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Grant Proposal Narrative

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Introduction

The STEM Bridge Project is a proposal from the University of Massachusetts Amherst (UMass) School of Education and the Science, Technology, Engineering, and Mathematics (STEM) Education Institute. It will award 52 Noyce Scholarships with an average value of \$8173.00 to 32 undergraduates preparing to become secondary science or mathematics teachers. The Scholars will be drawn mainly from the community colleges and the UMass University Without Walls program, which serves non-traditional students, including teacher aides. The broader impact of STEM Bridge is that is specifically designed to attract and support nontraditional, minority, and low-income students who will be able to receive their licensure as undergraduates. It is designed as an undergraduate program even though most of the recently UMass certified math and science teachers have completed post-BA/BS programs. Completing the licensure requirements as undergraduates is particularly attractive for these students, who typically have minimal financial resources. The project's intellectual merit is that it will serve as a model for reaching and supporting these cohorts. An evaluation program will measure the effectiveness of the program, including the qualifications of its graduates and their retention rates.

The University of Massachusetts system is a leading center of public higher education. Its flagship campus in Amherst (UMass) was founded in 1863 under the Land-Grant College Act of 1862. UMass offers bachelor's degrees in nearly 90 areas, master's degrees in more than 70, and the doctorate in over 50. The campus serves approximately 34,000 students: 18,000 undergraduates, 6,000 graduates, and 10,000 Continuing Education students. It is committed to excellence in research, education, and community outreach and also has external grants from numerous sources.

The UMass School of Education is one of the largest preparers of science and mathematics teachers in Massachusetts, and is a leader in pre-service and in-service teacher education as well as in educational research. The School works with many school systems in the region and in the state. The STEM Ed Institute's broad mission in science, technology, engineering, and mathematics education includes research, curriculum development, and teaching improvement in the schools and colleges of the region. It uses University and grant funding to support workshops, seminars, and a variety of programs.

The need for the program

At this time there is a severe shortage of qualified mathematics and science teachers for US middle and high schools (Ingersoll, 2003; Rhoton & Bowers, 2003). The shortage is caused by several factors including the low retention rate of teachers, which is exacerbated by the large numbers of teachers at retirement age (NCTAF, 2003) and the low numbers of students majoring in the science, technology, engineering and mathematics (STEM) disciplines (Hill, 2002). A similar state of affairs exists in Massachusetts. A recent study conducted by the President's Office of the University of Massachusetts found the supply

and demand for mathematics and science teachers (Churchill & Halsey, 2003) seen in Table 1.

Table 1: Supply and demand of mathematics and science teachers in Massachusetts, 2002-03

<i>Subject</i>	FTE[*] Teachers	Teacher Demand		Teacher supply
		Unlicensed FTE[*] Teachers	Teachers New to Profession[*]	MTEL Teacher Tests Passed^ü
Math Middle & High School	4858	642.3	170.4	62
General Science Middle & High School	2146	224.2	59.5	15
Biology High School	883.4	82.4	44.1	59
Chemistry High School	561.4	55.2	17.1	<10 ^{â¸}
Physics High School	367.6	40.1	13.8	<10
Earth Science Middle & High School	469.2	45.3	19.2	<10

The Massachusetts Test for Educator Licensure (MTEL) exam is required for all new teacher licenses in Massachusetts. Therefore, this data suggest that only a third of mathematics teachers newly hired in 2002-03 were licensed. Clearly the situation is similar or worse in chemistry, earth science, general science, and physics. It appears that there is a small over supply of biology teachers. However, this is probably not accurate because of the significant amount of out-of-field teaching and teachers with multiple certifications, e.g., biology and general science. (Ingersoll, 1999; Seastrom, Gruber, Henke, McGrath, & Cohen, 2002). In their report, Seastrom and her colleagues showed that in 1999-2000 almost 70% of middle school students are taught mathematics by teachers who are not certified and do not have a major in mathematics. In the high school grades this is true of just over 30% of math students. The figures are similar in the sciences. In 1999-2000 nearly 60% of middle school students were taught science by teachers not certified and without a major in the field. Less than 30% of high school science students were in a similar situation. While teaching out-of-field had its least impact on high school biology (45%), the large percentages of students in chemistry (61%), earth science (79%), and

* *Source: Data from Massachusetts Department of Education School System Staffing Report, 2002-2003*

^ü *Source: Title II website, October 2003 Massachusetts report, 2002-03 test data*

^{â¸} Counts between 0 and 10 are reported as "less than 10."

physics (67%) suggest that what seems like a surplus of biology teachers is actually part of the supply of out-of-field teachers for the other sciences. Anecdotally, we know that our biology teacher graduates are receiving multiple offers of positions.

Given that there are more than 35 college and universities in Massachusetts that prepare new teachers (Table 2), UMass produces a significant portion of the middle and secondary mathematics and science teachers each year (Table 3). Even so, very few of these new teachers complete the teacher education program as undergraduates. From 1999-02 less than 10% of the new science teachers in Table 3 were undergraduates.

Table 2: Numbers of Massachusetts IHE that prepare mathematics and science teachers (source: MA DOE website).

Subject	Level	Number of institutions
Biology	8-12	33
Chemistry	8-12	26
Earth Science	5-8, 8-12	11
General Science	5-8	11
Physics	8-12	16
Mathematics	8-12	36
Mathematics	5-8	21

Table 3: Production of licensed math and science teachers at UMass (Churchill & Halsey, 2003)

Subject	1999-2000	2000-01	2001-02
Math Middle & High School	5	2	9
General Science Middle & High School	12	8	4
Biology High School	10	7	9
Chemistry High School	1	3	1
Earth Science Middle & High School	0	0	3
Physics High School	1	3	2
Total science	24	21	19

The University of Massachusetts Noyce Scholarship Program (STEM Bridge) is designed to help alleviate this shortage of highly qualified teachers by increasing the production of new teachers who are enrolled as undergraduates in UMass as STEM majors. STEM Bridge will provide scholarships of \$7500 to \$10000 per year to 32 students. Twenty students will receive funding for two academic years, and 12 for one year, for a total of 52

scholarship grants with an average value of \$8173.00. Through its collaboration with local community colleges and the UMass University Without Walls (UWW) the program will recruit non-traditional students including those underrepresented in the STEM disciplines. STEM Bridge has the following features:

- It will provide a total of 52 scholarships to 32 students over a three-year period.
- Twenty to twenty-five more STEM students will complete the teacher education program as undergraduates than would have given historical data.
- It will recruit non-traditional students (community college transfers, UWW students, and teacher aides) into STEM majors and the Secondary Teacher Education Program (STEP).
- It will increase the numbers of mathematics and science teachers from underrepresented groups by targeting three non-traditional groups of students: community college transferees, students enrolled in the UMass University Without Walls (UWW), and a cadre of teachers aides currently or previously employed in Springfield, Holyoke, and other local districts with large African American and Latino populations.
- It will provide a systematic, structured, varied and tested program of new teacher support.
- It builds upon a 25 year long teacher education partnership between the UMass School of Education and surrounding school districts, including those designated by Massachusetts as "high needs" using the federal Department of Education standards.
- It builds upon the nearly 10-year collaboration between the local community colleges and the UMass STEM disciplines that are the result of the NSF-funded STEMTEC project.
- Scholarship students will benefit from the improvement of undergraduate STEM teaching and the creation of special tracks for prospective teachers within the STEM majors that were a result of the NSF-funded STEMTEC project.
- Scholarship students will benefit from the numerous innovations in place at UMass in the use of educational technology.
- In addition to the advising and support system that is a regular part of the UMass teacher education program, scholarship students will receive support through a series of educational and social activities.
- The UMass STEP program is NCATE and state-approved.

Description of the Program

During the three years of the program 32 students will receive scholarships ranging from \$7500-\$10000. Twenty students will receive funding for two academic years, and 12 for one year, for a total of 52 scholarship grants. The scholarships will be distributed according to the schedule in Table 4:

Table 4: STEM Bridge Scholarship Numbers by Year and Class

Year of studies	Grant year 1	Grant year 2	Grant year 3	Total scholarships
Junior	8	12 new scholarships	0 new scholarships	20
Senior	4	8 + 4 new scholarships	12 + 4 new scholarships	32
Number of new scholarship recipients	12	16	4	32
Total scholarships	12	24	16	52

The scholarships will be targeted to UMass undergraduates majoring who are majoring in the STEM disciplines and are either transfer students from community colleges, enrolled in the University Without Walls program, or have been employed as teacher aides. Scholarship recipients will be required to meet or exceed the minimum academic requirements for admission to the UMass Secondary Teacher Education Program (STEP). Seniors receiving scholarships must have been admitted to the STEP program, which also requires students to have passed the Communication and Literacy portions of the Massachusetts Test for Educator Licensure (MTEL).

Undergraduates preparing to be teachers in Massachusetts must major in their subject area or its equivalent. Therefore, teacher education is done in addition to other graduation requirements. Juniors and seniors can accomplish this by enrolling in the Secondary Teacher Education Program. The pre-student teaching course work constitutes a minor in education. It is expected that Noyce Scholarship recipients will have completed three STEP courses or their equivalent by the end of their junior year. Two of these courses also satisfy the University's general education requirements. In spring of the junior year scholarship recipients will apply to STEP. Because the criteria for the scholarship meet or exceed STEP admission criteria, it is expected that scholarship recipients will be admitted to the program as long as they pass the communication and literacy portions of the MTEL.

The Secondary Teacher Education Program

The program for licensure in middle and high school mathematics and science at the University of Massachusetts Amherst is located in the Secondary Teacher Education Program (STEP). STEP is a unit of the Teacher Education and Curriculum Studies (TECS) department of the School of Education. UMass has long been a leader and innovator in the preparation of secondary teachers. The STEP secondary mathematics and science programs draw upon and are in-line with the National Science Education Standards (NRC, 1996), the NCTM standards (NCTM, 2000), and the Massachusetts Curriculum Frameworks (MADOE, 2000, 2001)

UMass was one of the first universities in the state to establish professional development school relationships with local school districts, beginning with East Longmeadow in 1985 and spreading to include Springfield, Holyoke, and Greenfield by the early 1990s. At this time UMass has clinical relationships with five more school districts: Amherst, Easthampton, Gill-Montague, Longmeadow, and Northampton. It has also developed experimental and innovative teacher education programs such as 180 Days in Springfield, the Summer/Fall Option, and the MINT University of Massachusetts/Chicopee/Holyoke teacher education program. The 180 Days program places graduate students in prepracticum and practicum situations in the Springfield Public Schools for an entire school year while they complete the teacher education program. The Summer/Fall Option is a fast track program for post BA/BS students developed as part of the STEMTEC CETP project. They do all of their pre-student teaching education course work during the summer and then student teach in the fall. The MINT program is similar to Summer/Fall but is funded by the Commonwealth of Massachusetts and is targeted at career changers.

Two other programs will be important for STEM Bridge. First, at the request of the Springfield School District, UMass has offered for several years two after-school science courses each semester and summer for middle school teachers. The second is the NSF-funded Science Education Online, a similar set of courses offered online and available anytime, anywhere. Though originally designed to fit the schedules of in-service teachers seeking licensure as middle school science teachers, they will also be very well suited to the needs of many of the UWW students and inner city aides enrolled in the STEP program.

Description of courses and field experiences

All of these programs, including the on-campus academic year program that scholarship recipients will be enrolled in, are based on the same core of education courses. The courses and field experiences are listed in Table 4 and described below.

- The Work of the Middle and High School Teacher

This is the introductory course for STEP. The course objectives are:

1. To introduce prospective teachers to the complexities of the work of teachers;
2. To relate prospective teachers' understanding of the work of teachers to the social and organizational context in which that work occurs; and,
3. To relate the motives and goals for becoming teachers to the reality of the work that middle and high school teachers do.

It includes 24 hours of fieldwork.

Table 4. STEP Program Requirements

Course	Credits
The Work of the Middle and High School Teacher	3
Educational Psychology	3
TEAMS - Tutoring Enrichment Assistance Models for Schools	3
Education and the Law	1
Principles and methods of teaching secondary mathematics OR Principles and methods of teaching secondary science	3
Total course credit	13
Field experiences	Credits
Prepracticum in math or science	2
Student teaching in math or science	12
Student teaching seminar in math or science	2
Total field experience credits	16
Total credits	29

- Educational Psychology

In this course students examine the contributions that psychology makes to educational practice, including: 1) psychological development and with differences between individuals; 2) theories of how humans learn; including behavioral and cognitive theory; 3) cultural and social contributions to education and the general topic of student motivation; and 4) psychological aspects of schooling that influence educational outcomes. The course includes implications of the theories for educational practice.

- TEAMS - Tutoring Enrichment Assistance Models for Schools

TEAMS is a community service teaming project that seeks to promote improved learning and better schools for all students. Its main three objectives are: 1) to think deeply about how we were schooled, 2) to both envision and support how schools might better serve all students; and 3) to provide academic tutoring. TEAMS Tutors are placed in middle and high school classrooms in urban, suburban, and rural communities for 5-6 hours/week. The weekly seminar focuses on key issues in education including identity formation, gender in the classroom, race and racism in schooling, testing and tracking, multicultural schools, and tutoring strategies and scenarios.

- Education and the Law

This seminar course meets five times during the semester and focuses on teachers' rights and responsibilities under the law. Topics include due process, freedom of expression, school rules, discrimination, and harassment.

- Principles and methods of teaching secondary mathematics
- Principles and methods of teaching secondary science

These courses are designed to prepare pre-service middle and high school mathematics and science teachers to become professionals who can guide and facilitate classroom interactions to meet the learning needs of diverse populations of students. The purposes, problems, issues, strategies, and materials in the teaching of mathematics or science at the middle and high school levels are examined critically through classroom discussions, individual and group work, field experiences, class projects, and peer teaching. Students in this course are expected to be active participants in constructivist-fashioned lessons where best practices in secondary teaching are modeled and to participate in debriefing sessions held to analyze the elements needed for success in teaching, learning, and assessing school mathematics or science. The science methods course is taught by PI Feldman and the mathematics methods course by co-PI Sandow.

- Prepracticum in math or science

Students spend six hours per week for one semester engaged in teaching activities under the guidance of a sponsoring teacher in an area middle or high school. Whenever possible the sponsoring teachers are selected because of their use of reform-based pedagogy. An accompanying seminar connects the students' practice with educational theory.

- Student teaching in math or science

Student teachers are placed in either a middle school (grades 5-8) or high school (grades 8-12), to work with a teacher licensed in mathematics or the science subject, and at the level for which they are seeking licensure. Whenever possible the cooperating teachers are selected because of their use of reform-based pedagogy. Student teachers are immersed in the day-to-day activities of a teacher for a full semester including all duty assignments and meetings. It is designed so that student teachers move through a developmental sequence of increasing responsibility that includes observation, small group work, and team teaching, toward the goal of taking the major responsibility (under the guidance of the cooperating teacher) for daily planning, teaching, evaluating, and communicating with parents and other school professionals. The accompanying seminar includes subject matter support groups, professional development, and portfolio development sessions.

- Capstone project

All STEM Bridge scholarship recipients will be required to complete an action research study of teaching and/or learning in their student teaching placement. They will receive instruction in action research and the necessary guidance to complete their studies as part of their teaching methods course and the prepracticum and student teaching seminars. Completed reports will be collected, edited, and disseminated through the Internet.

University Without Walls

The UMass University Without Walls program (UWW) will be a major source of STEM Bridge Scholars. The program, founded in 1971, provides adult students with the opportunity to earn flexible, individually designed B.A. or B.S. degrees that can be interdisciplinary in nature. UWW is based at the UMass Amherst campus, with courses also offered in Springfield. In addition, UWW offers weekend-only courses as well as web-based distance courses. Nearly two thousand students have earned degrees through UWW, and a large number have gone on to earn higher degrees. UWW has three main features that make it unique and attractive to adult learners:

1. Students design individualized degrees. Each student develops a degree plan approved by a faculty sponsor and a UWW team that builds upon his or her strengths. The degree plan reflects a solid foundation in the field of study as well as depth of knowledge.
2. Students may earn credit for learning gained from experience. On average, 20-21 credits are earned for experiential learning, and, while it is not a requirement for the degree, most UWW students participate in the process.
3. Participants in UWW receive extensive support from academic advisors. Each student works with an academic advisor based in the UWW program and with a faculty sponsor based in a discipline closely related to the student's area of study.

Advising

Noyce scholarship recipients will be advised at all stages of their program. All UMass undergraduates are assigned an undergraduate advisor in their major field. UWW students have an advisor who guides them through the program and at least two faculty members from their major field of study who review their portfolios. In addition, all Secondary Teacher Education Students are advised by the faculty member who coordinates their licensure area. Co-PI Sandow advises all secondary mathematics students and PI Feldman advises all secondary science students.

Recruitment

As noted, the program will focus on recruiting community college transfer students and the older, nontraditional students in the UMass University Without Walls (UWW) program and teaching aides. Many of these students come from low income or minority

backgrounds, and might otherwise not be able enter the UMass teacher training programs without the Noyce Scholarships.

UMass has statewide agreements in place that provide a seamless transition from the community colleges to the campus. Furthermore, the STEM Ed Institute has close working relationships arising from the STEMTEC project and its scholarship program with the three nearest community colleges, Greenfield, Holyoke, and Springfield Technical. We will contact the science departments, academic advisors, and transfer offices at all the community colleges and encourage them to nominate promising students. We will provide advising materials and posters, and hold information sessions at the colleges and at UMass for prospective applicants.

UWW serves students who are older than the usual undergraduate cohort and who have had a variety of formal and informal educational experiences before entering the program. UWW advisors work very closely with their students in evaluating past experience and in developing individualized curricula. UWW director Gary Bernhart has assured us that he will make sure that these advisors encourage students with appropriate backgrounds and interests to consider mathematics or science teaching and the Noyce scholarships, and to construct the appropriate programs.

Also, through UWW we will target some scholarships at people now working as aides in the schools. UWW has a program to help them complete their community college associate degrees and then transfer to UMass. They would be ideal candidates for Noyce scholarships, since they are committed to teaching, and often have very low incomes and/or are members of under-represented minority groups.

As noted above, the face-to-face courses offered in Springfield and the Science Education Online courses will be especially important for these students. The UMass Education courses are offered in the late afternoon and evening on the UMass campus, usually with a once a week, three-hour format, so that people who are working can attend them. However, few science courses are offered at those times. The availability of these courses designed specifically for middle school science teachers will make it much easier for them to find the courses they need.

Selection process

A panel of mathematics, science and education faculty members, and the UWW director, Gary Bernhart, will select Noyce Scholarship applicants. The goal will be to select students with the academic ability, motivation, and personal characteristics needed to become exemplary teachers, while doing everything possible to increase teacher diversity. Financial need will determine whether students receive the minimum or maximum amounts allowed by the program.

Massachusetts secondary school teacher licensure requires a major (or its equivalent) in the subject, completion of an approved teacher education program including student teaching, and passing the Massachusetts Test for Educator Licensure (MTEL). This includes two tests of communication skills and a test of content knowledge. The first two are required for formal entry into the UMass Secondary Teacher Education Program (STEP), and the subject matter test is required before beginning student teaching. It will not be practical to require prospective junior scholars to pass the communication tests as a condition of applying, but we will require this for those entering the senior year. We will examine their course records, SAT scores (if available), and a writing sample to insure that those receiving junior year scholarships are likely to pass the exams. Studies of pass/fail data in the past indicate that such records are reliable predictors of success. In addition, review courses will be provided at no cost to the Scholars to prepare them for the exams. No senior will be granted a scholarship who has not taken and passed the communications tests.

Students will be required to meet the minimum academic requirements for admission to the UMass Secondary Teacher Education Program (STEP), and for mathematics, exceed them. Currently this is a recommended minimum GPA of 3.0 for students seeking licensure in secondary science, and 2.75 for those students seeking mathematics licensure. STEM Bridge mathematics candidates will be required to have a minimum GPA of 3.0. STEP students are expected to be either majoring in one of the academic disciplines most closely associated with the licensure area (e.g., the biology major for biology teachers, geology major for earth science teachers, and the mathematics major for math teachers), or to be acquiring the equivalent subject matter knowledge by majoring in a related STEM major and taking additional coursework if needed. Perspective middle school general science teachers can major in the University's interdisciplinary Science Major. Seniors receiving scholarships must have been admitted to the STEP program, which also requires students to have passed the Communication and Literacy portions of the Massachusetts Test for Educator Licensure (MTEL). In addition to these academic and subject matter knowledge requirements, STEP seeks students who demonstrate:

- An interest in and respect for middle and high school age youth.
- An interest and respect for diversity and a willingness to work for an equitable society through education.
- A potential for leadership through teaching.

Management and infrastructure

Co-PI Sternheim is Director of the STEM Education Institute, which will manage the STEM Bridge program. The Institute and its antecedents have managed a variety of professional development programs for pre-service and in-service STEM teachers since 1986. Many of these are highlighted on its web site, www.umassk12.net/stem. The site will provide information and resources for Noyce Scholarship applicants and awardees.

The Institute has administered scholarship programs since 1997 as part of its STEMTEC program. These have been directed by Dr. Sharon Palmer, who has taught at several colleges; she is also a licensed high school chemistry teacher and has taught at the local high school. The Institute has developed procedures for recruiting and evaluating scholarship applications, as well as programs for supporting scholars and providing informal advising to supplement the formal academic advising.

The Institute will take the primary responsibility for recruiting Noyce Scholars. This effort, as described above, will include information for the community college advisors and STEM faculty, and information sessions on the community college campuses and at UMass.

Institute support activities for new teachers are discussed below.

Scholar support

Once students are accepted as Noyce Scholars, they will have a variety of support mechanisms.

- Junior scholarship holders will enroll in a seminar on "Exploring Math and Science Teaching" begun under STEMTEC and targeting students thinking about secondary teaching.
- There will also be two events each semester for all the scholars with a combined academic and social agenda to assist in developing a cohort that will provide mutual support for its members.
- Each Scholar will be assigned a mentor in the department of his or her academic field. The mentor will meet regularly with the student to provide whatever assistance or encouragement is needed and to assure that the student is making good progress.

These activities will supplement the usual support mechanisms in place at the School of Education, including the formal advising structure of the STEP program, and in the students' major departments

New teacher support

New teacher support has been a priority of the STEM Ed Institute since 1997. After considerable experimentation, several components have been identified that actually work and are successful in helping new teachers, as reported by the STEMTEC evaluators.

- The New Teacher Support Group. It meets both in Amherst and in Springfield in order to serve teachers spread over the region. Evening sessions are held once every three weeks. The agenda includes informal conversation, discussion of an

announced topic such as classroom management or assessment of student learning, and a dinner. These are free to teachers who teach science or math and have three years or less experience.

- Science and Engineering Saturday Seminars. Offered six Saturday mornings each semester from 8:30-1, these sessions provide hands-on opportunities to explore interesting topics. Most are taught by UMass faculty. Recent topics include bird biology, bioluminescence, weather radar, global warming, and energy conversions. Part of the funding is provided by the Raytheon Corporation. These are also free unless teachers opt to register for graduate credit and do additional work; then they pay a reduced tuition fee.
- Online seminar. This is a graduate course developed by PI Feldman that explores issues confronting the new teacher.
- Afternoon seminars on STEM education topics. Offered alternate Tuesdays, these talks are offered by local faculty and visitors.
- Master's programs. There are several master's options for science teachers in addition to the conventional UMass M.Ed. The Springfield after-school and the Science Education Online programs are designed for this group, and may be appropriate in whole or in part for students who have not taken those courses as part of their B.S. A new option for teachers pursuing the M.Ed. is to include a research experience in mathematics or the sciences. They do background work in the spring, work as part of a research team in the summer, and develop related curricular materials in the fall. They can earn up to 15 graduate science credits towards the M.Ed.
- While the STEMTEC follow-on grant will end in July 2005, we are committed to continuing these programs with local funding if necessary through the duration of the Noyce grant and for at least one year afterwards.

Evaluation

There are four goals of the evaluation of STEM Bridge:

- 1) Evaluate the effectiveness of STEM Bridge in attracting, preparing, and retaining STEM individuals in teaching.
- 2) Evaluate the effectiveness of Noyce scholarship recipients as teachers.
- 3) Provide formative information for the improvement of the STEM Bridge project.
- 4) Track scholarship recipients during the period in which they are fulfilling their service obligation.

The evaluation plan consists of three main components: data tracking, performance assessment, and formative evaluation. All three components will be carried out under the direction of the UMass Center for Learning, Teaching and School Change. Data tracking

will be done in conjunction with the office of the Director of Teaching, which is responsible for Title II data collection and reporting. These data include demographic information, progress through the program, test scores, and teaching positions during the post-licensure induction phase. This data collection will continue through the end of the obligation period.

Performance assessment is an integral part of the UMass teacher education programs. Performance data is collected at entry into the program, during the prepracticum, during student teaching, and at the end of student teaching. Noyce scholarship recipients will be required to participate in the performance assessment process through the end of their obligation period in order to evaluate their effectiveness of teachers. These data will also be used to conduct a longitudinal study of the early stages of teachers' careers. Their students' standardized test scores will also be examined as a way to measure their effectiveness.

Formative evaluation of the project will occur through an analysis of scholarship recipient surveys, questionnaires and focus groups. Data will also be collected from other stakeholders such as cooperating teachers and school administrators.

Results from prior NSF support

STEM Bridge is a proposal from the UMass School of Education and the Science, Technology, Engineering, and Mathematics Education Institute (STEM Ed). These have outstanding records in teacher education and in promoting effective teaching in science, technology, engineering, and mathematics. They have an equally strong record in effective collaboration with teachers and schools.

PI Allan Feldman is Professor of Science Education and Teacher Education and the STEM Education Institute Associate Director. He coordinates the science education component of the Secondary Teacher Education Program. He is also Chair of the Teacher Education and School Improvement Doctoral Concentration in the School of Education. He is a co-PI on the STEMTEC and STEMTEC II projects described below. In addition, he is a co-PI of *Biogeochemistry of Fe(III) and sulfate reduction in extreme acidic environments*, a \$1.7 million NSF biocomplexity in the environment project. While the major focus of the project is on the bioremediation of acid mine drainage, it has a significant educational research that examines the effect of participation in a scientific research project on the knowledge, beliefs, and practices of secondary science teachers.

Co-PI Morton M. Sternheim is Professor of Physics Emeritus and the STEM Education Institute Director. He is the lead PI of the Science, Technology, Engineering, and Mathematics Education Teacher Education Collaborative (STEMTEC) project. A \$5,580,000 NSF CETP project (cooperative agreement #9653966, 1997-2003), STEMTEC began as an eight-college, seven-school district collaborative dedicated to producing more, better-prepared, and more diverse math and science teachers; subsequently, it expanded to

21 colleges. Nearly 200 math, science, and education college faculty and more than 50 K12 teachers have attended its institutes on reform-based pedagogy. New teacher preparation tracks have been created. A unique feature of STEMTEC is the close and highly effective collaboration among K12 and higher education faculty: K12 faculty serve as pedagogy experts in areas such as cooperative learning and alternative assessment, and college faculty are the experts on content and on research methodology. A 3-year, \$600,000 follow-on grant, STEMTEC II (#DUE0221265, 2003-2005) funds summative evaluation and an innovative new teacher support program which will be expanded to serve the teachers trained under the Noyce fellowships.

Sternheim is also co-PI of an NSF GK-12 grant, STEM Connections (#DGE0139272, 2002-2005; \$1,500,000) which teams GK12 Fellows with inner city middle school teachers; they work together with the students in carrying out original environmental research projects. A request for a renewal will be submitted later this year. In recent years he has also had NASA funding for a Planet Earth summer institute for teachers, Eisenhower funding for teacher enhancement courses in physics and nutrition, and internal UMass grants for the support of outreach activities. He was PI on two earlier NSF middle school teacher enhancement grants to Five Colleges, Inc., the consortium of UMass and its neighboring liberal arts colleges, Amherst, Hampshire, Mount Holyoke, and Smith Colleges. SpaceMet (TPE8850948, \$560,000, 1989-1992) used space science and exploration to get students and teachers excited about science. The 5C5E project (TPE915026, \$880,000, 1992-1995), showed teachers how to help students to conduct their own environmental science research projects. A 1995 PALMS grant to Five Colleges supported a version of the 5C5E program. Both projects involved telecommunications. Initially this involved PC based electronic bulletin boards, but by 1993, this became UMassK12, an Internet service for Massachusetts K12 teacher and students. As a free service, it introduced about 10,000 teachers statewide to the Internet. UMassK12 now continues operation as a low cost Internet service designed for the K12 community. It hosts teacher and student web sites as well as Internet based netcourses for teachers.

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Appointments

1993- Professor, Science and Teacher Education, TECS Department,
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Research Areas: Science Education, Teacher Education and Action Research,
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1984-89 Science Department Chair, Germantown Friends School, Philadelphia, PA.
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