at all K-12 levels central Appalachian students when compared to the state averages and/or students from more affluent regions of the states involved in the proposed partnership.

Enrollment in "higher level" mathematics courses, including Algebra II and calculus, is less than one-third the enrollment in "lower level" mathematics. Introductory science courses have more than three times the enrollment in higher-level courses such as chemistry and physics (Appendix 4). Although 25 of the central Appalachian school districts reported offering some type of AP or dual credit program, enrollment in these programs is non-existent in many schools and involves less than 2% of high school students in partner school districts. The graduation requirements for partnership schools overall indicate a lack of rigor in both science and mathematics programs (Appendix 5).

Attracting and maintaining a staff of highly "qualified" mathematics and science teachers in this region is a major problem for school districts. Data from the Kentucky Department of Education in 1998 indicate that "one-third of the middle school mathematics teachers lack the necessary mathematics and certification to teach middle school content" (Clements and Hartangwicz, 1998). These numbers increase dramatically in rural Appalachian school districts, lacking ready access to institutions offering both undergraduate and graduate programs in science and mathematics education.

The "pipeline data" also are not encouraging. From 1999-2001, less than 1% of undergraduates from the central Appalachian region majored in mathematics or science at the University of Kentucky. Only 37 students graduated with a teaching certificate in mathematics during this same period and only 23 students earned a teaching certificate in one of the science areas. Graduate data are even more revealing. Other than the students from the central Appalachian region earning initial teaching certification in a master's degree program, only 3 students earned a graduate degree in mathematics education and no students earned a graduate degree in science education.

The very low numbers of fully prepared mathematics and science teachers completing teacher education programs have resulted in far too many inadequately prepared inservice teachers. Data from the partnership districts indicate that 38% of the mathematics teachers at the middle school or high school level are teaching with a minor or less in mathematics; 37% of science teachers are in the same condition.

227 (37%) of the mathematics teachers and 213 (39%) of the science teachers have only a bachelors degree (Appendix 6). In the Appalachian states, teachers are required to earn a Masters degree or the equivalent within ten years of initial certification. Only a small fraction of teachers have earned this degree in their content area or have a strong content emphasis. Recognizing that a Masters degree in supervision or administration does little to improve a classroom teacher's subject area competency, some state boards of education are currently considering a change that would require teachers to complete the required graduate program (Masters level) in their content area in order to receive the salary increase for the higher certification level. The data from the planning meetings indicate that a high percentage of mathematics and science teachers certified at the bachelor's degree level are interested in pursuing an advanced degree in their content area rather than "general education." The proposed AMSP project would ensure that graduate level programs in science and mathematics, consistent with the content and inquiry standards required for teaching, are available to teachers across the central Appalachian region.

Few schools in the central Appalachian region utilize "standards-based learning experiences" which are designed to develop a deep understanding of a modest set of important concepts and inquiry and problem-solving skills. An analysis of the "key indicators" from an assessment of science and mathematics programs in 97 rural school districts in the central Appalachian region revealed that students were engaged in problem-solving activities in less than 10% of the mathematics classrooms observed and they were involved in "inquiry-based" activities in only 4% of the science classrooms observed (Appendix 8).

Higher Education Environment. The partner higher education institutions have a long history of working with central Appalachian school districts. The University of Kentucky established the Appalachian Center in 1977 to coordinate a broad range of activities for this region. Undergraduate teacher education programs in the partner institutions have produced the majority of teachers for the region; provided graduate programs and inservice training; collaborated with school districts in the development of curricula; and provided student opportunities for collegiate study in many fields.

In the teacher education arena, a strong relationship has traditionally existed between faculty in the Colleges of Arts and Sciences and Education. Teacher education majors receive their science and mathematics content preparation in Arts and Sciences and pedagogy, observation experiences, methods and student teaching through the College of Education. Although some collaborative efforts have involved faculty from the Colleges of Education and Arts and Sciences, funding and support for the development of strong, integrated programs from these Colleges have not been available. The AMSP will provide the opportunity for a sustained, collaborative effort to pool and utilize the strengths of the partners to accomplish this task.

II. PLANNING HISTORY

A viable partnership of school districts, regional higher education institutions, and ARSI has resulted in significant improvements in the "ARSI eligible" districts and formed a solid nucleus from which AMSP planning efforts were initiated. Building on this relationship, AMSP expanded the number of participating rural school districts, universities, and educational institutions and involved multi-faceted efforts to include all potential stakeholders. Individual and group meetings with the ARSI school district leaders and regional meetings with school district leadership personnel and partner university mathematics and science educators were held. Input was gathered from state science and mathematics supervisors, the Kentucky Commissioner of Education, the Prichard Committee for Academic Excellence (working with parent community groups in counties in central Appalachia) and the regional Gear-up coordinator. The AMSP has a strong affiliation with the NSF-sponsored Appalachian Collaborative Center for Learning, Assessment and Instruction in Mathematics (ACCLAIM) and is coordinating planned activities to link to, enhance and extend the ACCLAIM center's activities. The planning discussions and review of student achievement and school assessment data have resulted in the development of a list of "needs" from which the project's goals and objectives have been developed.

More than 91 educators and regional leaders representing 32 different school districts, universities and educational agencies participated in these discussions. The project planning team has completed a comprehensive data analysis, including a review of teacher certification and professional status data, K-12 student mathematics and science assessment data, university enrollment and graduation data, and science and mathematics program assessment information compiled from Program Improvement Review reports. The database for the project is included in Appendices 3-7 and a list of participants involved in the planning is included in Appendix 9.

The Partners have made significant commitments to participate in all AMSP initiatives. Generally, school districts will develop a MST "leadership team" and have committed to: MST program improvement efforts; implementation of mathematics and science professional development; implementation of MST standards-based practices; and assistance in recruitment and development of MST teachers. University partners have committed to partner for significant program improvement efforts in preservice programs for teachers and administrators, inservice training for teachers and administrators, provision of programs for high ability SMT students (particularly minority and low SES students), and research on factors which impact preK-12 science and mathematics programs. The detailed commitments made by partner universities and school districts are included as Appendix 13.

Past University Partner Collaborations. The partnership universities have a history of collaboration in the support of preK-12 instruction. They are currently contributing consultant services and support to school districts and centers in the ARSI collaborative network.

UK, the University of Tennessee and ARSI are major partners in the Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM) collaborative project. ACCLAIM is a $10M 5-Year Centers for Teaching and Learning NSF project focusing on the improvement of mathematics education in rural Appalachia in Kentucky, Tennessee, Ohio, and West Virginia. The AMSP goals and objectives, activities, and management plan have been carefully crafted to build upon and extend the initiatives defined in the ACCLAIM project.

UK, Eastern Kentucky University and Morehead State University were major collaborators in the statewide systemic, PRISM. Other major collaborative efforts of the partner institutions include: (1) Kentucky K-4 Mathematics Specialist project, a 3-year project to develop a network of teachers and teacher-leaders throughout Kentucky in partnership with the 8 state universities of Kentucky; (2) Kentucky Middle Grades Mathematics Teacher Network, a 3-year project built on the foundation and infrastructure of the K-4 Mathematics Specialist project which impacted over 50% of the middle schools in Kentucky; (3) Secondary Mathematics Initiative (SMI) of PRISM which was the culminating project in this sequence of university/school partnerships.

III. RESULTS FROM PRIOR NSF FUNDING

NSF EHR/ATE Kentucky Advanced Technology Education Project DUE-9454585, 10/01/94-12/31/97, $799,991, Paul Eakin, Co-PI for Technology. Directed the design and installation of fully integrated, networked system instructional computer laboratories, one for each of 14-campus UK Community College System. From any point in Kentucky one of these colleges is no more than 50 miles. Developed professional staff to operate and maintain the labs and mathematics faculty resources to employ them in calculus instruction through two year program of workshops, and direct satellite and network based distance-learning. The laboratory design and operation and large curricular materials resource base were derived from a previous NSF Calculus Reform Project DUE 9252494 which was a consortium A&I project with nine university partners. Curricular materials for math and computer science and all related software were published on two interactive CD's (CHISEL I and II).

Communicating Mathematics DUE-9952436 4/1/00 - 3/31/03 Paul Eakin, CO-PI and project director. A "Proof of Concept" curriculum project to develop a problem solving course for preservice and inservice teachers in which students develop and implement self-checking exercises in a web-based instructional support system. Project has completed design and full implementation of www.mathclass.com mathematics portal complete with integrated WHS math instructional system. The system is employed systematically (daily) in the UK math instruction program for over 2000 students per year. The proposed course is operational at UK in versions for preservice, middle, and high math teachers and in graduate course and workshop versions for inservice teachers; a draft text has been written and class-tested. The project has generated $900,000 in additional funding through KY and US Department of Education, and its results are the subject of an NSF DUE/CCLI A&I grant (# DUE-0127007, $150,000, Enhancing Math Communication) at the University of Tennessee at Chattanooga.

NSF ESI-0119679 Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics. Portion sub-contracted to UK from award to UT-Knoxville, 9/1/01 – 8/31/06, $1,166,262, Carl Lee, Co-PI: Have established criteria and procedure for the multi-institutional doctoral program in Education with UK, U of Louisville, UT, and Ohio U. First doctoral cohort now being recruited and admitted into the various institutions. First summer residence program (courses in mathematics, mathematics education, and rural sociology) will be offered July-August 2002 at UT. Courses in a distance-delivery format are under development with anticipated 2002-03 academic year offerings. Developing web-site as well as technology to assist program management and dissemination, and distance education, professional development, teacher education, and research initiatives. **Portion sub-contracted to KSTC, $982,552, Stephen Henderson, Co-PI:** Have established professional development sites at 8 partner schools, planned summer institutes in algebra for 4 state sites, conducted program development reviews at 8 PDT school sites.

Appalachian Rural Systemic Initiative (ARSI), (ESR-955 4465, $10.8 million, 1995-2000; ESR 0086188, $6 million. 2000-2005; P.I. – Wimberly Royster). ARSI is a K-12 program that reaches 66 economically disadvantaged counties in Kentucky, North Carolina, Ohio, Tennessee, Virginia and West Virginia. ARSI focuses on K-12 students through the development and support of catalyst schools designed to serve as models for other schools in the district. The resulting catalyst districts serve as leaders for reform efforts in the region. The ARSI model is based upon the team approach to school reform. A key component of the model is the Teacher Partners, who are skilled and experienced teachers released either full-time or part-time in order to provide assistance to their colleagues and are supported by five resource collaboratives located at universities across Appalachia. ARSI's network involves 53 catalyst districts with 64 Teacher Partners. Recent data show ARSI's impact is higher level of student achievement, improved quality of professional development and more schools with curricula aligned to the national standards. The following article has been published about the program: Harmon, H., Henderson, S., and Royster, W., Reforming Math and Science in Rural Schools. *Principal Leadership*, High School Edition, National Association of Secondary School Principals; January 2002, 28-32.

IV. GOALS AND BENCHMARKS

AMSP will build a coherent and focused program of activities which are integrated both horizontally across institutions and cohorts and vertically across instructional levels. Each component will be structured so that it clearly focuses on advancing the measurable indicators. The overall focus and primary goal of AMSP is to improve *all* central Appalachian students' performance in mathematics and science. Goals and objectives have been established for each initiative. The goals and objectives identified with each initiative are derived from the partnership's vision and are used to determine the benchmarks for performance. The primary goals are to: (1) Improve the preservice training of mathematics and science teachers by implementing a rigorous preparation program designed specifically to meeting the needs of preK-12 teachers; (2) Improve the preK-12 inservice science and mathematics teachers' knowledge of both content and pedagogy; (3) Enhance preK-12 mathematics and science

educational opportunities for *all learners* in the central Appalachian region; (4) Increase stakeholder and community expectations and support for mathematics, science, and technology education reforms.

Disaggregated student assessment data have been collected for participating school districts and, in addition to being used to establish the project benchmarks, the data will be used to establish individual achievement goals for each participating district. Benchmarks and assessment strategies will be established for all components of the project. In some cases, positive growth indicators will be increasing participation numbers such as the enrollment of students in higher level science and mathematics courses or recruiting students for mathematics, science, and teacher education. In other cases, monitoring of teacher performance will result in data showing a clear relationship between professional development activities and level of implementation for more viable instruction.

AMSP has established the following assessment strategies and benchmarks:
(1) Increase in student achievement in science and mathematics in all partnership school districts. Baseline data indicate a low percentage of students achieving "proficient" status on their state's assessment. The level of achievement of students from low socio-economic (SES) homes is not significantly lower than their counterparts, due in part to the high numbers (approximately 63%) of students living in this condition. The percentage of minority students living in the region served is quite low (3% of the students tested) and, in many cases, is included in the low SES numbers. However, when data are disaggregated by race/ethnicity, the number of students achieving "proficiency" is *significantly* lower than all other students. The goal for all partnership schools is an increase of 20% in the overall number of students achieving proficiency in mathematics and science and 40% increase in the number of minority students attaining this standard. Although annual statistics will be maintained, it is anticipated that the greatest growth will occur in the out years of the project after AMSP changes have been implemented. (See Appendix 3 for district data.)

(2) Increase in the number of students enrolled in higher level science and mathematics courses. Baseline data from the ARSI participants indicate that less than 1/3 (32%) of the students enroll in higher level mathematics courses defined as calculus, Algebra II or similar "advanced mathematics class. Less than ¼ (22%) enroll in higher level science courses defined as chemistry, physics or advanced biology. These data, and data regarding course requirements, indicate a lack of rigor in the curricula of Appalachian rural school districts. The goal of AMSP is to double the enrollment of students in higher level mathematics and science courses by the end of the five year project.

(3) Increase in the numbers of students from partnership school districts enrolling and successfully completing a science, mathematics or SMT teacher education program. Baseline data for the lead institution indicate that only 319 Appalachian region students (14% of all such students) matriculated with a major in mathematics, science or mathematics/science education and 51 students graduated with these majors in 2001. The overall goal for AMSP is to increase the enrollment numbers by 30% over the duration of the project and double the graduation number. Baseline and progression data will be collected for all partnership institutions.

(4) Increase in the number of inservice teachers successfully implementing standards-based and inquiry oriented science and/or mathematics programs. Although general baseline data is available for ARSI schools having completed the Program Improvement Review (PIR) (Appendix 8), classroom performance benchmarks have not been established for most AMSP school districts. Although it is expected that all schools in the partnership districts will be impacted by AMSP, each partner will identify one AMSP school as the "baseline improvement site." Implementation baseline data will be collected and benchmarks identified using the PIR process which examines the level of curriculum implementation, classroom instruction, parent involvement and level of principal leadership for mathematics and science program improvement.

(5) Increase the number of preservice teachers who demonstrate an understanding of the standards-based concepts they are expected to teach. Criteria will be established by the partners using a pre/post testing design to measure progress. The criterion level established is 80% proficiency by the end of the project. Baseline data and additional benchmarks regarding the number of students enrolled in advanced placement type courses, parent involvement, principal and counselor training will be established.

Sustainability and Lasting Impact. Consistent with the intent of this partnership to foster greater collaboration between higher education, preK-12 education, and local communities, the University of Kentucky has recently established a Vice President for Outreach and Public Service. As a lasting impact, it is establishing two new outreach tenured positions, one in mathematics and one in science, for the purpose of working with preservice and inservice teacher education programs and instructional programs in preK-12 schools. A second and unique feature of the AMSP that will further impact schools over time is the formation of "Partnership Institute for Mathematics and Science Reform" at the University of Kentucky. The Institute will become the *permanent center* for the development, dissemination, and implementation of mathematics and science professional development and program improvement initiatives. At the outset, it will be the locus through which AMSP activities will be coordinated. As the program develops, it will be staffed with a coordinator who will facilitate the collaboration of university faculty and inservice and preservice MST working on the development and dissemination of instructional resources, professional development, assessment strategies, and research.

The Institute will include the following functions: (1) Assessments conducted in local school districts to determine MST improvement needs; (2) Coordination of university mathematicians, scientists, math and science educators from partner institutions to develop and assist in delivery of professional development activities; (3) Coordination of mathematics and science teachers with teacher education majors and university mathematics and science educators for the purpose of developing curricula, professional development activities, student activities, and parent/community activities; (4) Coordination of the development of "virtual professional development"; for-credit courses and other inservice offerings; (5) Coordination of the development and implementation of middle and high school student MST learning opportunities.

AMSP's impact will be sustained beyond the initial funding through a number of other venues. Generally the impact will consist of the improvement of personnel, programs, and learning opportunities at all levels and include: (1) programs for preservice teachers implemented and sustained at partner institutions; (2) policies and curricula which require a more rigorous program for all students; (3) increased numbers of highly qualified instructional and leadership MST personnel in the central Appalachian region; (4) increased collaboration between universities, school districts, and communities in educational reform efforts; and (5) additional personnel at higher education institutions specifically for "outreach" functions.

V. PROGRAM DESIGN AND IMPLEMENTATION

The overall partnership program design is built around four integrated components: (A) Preservice mathematics and science experiences for teacher education majors and principals; (B) Professional development/leadership training programs for inservice teachers and school administrators; (C) K-12 student development programs; and (D) Research. The science and mathematics strands are described separately for some initiatives to provide clarity of partnership activities. Both strands will integrate preservice and inservice efforts, make extensive use of technology for communication and delivery of professional development, deliver consistent programs across the region (planned cooperatively through the partnership), and be guided by the overall goal of improving student achievement in standards-based mathematics and science across the Central Appalachian region.

A. Preservice Education

Based on the research literature and clear needs established for the central Appalachian region, the objectives for the preservice education component are to: (1) Improve the MST content/pedagogy program for teacher education majors; (2) Improve skills in the use of technology as both a tool for teaching MST and medium for continuous professional development; (3) Increase the number of high school graduates enrolling and completing MST teacher education programs; (4) Increase the number of students earning MST teacher certification through alternative routes; and (5) Incorporate MST instructional leadership training in all principal certification (preservice) programs.

The national science education standards emphasize the importance of addressing concepts for a modest set of science topics in depth through an inquiry approach. It follows that university instruction should facilitate the construction of a rich understanding of these science concepts by preservice teachers, to the point they are able to apply the concepts and clearly communicate their understanding. However, general studies science courses often consist of a survey of a large number of topics and are likely to have little impact on conceptual understanding (Hake, 1998; Hestenes, Wells, & Swackhammer, 1992; McDermott, 1991). Such lecture-based general studies surveys are the science courses that preservice elementary and middle school teachers too frequently complete in their initial certification program. The result is inadequate preparation for teachers to fully address the standards in their classrooms.

Further complicating the problem of insufficient conceptual understanding is the related finding that preservice teachers frequently have been found to hold non-scientific conceptions of science topics they may reasonably be expected to teach (Atwood & Atwood, 1997; Bendall, Goldberg & Galili, 1993; Schoen, 1995). For any program to prepare effective teachers, strategies which promote the desired level of understanding of science content must be utilized (Barnett & Hodson, 2001). Otherwise, teachers with superior pedagogical knowledge may be simply more effective at teaching misconceptions.

Some partner institutions already have special mathematics and/or science courses in place for elementary teachers. However, more developmental work is needed at all grade levels to better prepare teachers to address the standards, including a greater focus on problem solving and conceptual mathematics. The preservice education component will include the following initiatives: (1) develop and/or revise and implement science and mathematics coursework for teacher education majors; (2) design, develop and implement programs through which preservice science and mathematics students have opportunities to serve as "teachers" in university and/or school settings; (3) recruit talented students to enter teacher education programs in science and mathematics; and (4) develop and implement consistent and efficient procedures through which non-certified, but highly trained mathematics and science professionals can enter the teaching profession (alternative certification).

Enhancement of the Preservice Curriculum. The AMSP preservice teacher component will systematically upgrade the partner MST preservice curricula to insure that the MST preservice teacher experiences consist of learning through collaborative and inquiry-oriented, standards-based courses. Rich introductory experiences will include MST teaching and learning through field experiences in the partner districts. **Comprehensive time lines for planning and implementing preservice course changes in the science and math strands are included in Appendices 12A and 12B.**

Selection of Model Courses and Experiences. A preservice curriculum committee, made up of representatives from all partner institutions, will be formed to advise the development of the preservice teacher program. The partner universities will work from recommendations of a this committee to: (1) arrive at a consensus description of the status of their (collective) preservice MST curriculum; (2) identify the areas of concentration for the forthcoming year; and (3) identify inquiry oriented, standards-based course models at partner institutions or elsewhere which will be further developed, adopted and implemented. These will be the new courses, which will be systematically introduced into the curriculum

at partner institutions. Each course will have an associated lead partner institution and a team of "developers," faculty from each of the partner institutions, who will participate in the adaptation and implementation (A&I) effort for a particular course.

Initial courses have been identified for year one. **In the Science Strand, the Physical Science course for elementary teachers serves as the model for course development and is fully described in Appendix 10. Initial courses in the Math Strand are identified in Appendix 12B.** UK will serve as the lead institution for these courses to help establish the procedures to be used on a recurring basis. Some subset of the college partners will select these models for adaptation and implementation (A&I), which will likely involve study and experimentation over a year or more.

The local A&I project staff are expected to prepare and deliver formal presentations on their projects at AMSP annual meetings and, at a minimum, prepare a final report in the form of a paper for publication in the (online) program journal. The format will be compatible with professional on-line journals such as JOMA http://www.joma.org/.

Experiences for Preservice Mathematics and Science Teacher Education Majors. Three major experiential initiatives will begin in the University of Kentucky: (1) Collaborative learning "Excel" activities, (2) The Explorer program for early experiences in teaching; and (3) Undergraduate Teaching Assistants (UTAs). These initiatives will directly connect students at all levels. **See also Appendix 12B.**

Excel: Peer-Supported Collaborative Learning. "MathExcel" is a successful program originally developed in mathematics at UK by Michael Freeman based on Uri Treisman's program of facilitated collaborative study. There are similar "Excel"-type programs at institutions worldwide, including some in Chicago and Portland public schools. All have in common the employment of more advanced students as "leaders" or "facilitators" of small collaborative groups of lower-level students. The activities are highly structured, coordinated and supervised by a teacher and well trained facilitators. AMSP will facilitate the creation and operation of "Excel"-type activities at college partners and partner high schools and middle schools. High school MST students will be trained to help facilitate middle school collaborative groups; high school students in advanced MST courses will help high school students in foundation courses; college students will assist high school groups; and graduate students will facilitate Excel activities at both the secondary and college levels.

Exploration of MST Teaching. At partner colleges with Excel programs, students will be included in the AMSP Exploration program through which prospective teachers (including professionals) contemplating career shifts into teaching) can learn about and experience something of helping others learn MST subjects. Students formally enrolled in Exploration (typically freshmen and sophomores) will participate in a weekly seminar run jointly by faculty specializing in content and pedagogy along with partner school teachers. AMSP exploration is not just about teaching careers in MST; it is, in particular, about teaching MST in the partner districts. Students in Exploration will have faculty mentors with whom they will work meaningfully and closely on activities that help others learn MST subjects.

Undergraduate Teaching Assistantships (UTA). Partner colleges will implement undergraduate teaching assistantship (UTA) programs in which mathematics students are more deeply engaged in teaching experiences. As with the Explorers program, each UTA will have a faculty mentor who will direct his/her teaching experience, and they will also participate in a coordinating seminar in which they interact with faculty experts in both content and pedagogy and with master teachers from the AMSP school districts. The priority for UTA experiences will be with AMSP courses or workshops that bring them directly into contact with the district partner students and teachers. Some AMSP UTAs will be employed as "electronic teaching assistants" (ETA) for distance learning courses and in support roles for partner district "dual credit" teachers. Some AMSP UTAs will serve as assistants for summer and

academic year workshops for partner district teachers.

When appropriate, UTAs will travel to the school location of an academic year workshop and act under the supervision of a master teacher as substitutes to allow teachers to participate fully in AMSP professional development experiences. The effort will bring bright, prospective new teachers directly into the AMSP region where they can meet the people, observe the life style and the natural beauty of the region, and have a basis for seriously considering a career in the rural schools of the region. For partner school districts, it will provide an opportunity to meet and recruit highly qualified prospective teachers.

B. Professional Development and Leadership Training

The general AMSP program for inservice teachers has many features in common with the preservice program and includes specific components to address the needs identified by the partner school districts. The data from these districts indicate that there is a clear need to: (1) increase standards-based content knowledge in mathematics and science for teachers at all instructional levels; (2) increase teacher instructional skills in the use of inquiry-based and problem-solving strategies; (3) increase the knowledge and skills of principals, counselors, and other administrators to better provide leadership for science and mathematics program assessment, program monitoring, teacher assessment, and curriculum development.

Consistent with the preservice component, the professional development component is based on state and national standards in mathematics and science. The component is comprehensive in that it includes graduate level coursework, academic year workshops, summer institutes, graduate internships, and coaching/mentoring on-site in individual teacher classrooms. The professional development program will integrate preservice and inservice training opportunities, provide opportunities for graduate degrees in mathematics and science education, integrate professional development/leadership training for teachers and principals, and facilitate the process through which some teachers earn National Certification. Graduate courses and selected professional development activities will be delivered through both face-to-face and virtual strategies.

Development and Implementation Programs. An Inservice Program Committee, consisting of representatives from all partner institutions, will be formed to advise the development of the inservice teacher and administrator program. At the AMSP annual meeting the partners will work from recommendations of a Committee on the Inservice Curriculum to examine the status of various levels and specific content areas such as high school physics, middle school math, elementary life science, and select the foci for development and implementation (D&I) efforts. Each effort will have an associated lead partner institution and developers (typically faculty at the lead institution). The developmental work to modify preservice coursework contributes to the development of inservice programs. This logical and cost-effective process will result in skilled workshop leaders who can adapt standards-based practices to serve both inservice and preservice needs.

Teacher professional development projects will be large in scale and generally have three phases. Phase 1 consists of the development of courses, modules, or workshops that can be taught or offered by partner colleges for inservice teachers. For example, one offering might focus on physical science and be a one-week, electricity and magnetism workshop for elementary school science teachers, while another could be a new graduate geometry course for teachers that can be offered effectively through distance learning. The course development team is led by the lead faculty and includes UK project staff, other higher education partners, partner teachers, and students involved in AMSP student experiences. Integral parts of the course or workshop produced will be: (1) assessment instruments for both the workshop participants and for their students (including baseline evaluation) and (2) support materials for a mentored implementation by the teacher-participants who take the course or workshop. The AMSP Research Component will partner with the developers in producing evaluation and assessment instruments to insure quality and consistency.

Phase 2 of a development and implementation project is course or workshop adaptation and dissemination by a cohort of college faculty implementers. Implementation is complementary to the adaptation and dissemination described in the preservice component. While courses and workshops will be taught at university and school sites and serve many teachers, web-supported alternatives will be available for some topics to increase accessibility. Another approach, currently under development, will provide technical support for groups of teachers working on a specific mathematics or science topic through the use of an instructional CD and web-based "ask the expert" support system which is operated by a university faculty member with graduate student assistance.

Teachers participating in Phase 2 make a commitment to completing Phase 3, which is the Mentored Implementation. This is a structured academic year follow-up and implementation. In it, the implementing teacher is assisted by a teacher-leader who will provide in-class support based on both personal experiences with his or her own students and specific training for the course or workshop from Phase 2. The ARSI "Teacher Partners" and "Master Teachers" will be the initial group of district personnel employed in this capacity. Additional Teacher Leaders will be developed to serve all partner districts. College and university workshop leaders also will provide in-school implementation assistance. Teachers participating in the implementation must commit to administer a baseline and post assessment of student understanding of concepts being targeted. Teachers will also be supported in Phase 3 with sample lesson plans and instructional materials. **A time line for planning, summer institutes and mentored implementation in the science and math strands are included in Appendices 12A and 12B.**

Mentored Internships. Building ARSI's successful "Teacher Partner" model, the "Mathematics and Science Teacher Mentored Internship" program will provide advanced preparation and leadership opportunities for mathematics and science teachers throughout the central Appalachian Region. Internships will be of varying lengths of time (up to one academic year) based on the individual teachers "professional improvement plan" developed collaboratively by the teacher, school district, and supervising partner university. The first aspect of the professional improvement plan will address one of the following components of the partnership program: (1) service to the AMSP such as collaborating with a university partner in the development of preservice mathematics/science courses or inservice workshops for mathematics or science teachers; (2) service to the "home school district" such as delivery of professional development, curriculum development, and mentoring of other teachers. The second part of the plan will focus on "personal professional advancement" through one of the following: (1) professional advancement through graduate coursework leading to an advanced degree, additional or enhanced certification, or increased content preparation; (2) completion of the requirements for National Certification; or (3) research related to the impact of changes in instructional practice or use of innovative resources, including instructional technology. The Internship will result in one or more of the following products: (1) ongoing formative assessment of the internship activities; (2) a culminating project, such as curriculum materials, professional development program, report of research conducted, article prepared for publication; (3) advanced degree or certificate. The internship plan and contract will be jointly approved by the school district and AMSP and will require that the teacher return to his/her science or mathematics teaching position for 2 years following conclusion of the internship leave.

Leadership Training for Principals. The school principal plays a very important role in providing support and leadership within a school. Principals have responsibility for the development and implementation of the curriculum, classroom instructional activities, parent/community engagement efforts, and all factors which directly impact student learning. In most cases, the school principal is not a mathematics or science major, and many have had little experience in school reform initiatives. Also, school principals have a myriad of responsibilities, which often result in science and/or mathematics program improvement efforts receiving a low priority.

The intent of AMSP is to provide a training and support system which will enable principals to become science and mathematics advocates, resources for other principals in their district and leaders for district-wide MST program improvement efforts. The overall goal for this initiative is to build local school district leadership capacity for mathematics and science program improvement by enhancing the knowledge and skills of "leader principals" in each participating school district. These persons will provide leadership, training, and support for their peers. The specific objectives are to: (1) identify and develop a cadre of mathematics and science "leader principals" referred to as Principal Partners; (2) provide training for Principal Partners in strategies which can be a MST resource and increase instructional leadership skills of other principals in their districts; and (3) coordinate training and support for all principals in participating districts, through the Principal Partners, that will result in more effective learning environments in mathematics and science.

Professional Recognition. Teachers consulted in the development of the partnership, particularly those at elementary and middle school levels, have indicated a need for recognition of their mathematics and science competency beyond the "formal status" of their standard teaching certificate. In many cases, peers with whom they work do not recognize the level of content or pedagogy expertise which has been acquired through courses, workshops, and other professional experiences.

AMSP will offer an opportunity for teachers to demonstrate their MST competency in alternative ways. Colleges and universities have traditionally recognized the completion of defined programs of structured and evaluated academic experiences through the awarding of diplomas. While some teacher participants will organize their participation to apply to traditional masters and doctoral degrees, others will direct their efforts toward less formal but important recognition (e.g., some elementary teachers may wish to establish qualifications as math or science specialists; some middle school math teachers may wish to establish their qualifications to teach Algebra I). The AMSP Graduate Certificate is a non-traditional recognition offered through partner colleges to meet these needs. Generally, graduate certificates are available only to holders of an accredited BA or BS degree and require, at most, 15 semester hours of study. At least 9 hours must be at the graduate level. "Graduate" describes the participant as well as the program. At a higher level, partner colleges may award Specialists' Certificates (e.g., High School Mathematics, High School Life Science, Elementary Mathematics and Science) for specified programs of experiences which earn two Graduate Certificates. The first in this case would be called the qualifying and the second the advanced component of the individual specialist's certificate program.

Certificates are written assurances that certain expectations have been met. They are <u>not</u> certification in the sense that the states credential teachers. Rather, they represent an efficient mechanism through which individuals can receive recognition for a significant change in their qualifications. For example, UK will offer specialists certificates in AP and dual credit mathematics, areas for which there is no formal state certification. The dual credit certificate would certify that the recipient has met the letter and spirit of the Southern Association requirements and has successfully taught a college-level course in a mentored context.

The Role of Technology: Distance Learning. Functionally, courses and workshops for students, teachers, and leaders at all levels are the primary units of AMSP activity. In many cases there will be both on-campus and off-campus adaptations of the same course providing equivalent quality and experiences. The AMSP philosophy is that, across the project, all realizations of a course or workshop be of the same high quality and provide equivalent experiences. Some offerings will of necessity involve distance learning. However, much of the "distance" will be covered by instructional teams that travel to locations convenient for off-campus students to convene in traditional face-to-face instructional settings. AMSP partner colleges have the full set of modern distance learning tools, such as direct broadcast Kentucky Educational Television satellite channels, "smart" classrooms connected by high speed real-time, two-way video links to the various campuses and off-campus centers in the region, internet-based

conventional video conferencing, streaming video, internet telephones, fax machines, etc. These, and the technologies that will render them obsolete within AMSP's 5-year lifetime, will be employed extensively. They will be used for instruction and as communications bridges which facilitate coordination and collaboration among the partners. They will be particularly useful in connecting teachers and students in the interim between regular, face-to-face instructional sessions. Instruction via technology may, for example, be chosen by small groups of teachers living next door to a partner higher education campus as well as by teachers residing in remote locations. This would be an option for the web assisted instruction available for selected physical science topics.

mathclass.com/WHS, A Common MST Instructional Support System. mathclass.com mathematics *portal* and associated "web homework system" (WHS) has been developed and fully implemented at the University of Kentucky. The mathclass/WHS system provides: (1) a common technical base for AMSP course development and implementation and a very effective means for materials dissemination and implementation; (2) a common, convenient mechanism for evaluation data collection, (3) a platform for systematic integration of "local" and "distant" instruction. It is used systematically by faculty at UK for mathematics instruction and is currently being adapted at The University of Tennessee at Chattanooga (UTC) under NSF sponsorship.

All mathclass.com/WHS data reside on a secure, redundant, system at UK, which is integral with the Kentucky Early Mathematics Testing Program (KEMTP) (see below). In addition the Kentucky Department of Education, as part of the AMSP partnership, is providing for integration into this database complete teacher credentials and assignment data (by class hour, number of students, age of students, etc.) for the entire state.

All data in the system comes under the provisions of the act of the 2000 Kentucky General Assembly which established the KEMTP and University of Kentucky regulations which (1) guarantee that student information can be released only to individual students, their parents, and teachers (and then only for their students on a particular test) and (2) make the data available in aggregate form for research under human subjects guidelines. These provisions are completely consistent with use by the AMSP Research program and the project evaluation and assessment and thus provide the program with an extraordinary ability to measure progress by project and program. **See Appendix 11 for more details.**

C. Increasing Student Mathematics and Science Learning Opportunities

Increasing student learning opportunities is the central purpose of AMSP project and is supported by all components. As stated earlier, the primary goal for this project is to increase the level of scientific and mathematical literacy of all students, eliminating the "achievement gap" of preK-12 students, which exists between students in the central Appalachian region and other, more prosperous sections of the states. The design of this particular component includes "direct student activities" and "services/activities which support student learning." The primary strategies for this component include: (1) developing and implementing of mathematics and science programs at university sites for middle and high school students; (2) increasing student enrollment in higher level mathematics and science courses including dual credit, AP and on campus courses; (3) providing better counseling and advising services for students, particularly under-represented students; and (4) developing and implementing programs for parents and other community stakeholders. By the very nature of the reform needed to improve MSP learning opportunities for all students, it is also critical that the following be incorporated into the AMSP program: assessment of mathematics and science programs; review, revision and development of policies; and, assistance with the development, implementation, and monitoring of science and mathematics standards-based curricula

Summer Programs for High School Science and Mathematics Students. The AMSP partner universities will collaborative in the development and implementation of summer programs for middle

and high school students from the partnership rural school districts. The "Appalachian Science and Mathematics Scholars" program will be planned cooperatively by university, school district and Gear Up partners and be offered at different sites across the central Appalachian region during the project's duration. Selected through close collaboration with Gear Up Kentucky, mathematics and science talented minority students and students from low-socioeconomic levels will have the highest priority for attendance in these programs. The overall goal of these summer programs is to increase the number of students from economically disadvantaged, rural communities majoring in mathematics and science at the collegiate level. The program objectives are three fold: (1) improvement of the mathematics and science academic preparation of students for higher education; (2) adaptation of students into the university academic and social setting; and (3) creation of a greater awareness of career opportunities in science, mathematics, and the teaching of these subjects.

"Appalachian Mathematics and Science Scholars" is a residential program provided for rising high school sophomores and juniors. This program will focus on the development of science, mathematics and technological skills taught through an inquiry-based laboratory approach. It will introduce students to university entry-level science, mathematics, and technology coursework taught by senior mathematics and science faculty from the partner institutions. Students will be recruited based on a particular career interest such as medicine, engineering, or teaching. The program will incorporate appropriate laboratory and field experiences which acquaint students with these career choices.

Increasing Enrollment in Higher Level Science and Mathematics Courses. To achieve the student achievement goals established by the AMSP will require that significantly more students enroll in higher level mathematics and science courses. A primary AMSP objective is to increase the number of students taking advanced MST courses. Enrollment statistics in upper-level courses, which range from less than one-third to less than one-half the totals for lower-level courses in the partner districts, reflect the fact that the majority of students opt to meet minimum requirements (Appendix 4). The need clearly exists to change prevailing attitudes and norms.

Partner institutions will offer certificate programs in "advanced mathematics" teaching as a means of helping teachers establish higher-level programs. However, "advanced" need not be synonymous with "AP" and dual credit. In fact, in science the most pressing need is to increase the number of high school students who select and complete chemistry and physics.

The AMSP partners will address this complex problem through the following strategies: (1) change in school and district policies increasing both the rigor and duration of the science and mathematics curriculum required of all students; (2) curriculum development to improve the quality of mathematics and science program offerings; (3) increased accessibility through virtual course delivery; (4) improved counseling and advising for middle and high school students; and (5) increased opportunities for advanced placement type courses such as "dual credit."

Dual credit is a program in which students concurrently take courses for both high school and college credit. The AMSP professional development initiative will include programs to develop teachers with the credentials to qualify as college instructors for dual credit purposes. Incentives are planned to motivate schools to offer these courses and to encourage students to take them. The primary disincentives to dual credit for students in this high poverty region are the cost of tuition, approximately $300 for the three-hour college algebra course at partner institutions. The University of Kentucky will reduce the dual credit tuition by $150 per course for up to 500 students from AMSP districts each year.

Counselor Training. School counselors are key to initiating change in student programs. They are critical to information dissemination and academic advising regarding course selection, career preparation, and student support services in mathematics, science and technology.

The project plan includes intensive counselor training on 1) the need for a technologically capable workforce at all levels of the socioeconomic continuum and 2) motivational strategies to encourage all students to enroll in more advanced courses. A series of workshops have been devised to introduce school counselors to initiatives of the region in developing a knowledge-based economy and, particularly, on the emphasis on workforce development in their own region. Sessions will feature the statewide efforts to stimulate economic development and the critical role of schools and universities in creating a technologically proficient workforce. Seminars will include presenters at different levels in scientific and technological career fields, so that counselors better understand that MST achievement is essential to careers at all levels of the workforce.

Further, the project partners and school counselors will implement a series of student assemblies, at regular intervals throughout the K-12 years, which address MST career preparation. The partners will incorporate programs such as the *Role Model Program*, a collaboration of the Office of the New Economy, the Office of the Governor, University of Kentucky, and the University of Louisville to expose students to scientists and engineers as role models.

Parent and Community Engagement. The Prichard Committee for Academic Excellence, a very successful and nationally recognized parent program advocate, will provide *Commonwealth Institute for Parent Leadership* training for five pairs of parents from AMSP parents each year. The ten parents for Parent Leadership will attend six days of training focused on parent engagement and student achievement. Parents will receive a combination of information and skills to help them understand a standards-based education system, use their school's math and science data to determine priority needs for improvement, and work with other parents at their school to develop a project that impacts student math/science achievement in a lasting way. Throughout the process they will have the support and coaching of a Prichard Committee Community Support Coordinator.

Parents trained in the Commonwealth Institute become members of a network of trained parents focused on analyzing school achievement data and participating in projects and activities at their schools and in their communities to improve achievement. They are charged with involving other parents to increase school and community awareness of the importance of improving student achievement. With this training they become better prepared to serve on regional committees, task forces, and awareness sessions about such opportunities as distance learning, technology in schools, etc. Parents trained through this process will work with AMSP to provide support for parents and community members throughout the region. These parents will also work with the ARSI Resource Collaboratives' parent/community projects currently being conducted by ARSI school districts to expand to all AMSP targeted schools.

D. Research Component

The research component will be designed to generate and interpret formative and summative data for the project initiatives, contribute to the research base on mathematics and science education in rural settings and prepare a cadre of teachers to conduct research in school settings. This component will be closely aligned with the research in mathematics education being conducted through the ACCLAIM project.

Evaluation tasks and instruments will be developed for the preservice, inservice, and classroom implementation efforts. UK will lead this work; partners will collaborate with the development and use of the assessment tasks and instruments. Considering the large number of persons to be assessed, a major assessment tool will be multiple-choice tasks, which make extensive use of popular non-scientific conceptions in the distracter options. "Application" will be the target level of cognitive functioning assessed. The Force Concept Inventory (Hestenes, Wells and Swackhammer, 1992) has been used extensively for introductory college physics and high school physics. Project personnel have had experience in developing and utilizing this type of instrument (Atwood & Christopher, 2000). Project

personnel also have had experience using one-on-one interviews to gain a rich understanding of conceptual understanding (Trundle, Atwood & Christopher, 2001). These interviews are very labor intensive, but provide the researchers great insight. Some teacher leaders, doctoral students, and other interested partners will be trained to conduct individual interviews for small samples. Data obtained will be used to cross-validate multiple-choice data and provide formative and summative information. Results of research on conceptual understanding and conceptual change that contribute to the field will be disseminated through scholarly publications, and paper presentations at state, regional, and national conferences.

Students from the Appalachian region participating in graduate programs at the partner universities will be encouraged to develop research studies related to AMSP initiatives. A variety of research studies will be designed with a strong emphasis on conceptual understanding and conceptual change. Dissertation research opportunities will be numerous. Many opportunities for involvement in research, integral to the AMSP project, will also be provided to faculty members at partnership institutions. UK's distance learning facilities, two-way video via PC's, and other technology will be used extensively.

ARSI Master Teachers, funded by a NSF project, are being trained in "Action Research" methodologies and will be utilized to assist teachers and school administrators plan and implement action research studies. This initiative, and the empirical research component, will be closely coordinated with the "mathematics education in rural school settings" studies instituted through the ACCLAIM project. The research component will build on the findings and recommendations of the recently completed "Understanding Achievement in Rural School Settings" conference (Conference Proceedings, Stephen Henderson (Ed.), 2001) conducted by ARSI with NSF support.

VI. PROJECT MANAGEMENT, STAFFING AND OPERATION

The Lead Organization of the Partnership is the University of Kentucky. Partner sites will be Kentucky State University, Eastern Kentucky University, Morehead State University, University of Tennessee-Knoxville, the University of Virginia College at Wise, Pikeville College, Somerset Community College, and Union College. Each partner institution will provide necessary space to accommodate staff.

The selection of UK as the lead institution is a national outgrowth of the relationship established over the past seven years in which the University has served as a Resource Collaborative for ARSI and provided significant consultant and technological support for the project. UK's Appalachian Center and other faculty have promoted the study of Appalachia over a period of years. In addition, the University's land-grant role provides access to rural communities through its network of "field agents" whose responsibilities complement the parent/community component of the project.

The management plan as envisioned consists of two facets: the academic partner program activities and the program delivery activity. In the academic program activities the mathematics and science components are managed similarly. Each is directed by a co-PI and focuses on student and teacher learning at all levels -- preK through University. The major difference is that due to the multi-disciplines in the sciences, there is a sequencing of discipline concentration over the five-year period determined by needs, resources and interest of partners, whereas in the single discipline of mathematics, the different levels of activities will determine partner involvement.

The delivery of the partnership programs and services will be coordinated through a regional network of "centers" (Resource Collaboratives) building on the successful implementation sites established for ARSI. The centers are located at strategic university sites in close proximity with the partnership school districts. An AMSP coordinator will be housed at each site for the purpose of building and maintaining the bridge between development and implementation, theory and practice. The coordinator will be

responsible for connecting school districts and university personnel to implement AMSP goals and objectives including (1) the development of science and mathematics professional development programs, student programs, and research studies; (2) assisting local school districts in developing science and mathematics improvement plans for both the school and district levels; (3) working with the AMSP planning teams to "match" program development with needs; and (4) planning for and managing offerings at regional and school district sites.

Leadership. The primary leadership for the AMSP is vested in the Principal Investigator and the co-Principal Investigators. Dr. Paul Eakin (UK) will serve as Principal Investigator and Director. Co-Principal Investigators are Dr. Ron Atwood (UK), Dr. Carl Lee (UK), Dr. Stephen Henderson (ARSI Project Director), and Dr. Wimberly Royster (ARSI Principal Investigator). Dr. Eakin's responsibilities include the overall management of the project, its budget, and communication with NSF. The Co-PI's responsibilities include managing their respective initiatives working with partner schools and universities and serving on the Management Team.

Dr. Carl Lee, Professor of Mathematics and co-PI of ACCLAIM, will have general responsibility for the mathematics program and its alignment with program goals and objectives. He will meet regularly with partner mathematics faculty to assess progress and assure coordination of mathematics component. He will annually present mathematics program budget requests for program-level resources and in consultation with Mathematics Program Council, will recommend new activities in mathematics and changes in on-going ones.

Dr. Ron Atwood, Professor and Science Educator, has the responsibility for the science program and its alignment with program goals and objectives. He is responsible for coordinating the development and offering preservice and inservice courses, developing budget and resources needed for the program. In consultation with the Science Program Council, he will recommend new activities and changes in existing programs. He will direct the research component activities in the science strand.

Dr. Stephen Henderson, Science Educator and Project Director of ARSI, will direct the program delivery activity through the ARSI network. Responsibilities will include overseeing the planning for workshops, conferences, leadership development for school administrators and counselors, working with district partners to implement AMSP programs and identifying technical assistance that assists with integration of the pre K-University initiatives.

Dr. Wimberly Royster, ARSI Principal Investigator, Statewide EPSCoR Director (1992-June 30, 2002) and Vice President for Research and Graduate Studies Emeritus, will serve as Executive Program Coordinator. His responsibilities will include overseeing the coordination of institutions of higher education partners' involvement in AMSP as it relates to institutional policies. As Chair of the Management Team he will work to increase the interface between and among the mathematics/science program delivery initiatives and the school district partners.

The management team will include the P.I. and the Co-PIs and representatives from AMSP Partners which include a superintendent of schools (Joe Dan Gold, Superintendent of Morgan County Schools), HBCU KSU Chairperson (Fariba Bigdeli-Jahed), school district liaison (Frieda Mullins, Knott County, KY), school teacher (Aleta Duncan, Johnson County, TN), ARSI Resource Collaborative Coordinator (Terry Lashley, University of Tennessee) and university partners representative (Gerald DeMoss, Morehead State University). The responsibilities of the management team include policy, planning and budget oversight for the partnership. This involves reviewing the initiative activities and implementation plans, assisting in implementation (collaborative and coordination) across the project, resolving Partner issues and assisting with leveraging resources.

Initiative Advisory Councils. AMSP will have initiative advisory councils in mathematics and science. The respective Co-PIs will lead the councils. The councils' membership will include project participants from both higher education and school district partners. The councils will help identify specific needs regarding new developments and initiatives, and changes needed in ongoing group activities. They will identify resources and programs to support the project, and will communicate, and promote the project with pre K-University stakeholders.

AMSP Advisory Board. A group of well known responsible professionals in the area of mathematics and science, primary, secondary and a postsecondary education will serve as AMSP's Advisory Board. It will meet twice a year to receive updates on the partnership's activities and accomplishments and assist in the development and evaluation of AMSP initiatives. Members who have agreed to serve are: Dr. John Conway, University of Tennessee; Dr. Bernard Madison, University of Arkansas and Mathematics. Associate of America; Dr. Robert Yager, University of Iowa; Dr. Daniel P. Maki, Indiana University; Dr. Lois-Adams Rodgers, Kentucky Department of Education, Dr. William E. Kirwan, President, Ohio State University and Chancellor-elect, University of Maryland System; and Dr. Ertle Thompson, Professor emeritus, University of Virginia. Members representing professional organization of school administrators and teachers will be added.

Members of the Partnership have a history of involvement in mathematics, science and technology education in the region. Many preservice and inservice teachers tend to obtain their training at universities in closest proximity to their place of residence. To accommodate this circumstance the Mathematics Department at the University of Tennessee has chosen to increase its impact through an "outreach" professor. UK recently established a Vice Presidency for Outreach and Public Service and consistent with this new effort, is establishing two tenured new outreach positions: one in Mathematics and one in Science to be filled by the second year of the AMSP Project. In addition a tenured position in Mathematics Education will be added.

VII. ASSESSMENT/ACCOUNTABILITY

Dr. Mark St. John and Dr. Michael Howard of Inverness Research Associates have been contracted to provide the AMSP Partnership with external evaluation services. Inverness Research has a seven-year history of working in Appalachia with ARSI and the more recently funded ACCLAIM Center for Learning and Teaching. In addition, they have a long history of studying mathematics and science initiatives including multiple Rural Systemic Initiatives. (See www.inverness-research.org.)

The evaluation effort will have three major purposes. First, it will provide the AMSP Partnership with formative feedback, helping to shape the partnership as it proceeds. Second, the evaluation team will oversee the gathering of all summative data, assessing the ways and the degree to which the Partnership is contributing to Appalachian students, instruction, schools and infrastructure. Third, the evaluation team will work closely with the research initiative staff as needed to complete applied research and expand the body of knowledge about mathematics and science education reform in rural regions.

Formative: Inverness researchers will independently study all four components of the Partnership work each year. Using a "logic model" approach they will document the evolving theory of action for each component, and compare those strategies with realities observed in the field. Twice each year the evaluators will meet with AMSP Partnership leaders to report their findings and facilitate a discussion on the implications for change. In addition, the evaluators will be given the responsibility and license to assess and document the health of the Partnership and to report out both strengths and weaknesses.

Summative: Inverness researchers will study each of the four components and the degree to which the components are interacting with and supportive of each other. For each initiative, the evaluation will assess the degree to which the Partnership is achieving its stated benchmarks for progress (see above).

Rather than restate all of those specific goals and objectives, it will be more useful to use the limited space in this proposal to point out the overall design and approach of the summative evaluation.

The evaluation will study the partnership carefully, both its operation and impact, at different "levels" of the system. These levels run "upwards" from student achievement to quality of instruction to system capacity to Partnership activity.

At the first level the evaluation will carefully monitor the influence of the partnership on students – both students in classrooms and preservice teachers. With the assistance of local university faculty, staff and students, Inverness will help to design and maintain a database of opportunity and achievement throughout the targeted region. Drawing on existing state measures and other indicators of the quality of learning opportunities, the database will provide a longitudinal record of the health of mathematics and science achievement in Appalachia over time. More specifically, by examining a sample of Appalachian communities over time, the evaluation will assess the incremental contribution of the Partnership to the quantity and quality of the "opportunity to learn" mathematics and science – for young people, for teacher candidates, for teachers, and for administrators.

Second, the evaluation will look at the nature and quality of instruction and its correlation with Partnership activities. Using instruments and protocols developed for the NSF-funded LSCs, the evaluation will examine the quality of local classroom instruction, local preservice instruction, and local professional development, assessing the "value-added" aspects of the Partnership's presence and activities.

Third, the evaluation will look at the degree to which, and the ways in which, the AMSP Partnership contributes to the capacity within Appalachia for self-improvement of mathematics and science programs. This project plans to build that capacity in its partner schools and Regional Collaboratives and the evaluation will study those mechanisms. Additionally, by studying a representative sample of communities over time, the evaluation will document the development of local leadership – teachers, administrators, and faculty members. Inverness will document the changes in other capacities such as the local ability to provide professional development, adopt and support challenging curriculum, develop and interpret a mix of assessments, and create supportive local communities.

Fourth, and finally, the evaluation will assess in a summative way the design, structure, management, activities, and productivity of the Partnership itself.

Research -- The evaluation will study the research efforts of the AMSP Partnership, assessing the degree to which research is contributing to local improvement efforts, as well as the degree to which the research coming out of the region is disseminated and seen as useful. The evaluation teams will use their evaluation data to write more generally about the process of improving mathematics and science education in rural impoverished regions. (See "Setting the Foundation for Reform: The Work of the Rural Systemic Initiatives" at http://www.inverness-research.org/reports/ab_rsi_compl.html). Where appropriate, the evaluation team will use local faculty and graduate students to assist in the work of studying and documenting improvement efforts in their regions.