


1999

Annual Report

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II. ANNUAL REPORT

A. 1. STEMTEC Activities and Impact (organized in accordance with the objectives stated in the Cooperative Agreement)

STEMTEC's cooperative agreement with NSF stipulates five central project objectives and a number of sub-objectives (indicated by bullet notations). The following documents how STEMTEC's 1998 and early 1999 activities helped fulfill these objectives, and the impact these activities have had within the Collaborative.

Cooperative Agreement Objective #1: To establish an ongoing collaboration among the Five Colleges Incorporated consortium (the University of Massachusetts at Amherst and Amherst, Hampshire, Mt. Holyoke and Smith Colleges) with the three area community colleges (Springfield Technical, Holyoke and Greenfield Community Colleges) and the neighboring school districts (Springfield, Holyoke, Amherst, Hadley, Northampton, South Hadley, and Franklin County). In order to effect this change the following activities are planned:

- Establish a Management Team to meet monthly to include a Council composed of the 5 Principal Investigators, campus coordinators, mentor teachers and a representative of the evaluation team to provide direct administrative supervision.

➤**1998 Activities and Impact:** During 1998, the STEMTEC Coordinating Council continued to meet on the first Monday evening of each month (excluding the summer and holiday seasons) to make policy decisions, determine programming, and exchange information. Minutes from those meetings is included in *Appendix I*. As noted in Section III of this report, two campus coordinators left the Council (one because of increased departmental responsibilities on her campus, another to enroll in an advanced degree program) and were replaced by counterparts on their campuses. Two of the four K-12 representatives also resigned for personal or professional reasons, and are currently being replaced. With a new out-of-state evaluation team now in place, it is no longer possible for its representative to attend monthly meetings, but information from the evaluation team is regularly communicated to the PIs and shared with the Coordinating Council (and vice versa). In addition to monthly meetings of the Council, the five principal investigators and STEMTEC support staff meet weekly to discuss strategic and tactical issues of importance to the project. Again, summaries of those meetings are provided in *Appendix I*.

Both Council and PI meetings have a significant impact on the structure and programming of the Collaborative. As seen in the appendix summaries, Council members regularly bring important information and ideas from their home campuses that enrich the direction and programming of the project. In turn, members are able to take ideas back to the individual campuses, where STEMTEC faculty shape them to fit unique institutional and departmental structures and cultures. The K-12 representatives on the Council provide important insights into the needs of students preparing to be excellent teachers and ideas about how to fulfill those needs. They also help provide the contacts necessary for arranging teaching experiences for STEMTEC students and help commit local K-12 administrators to the goals of the project. The Council is one of many avenues for disseminating STEMTEC reforms and initiating the institutionalization that will take STEMTEC beyond its initial funding from NSF.

- Establish a Board to meet semiannually to include the Council described [above], deans of the eight campuses involved, and the superintendents of the eight school districts involved to act as an advisory, planning and policy body.

➤**1998 Activities and Impact:** The composition of the STEMTEC Advisory Board has changed somewhat since last year due to personnel changes on the campuses (changes are noted in Section III), but the Board continues to be composed of the campus presidents, deans, and school superintendents in the region. The group also continues to meet semiannually. As noted by the National Visiting Committee in its most recent report, the Board thus far has been underutilized. However, now in its second year of operation, STEMTEC is already beginning to examine important strategies for institutionalizing science and math education reforms on the campuses of the Collaborative. In that examination, the Board looms large since it contains key players in institutional decision-making, administrators positioned to press for continued reform of science and math teaching and quality K-12 teacher preparation. A subcommittee structure for the Board, which would facilitate work on specific strategies for institutionalizing STEMTEC, is currently being discussed by the PIs, the Coordinating Council, and active Board members. More details on these potential subcommittees is provided below in Section D. Updated Strategic Plan.

In addition to the overall advisory Board, a special NSF/STEMTEC Scholarship Advisory Board was established in 1998 to advise and oversee the administration of the new scholarship program. The committee is co-chaired by Dr. Vanessa Rivera, director of the UMass Minority Engineering Program and Interim Assistant Admissions Director at UMass, and Dr. Allen Forsythe, the dean of the Division of Science, Engineering, and Mathematics at Holyoke Community College and a STEMTEC Advisory Board member (other members of the Scholarship Advisory Board are listed in Section III). The committee as a whole serves as a policy-making body for the scholarship program, and two subcommittees are active: the selections subcommittee, which reads applications and selects final recipients, and a public relations subcommittee, which helps solicit applications and publicity for the program. As discussed in other parts of this report, the Scholarship Advisory Board selected 50 recipients in the first round of scholarship nominations and applications, and planned an awards banquet in their honor for the spring of 1999 (see especially *Appendix E* for materials and information related to the scholarship program and selections process).

- Establish a Curriculum Council to meet four times a year to include chairs of the curriculum teams involved with reform, the PIs and a member of the evaluation team to act as a coordinating and review body for course development.

➤**1998 Activities and Impact:** While not as active as the other governing bodies of STEMTEC, the Curriculum Council continues to meet to discuss course development, and its members work with individual curriculum teams on determining needed programming and support for continued reform.

Cooperative Agreement Objective #2: Redesign the curriculum, field experiences and selected science, mathematics, and education courses so as to reflect current research on teaching and learning and to encourage cross disciplinary conversation. Courses will be inquiry-based and interactive in format. Science courses will include hands-on laboratory experiences. In order to effect these changes, the following activities are planned:

- Within the first two years, redesign of ten science and mathematics introductory courses currently taken by students preparing to be teachers; two each in biology, chemistry, geosciences, physics and mathematics.

►**1998 Activities and Impact:** This component of Objective #2 has been met, and more. As discussed in other planning documents and reports, and in Section II.A.5 below, STEMTEC’s approach to course redesign has been shaped by certain realities pertaining to teacher preparation locally and statewide:

- 1) Since 1993, students preparing to be teachers in Massachusetts are required to have majors in content areas other than education. The majority of students preparing to be elementary teachers typically choose majors outside of science fields or mathematics. While STEMTEC hopes to impact that number, the project leadership considers it important that the general education courses prospective elementary teachers take offer a solid grounding in content knowledge and exposure to recommended pedagogical practices. Reforming introductory courses that students preparing to be elementary students take is hence central to STEMTEC’s overall approach to improving teacher preparation.
- 2) Few students preparing to be secondary teachers of math and science make that decision until the advanced stages of their undergraduate career. Unlike prospective elementary teachers, these students are required to have majors in science fields or mathematics to become certified to teach. While they hone content knowledge in upper-division courses, introductory courses which model student-active, inquiry-based methods, include information about teaching as a career, and offer teaching experiences, can be important in the eventual decision to teach.
- 3) Many students in Massachusetts take advantage of a statewide community college system that offers quality courses at an affordable cost. A number of students interested in K-12 teaching careers transfer to four-year programs after taking their introductory courses at local community colleges. Redesigning introductory math and science courses at the two-year colleges in the Collaborative is again critical to better preparing prospective elementary and secondary teachers in the state.
- 4) Students enrolled at one of the Five Colleges, Inc., colleges are able to take courses at any of the colleges through the consortium’s interchange program. Students at Hampshire College and Amherst College, which do not have teacher preparation programs in place, are hence able to become certified through the colleges which do—UMass Amherst, Mount Holyoke College, or Smith College. Students typically take their introductory math and science courses on their home campuses, however. Hence, reforming introductory courses on all campuses of the Collaborative is important in improving the preparation of prospective K-12 teachers.

Through STEMTEC workshops, participation in ongoing support groups or other mechanisms, and collaboration with qualified K-12 faculty in the region, college faculty on all campuses of the Collaborative, and in all disciplines, have now redesigned the introductory courses they teach to make them more student-active and inquiry-based. All courses undergoing significant redesign are listed and described in *Appendix C*. Below, however, we list a few introductory courses within each discipline that are undergoing changes.

BIOLOGY

- BIOL 100: Introductory Biology (UMass, Steve Goodwin)
- BIOL 100L: Introductory Biology Laboratory (UMass, Steve Brewer)
- NS 121Pp: Human Biology: Selected Topics in Medicine (Hampshire, Merle Bruno)
- BIO 103: Biology Today I (Holyoke CC, Erica Bergquist and Win Lavallee)
- MB 102: Principles of Biology (Springfield Technical CC, Bob Dickerman)
- BIO 111: Introduction to Biology (Smith College, Dick Briggs)

CHEMISTRY

- CHEM 102: General Chemistry for Non-Science Majors (UMass, Ev Turner)
- CHEM 121: General Chemistry I (UMass, Bill Vining)
- CHEM 8: Chemistry in the Environment: The Hydrosphere (Amherst College, Dick Fink)
- CHEM 11: Introductory Chemistry (Amherst College, Pat O'Hara)
- CHE 105: Basic Principles of Chemistry (Greenfield CC, Ana Gaillat)
- CHEM 101: General Chemistry I (Holyoke CC, Diane Stengle)
- MC 101: Survey of Chemistry I (Springfield Technical CC, Jack Barocas)
- CHEM111a: Introductory Chemistry (Smith College, Bob Linck)

GEOSCIENCES

- GEO 101: The Earth (UMass, Chris Condit)
- GEO 103: Introductory Oceanography (UMass, Mark Leckie, Laurie Brown, Richard Yuretich)
- NS 107: Evolution of the Earth (Hampshire College, John Reid)
- GEO 11: Principles of Geology (Amherst College, Jack Cheney)
- GEO 101: Physical Geology (Greenfield CC, Dick Little)
- GEO 109: The Environment (Smith College, Amy Rhodes)
- GEO 111a: Introduction to Earth Processes and History (Smith College, Bob Newton)
- GEO 121a: Geology in the Field (Smith College, John Brady)

PHYSICS

- PHYS 100/: Electricity and Magnetism (for teachers)(UMass, Chris Emery and Steve Murray)
597T
- PHYS 119: Motion, Interactions, and Conservation Laws: An Active-Learning Approach to Physics (UMass, Bill Gerace)
- PHYS 131: Introductory Physics I (UMass, Stan Hertzbach and Monroe Rabin)
- PHYS 101: General Physics I (Greenfield CC, Peter Letson)
- SCI 103: Astronomy (Greenfield CC, Toby Sutton)
- PHYS 101: General Physics I (Holyoke CC, Sharma)

MATHEMATICS

- MATH 113: Elementary Algebra (UMass, Donna Bedinelli)
- MATH 113: Mathematics for Elementary Teachers I (UMass, George Avrunin)
- MATH 135: Calculus with Mathematica (UMass, David Hayes)
- MATH 17: Introduction to Statistics (Amherst College, Jim Denton)
- MATH 105: Algebra and Coordinate Geometry I (Greenfield CC, Norman Beebe and Lindy Gougeon)

- MM 123: Math for Early Childhood and Elementary School Teachers (Springfield Technical CC, Lauren Brewer)
- MM 300: Teaching Experiences in Mathematics (Springfield Technical CC, Juan Carlos Jimenez)
- MATH 107: Seminar in Geometry (Mount Holyoke College, Jim Morrow)
- Develop two new courses with a strong technology focus: *"Science, Mathematics and Technology,"* and *"Using Technology in the Science Classroom."*

➤**1998 Activities and Impact:** STEMTEC made progress in 1998 on providing prospective teachers with better preparation for using technology in the classroom. Four courses are being taught by faculty participants in, or associates of, STEMTEC that help prospective teachers think more about using technology effectively in the classroom. All of these courses are available to students at the five colleges through the interchange program.

➤**EDC 333a: Information Technology and Learning**, Smith College. This course is taught by Al Rudnitsky, Professor of Education at Smith College and STEMTEC Cycle I participant. This course is part of Smith's Curriculum and Instruction program and examines the design, use and effects of educational technology. Rudnitsky pays particular attention to how computers can be used to best structure, present and influence learner interaction with information. During the 1998 Summer Institute for Student-Active Teaching, Rudnitsky presented important findings about the enhancement of learning through educational technology and insights he has gleaned from teaching the course. He also exhibited student projects from the course and talked about how they had contributed to learning and especially to prospective teachers' understanding of the potential of technology for their own classrooms.

➤**NS 244: Computers and Science Education**, Hampshire College. This course is co-taught by Merle Bruno (Professor of Natural Sciences and STEMTEC Cycle I participant) and Michelle Murrain. A description of the course comes from their Spring 1998 syllabus: "Computers and the so-called 'information superhighway' are becoming ubiquitous in our environment. It is increasingly important, then, to address the uses of these technologies in the service of education. An increasing number of secondary schools are obtaining computers for students and teachers to use. Few students actually have access to these computers and few teachers have experience using computers for anything other than rote drill. In addition, many schools are becoming connected to the internet, but this does not guarantee that this resource is being used well. It is possible for students to use computers and the internet as active learning tools. In this class, we will read some of the literature on the use of computers in education, as well as some critical literature on the role and utility of networks, and will learn to use and assess the educational potential of a variety of software and the Internet itself." When the course was last taught (spring 1998), two STEMTEC K-12 participants—Diana Campbell, Frontier Regional School Technology Coordinator, and Amy Wolpin, Grades 3-4 teacher at Mark's Meadow—contributed to the course. According to Bruno, STEMTEC support enabled a great K-12 focus for student projects, and also offered ideas for group work.

➤**EDUC 462: Principles and Methods of Teaching Science in the Elementary School**, UMass Amherst. This course is taught by Kathy Davis, assistant professor in the UMass School of Education and a STEMTEC Cycle II participant. While not exclusively focused on

using technology in the science classroom, Davis has a particular interest in the integration of computer technology in science instruction. A central assignment in Davis' course is the completion of group projects investigating questions students have formulated about plant growth. Students formulate their own research questions, collect and analyze field data, and present their findings in a formal presentation to the whole class. Technology is integrated through the use of digital cameras (to collect data and document growth), spreadsheets (for data analysis), and presentation software and hardware. Davis in turn has been collecting data about how this technology integration is working, and particularly how it enhances learning by female students and their better preparation as teachers. STEMTEC has supported the development of this course through the purchase of digital cameras, software, and some graduate assistant support.

➤ **EDUC 615W: Design of Educational Web Sites—Evaluation and Creation,**

UMass Amherst. This course is currently taught by Eric Klopfer, a post-doctoral student of PI Feldman's, who also took part as an observer during the STEMTEC 1997 Summer Institute on Student-Active Teaching. The course is primarily for post-baccalaureate students preparing for certification. While one goal of the course is to teach prospective teachers how to create web pages, a central purpose is to help teachers evaluate how the World Wide Web can be used for a variety of classroom applications and to enhance student learning.

Additionally, a proposal to enhance the use of technology in science classrooms has been submitted to the US Department of Education by Terry Dun (STEMTEC Cycle I Technology Curriculum Team Chair) and Eric Klopfer. Titled "Preparing Tomorrow's Teachers to Use Technology," the proposal would provide approximately \$100,000 per year for developing innovative strategies for incorporating technology use in local preservice teacher training courses and programs. This proposal has been submitted under the umbrella of the UMass STEM Education Institute, directed by PI Sternheim.

- Ultimately effect redesign of at the minimum 74 courses.

➤ **1998 Activities and Impact:** Each college faculty who becomes a participant in STEMTEC is required to effect redesign of at least one course in her or his department or institution. With 107 continuing faculty participants in the project, STEMTEC has met this requirement of the Cooperative Agreement. Of course, the impact of STEMTEC on curricular redesign goes beyond these initial courses. Most STEMTEC faculty report that once they began to reconceptualize the objectives for their "official" STEMTEC course (the course they propose for reform and receive funds to transform) and change their teaching practices, they can't help but repeat this process for most of the other courses they teach as well. One of the STEMTEC Cycle II participants expresses the sentiment of many when asked for a syllabus for his "official" STEMTEC course (a new seminar on beauty and/in mathematics):

This is the syllabus for my current Problem Solving course. This is not my official STEMTEC course but it reflects much of the work we have been doing at STEMTEC. The official STEMTEC course will not be taught until spring 2000. However, I object [to] the entire concept

of an "official STEMTEC course". I believe that we are working on reforming all of our teaching and that it is natural for all of our courses to be [a]ffected to at least some extent. How can we disseminate the ideas to our colleagues if we don't even let it spread throughout our own teaching practices? That said, I hope the attached document will be useful. (Email communication from Dan Radin, math department at Greenfield Community College, March 2, 1999)

Appendix C contains descriptions of all those courses faculty proposed to the STEMTEC leadership for redesign. As seen in the appendix, faculty are experimenting in a range of ways. They are using more interactive techniques, focusing on student active learning and cooperative learning. In particular, small group work is being instituted in many classes. Less time is being spent lecturing and more time doing in-class problems and activities. Changes range from book-end lectures to complete curriculum alterations to a focus on case-/problem-based learning. Reformed classes also include increased opportunities for student feedback on both teaching methodologies and subject-specific topics. There is an increase in the use of videos, CD-ROMs, and other technology designed to enhance learning. The revisions described in the course proposals are being seen by classroom observers and noted in student surveys, as reported in the separate evaluation report.

- Provide field (teaching) experiences as part of the regular science and mathematics curriculum in addition to the prescribed experience in the field.

► **1998 Activities and Impact:** STEMTEC provides teaching experiences through its redesigned courses as a way to interest students in teaching as a career, and as a strategy for providing students already committed to a K-12 teaching career diverse, high-quality teaching experiences. One of the key mechanisms for arranging these field experiences is a system of “want ads” posted on STEMTEC’s home page and advertised in the STEMTEC newsletter. We include below an example of an ad posted by a college instructor interested in a K-12 partner, and an example of another ad posted by a K-12 teacher searching for a college faculty partner. Additional ads are available for viewing on the STEMTEC home page (<http://k12s.phast.umass.edu/~stemtec>).

WANTED: School Partners

Teacher: Julian Tyson, UMass Amherst

Course: CHEM 312, Analytical Chemistry

Collaboration Proposed: Interaction with a K-12 class or classes for non-chemistry science students taking analytical chemistry. K-12 classes wanted for observing and presenting materials related to a chemistry topic. We would also be interested in hosting visits by small classes and having secondary level students “shadow” students in my course.

WANTED: College Partners

Teacher: Jan Demers, Crocker Farm Elementary School

Grade Level: 1st Grade

Collaboration Proposed: My class has received a Community Service Learning grant to help solve the problem of litter on our school grounds. I am looking for a group of 4-6 college students to help teach about recycling and develop activities that demonstrate decomposition rates.

Student survey data collected in the fall of 1998 and analyzed by PI Feldman show that few students are aware of possible teaching experiences through their STEMTEC courses (see separate evaluation report). However, data from tracking actual experiences reported during the spring of 1998 by graduate assistant Tarin Weiss paint a slightly better picture. Then, 21 college faculty and two college staff affiliated with STEMTEC oversaw non-practicum teaching experiences for more than 160 different students. While data from the fall of 1998 and early months of 1999 were not kept in comparable form, a number of faculty arranged teaching experiences for their students. Some of those experiences are listed below by campus:

- **Amherst College:** Students from **Pat O'Hara's** Chemistry 11 class traveled to local schools in Amherst and hosted K-12 students on campus, participating in a number of "hands-on" science activities (Fall 98) (see article in *STEMTREK*, Winter/Spring 1999, *Appendix J*).
- **Greenfield Community College:** **Ana Gaillat's** chemistry student participated in the "Girl's Day in the Lab" program (Spr. 98). **Daniel Radin's** mathematics students are planning individual visits/projects with local elementary schools (Spr. 99). **Toby Sutton's** astronomy students traveled to local schools with a portable, inflatable planetarium (Fall 98).
- **Hampshire College:** **Merle Bruno's** science students taught in teams at local schools (Whately and Sunderland) for 4-6 visits, hosting activities involving chromatography, plants/forestry, and natural dyes (Fall 98). **Charlene D'Avanzo's** ecology students observed and presented topics on a variety of subjects at the elementary, middle, and high school level (Spr. 98). **Debra Martin's** biology students worked with a Smith vocational high school class (Fall 98 and Jan. 99) and will participate in "Girl's Day in the Lab" (Spr. 99).
- **Holyoke Community College:** **Erica Bergquist's** biology students observed and presented topics to students in middle and high schools in the Holyoke area (Spr. 98). **Gerry L'Heureux's** science seminar students and **Win Lavalee's** biology students observed, tutored, and presented topics in pre-K to 12th grade students in the Pioneer Valley, as part of a service learning project (Spr. 98). **Joan Mikalson** is the liaison responsible for matching HCC students with K12 settings.
- **Mount Holyoke College:** **Giulana Davidoff's** algebra students worked with **James McDonald's** Algebra 2 class at STCC, lecturing, peer teaching, and tutoring (Spr. 98, Fall 98). **Mark McMenamain's** biosphere students traveled to the Petrified Sea Gardens and on the Enviro-Lab III research vessel with 7th graders (Fall 98). **James Morrow's** math student assisted and tutored in a high school math class (Jan. 99).
- **Smith College:** Seventeen Smith math and science students assisted in elementary and middle schools (Jan. 99).
- **Springfield Technical Community College:** **Anna Gallo Foss's** anatomy students worked with a bilingual high school science class (Fall 98). **Juan Carlos Jimenez's** math students observed and presented topics to students in middle and high schools (Spr. 98). **James McDonald's** algebra students worked with Mount Holyoke students (see above) (Spr. 98, Fall 98). **Nancy Rapoport** has six interns from STCC working with two teachers in two

Springfield middle schools, directing meaningful science enrichment activities in the classrooms. In May, the students in the middle school classes are invited to a field trip to the STCC biology department. (Spr. 99)

- **University of Massachusetts Amherst:** Students in **Allan Feldman**'s and **Richard Yuretich**'s teaching experiences seminar developed and taught lessons in various schools. **Chris Emery** and **Steve Murray** regularly place their physics students in Amherst and Springfield schools for classroom observation. **George Avrunin** works with **Jan Demer**'s first graders to provide classroom experiences for students in his math course for elementary teachers.

Data from tracking actual experiences during the spring of 1999 may also show more opportunities than perceived by students in STEMTEC courses. The impact of these experiences on enhancing student interest in teaching as a career and providing excellent training opportunities awaits more formal evaluation.

Cooperative Agreement Objective #3: To recruit and retain promising students into the teaching profession, with particular attention to students from underrepresented groups through the development of an "apprentice teacher" program to be offered to students starting in their freshman year. In order to effect these changes the following activities are planned:

- Offer teaching opportunities to all science and mathematics majors as part of regular courses, volunteer activities and/or special seminar courses.
- Increase the number of science and mathematics majors electing to teach through identifying and advertising to all students (including students not identifying themselves as teacher preparation candidates) teaching opportunities in existing science, mathematics, technology courses and programs throughout the participating institutions.

➤**1998 Activities and Impact:** In addition to the activities already discussed, NSM/EDUC 197A: Exploring Math and Science Teaching, a seminar at UMass being taught by co-PIs Feldman and Yuretich, is open to all students through the five college interchange. The spring semester of 1999 marks the third semester the course has been offered. The course typically enrolls approximately 10 students, and supplies three things important to attracting and training good teachers: readings about, and activities which model, recommended pedagogical practices; opportunities to participate and present lessons in local K-12 classrooms; and in-class interaction with experienced K-12 teachers, who co-teach with Feldman and Yuretich approximately every other week. No formal evaluation of the impact of this course on student's career aspirations or training has yet been made, but the course is successful in attracting science and math majors at UMass with high GPAs who are just beginning to think about a teaching career.

At the community colleges, courses are being developed with a particular eye to student representation. For example, at Springfield Technical Community College, Juan Carlos Jimenez has developed and is teaching MM300: Teaching Experience in Mathematics. This course provides STCC students with an opportunity to be a teaching assistant in the Springfield elementary and middle schools. Jimenez covers principles of instructional design, instructional methods, instructional technology and models of assessment in seminar before students teach their lessons. Additionally, credit courses modeled after NSM/EDUC 197A are being discussed

on some of the other campuses of the Collaborative (for example, Gerry L'Heureux and Kate Maiolatesi are developing a course proposal at Holyoke Community College).

Opportunities for students to gain teaching experiences outside established college or K-12 classrooms are also being developed. For example, Toby Sutton, an astronomer at Greenfield Community College, used STEMTEC funds to help purchase a portable planetarium. He has now trained approximately a half dozen students (including a STEMTEC scholarship recipient) to operate the planetarium. He and the students are using the planetarium in after-school programs and at other events around the region. Additionally, each of the eight campuses has an office devoted at least partly to community-based learning experiences for its students, and Five Colleges, Inc., has begun to examine ways to enhance community-based learning across the collaborative. Through continued and growing collaboration with these offices, STEMTEC hopes to increase opportunities for informal science teaching experiences as well.

Peer tutoring is happening in a number of STEMTEC courses, in a variety of ways. Of course, many of the pedagogical practices STEMTEC recommends and models in workshops place peer tutoring at their core. Think-pair-share, for example, depends fundamentally on peer tutoring. In addition to the peer teaching that goes on in formal and informal groups, a number of faculty have asked students from previous semesters—exceptional students who express a possible interest in teaching—to return to their STEMTEC courses to serve as teaching assistants. Some faculty have also encouraged students to set up “learning circles” outside of class where peer tutoring can take place. In the geology department at UMass, a new credit-bearing course, GEO 497A, has been established as an opportunity for peer tutoring.

A key mechanism for attracting students to science and math teaching is the award of scholarships. The first round of awards occurred in January 1999. Fifty students representing all eight colleges within the Collaborative received scholarships ranging from \$1,000-\$5,000. Seven of these students were designated “Distinguished Teaching Scholars” for their exceptional academic merit and commitment to a K-12 teaching career. The majority of the scholarship recipients are math and science majors interested in secondary level teaching. The second round of scholarship nominations and applications is occurring during the spring of 1999. All scholarship recipients are required to have college faculty or K-12 mentors, engage in pre-practicum teaching experiences, and attend various events sponsored by STEMTEC. On February 26, 1999, a banquet was held celebrating the first scholarship recipients and their accomplishments. A list of the first recipients is included in *Appendix E*, along with scholarship application materials and other scholarship-related documents.

STEMTEC information sessions are now held every semester on each campus by Student Services Director Palmer. These sessions offer a range of information, from how to achieve teacher certification, to scholarship requirements, to STEMTEC courses students can register for, to teaching opportunities available to all students. In addition to these campus sessions held each semester, STEMTEC sets up information booths at special events (e.g., a Forum on Academic Affairs on September 18, 1998, the Majors Fair on November 10, 1998, and the Campus Career Fair on February 17, 1999, all at UMass). Tables are also set up on the UMass Campus Center concourse for distributing information about STEMTEC scholarships and courses. Additionally, advertisements for STEMTEC courses are sent to all eight campuses to be posted, included in newsletters, and stuffed in faculty and student mailboxes. At the

university, an ad is being taken out in the student newspaper, *The Daily Collegian*, immediately prior to pre-registration.

Finally, a one-year certification program at the university has been developed by PI Feldman. Comprised of existing courses, but offered in such a way that students can complete the program in two semesters and a summer, STEMTEC's leadership anticipates that this program will be very attractive to post-baccalaureate students interested in teaching who shy away from a two-year graduate school commitment.

- Establish a set of K-12 teachers and science and mathematics faculty to act as mentors (ten in year one, fifty in subsequent years) to help students in their teaching experiences, write reflective papers on these experiences and help these students appreciate the value of a teaching career.

➤**1998 Activities and Impact:** As indicated in the *Year 1 Annual Report*, the proposed distinction between “Curriculum Scholars” (K-12 teachers appointed to continuing disciplinary teams) and “Mentors” (K-12 teachers serving as “point persons” for identifying and arranging pre-practicum teaching experiences) proved awkward and was eliminated (see p. 42 of the earlier report). This elimination was approved by NSF both substantively and budgetarily. However, a sizable number of K-12 faculty are available to STEMTEC undergraduates. Forty-eight different K-12 faculty have been participants in STEMTEC Cycle I, II, and Winter Series workshops. These faculty were selected for their reputations as skilled teachers familiar with constructivist pedagogy. They not only served as important advisors about student-active and inquiry-based pedagogy for college faculty in the workshops, they continue to serve as mentors or potential mentors for undergraduates interested in pre-practicum teaching experiences. STEMTEC teachers participate regularly in PI Feldman's and Yuretich's seminar on math and science teaching. In addition to this core set of mentors, the project leadership has connections to teachers through its other associations (e.g., PALMS, the NASA Planet Earth project, the UMass School of Education doctoral program) who also provide mentoring. At Smith College, undergraduates are provided teaching experiences through a January internship program coordinated by Casey Clark, STEMTEC's campus coordinator there. Additionally, a number of faculty requested funds in their course revision budgets for supporting teaching experiences in K-12 classrooms and for bringing K-12 teachers in as speakers to college courses. College faculty are not restricted to working with STEMTEC teachers. Indeed, a number of the cooperating teachers have been unable to participate in STEMTEC workshops, and hence are not “official” STEMTEC participants. However, they are typically sought after by college faculty because of their excellent reputations and their past associations with the public and private colleges in the area. For example, Pat O'Hara, Amherst College, works closely with two excellent, but non-STEMTEC faculty, Roger Wallace of the Amherst regional schools and Julie Jones of the local Montessori school.

- Monitor the progress of students who have such teaching experiences to determine the effectiveness of such experiences as a recruiting aid for new teacher candidates.

➤**1998 Activities and Impact:** See discussion above under Cooperative Agreement Objective #2.

- Establish a tracking system to identify, early in their academic career, all students preparing to be teachers and monitor for those who do elect to teach.

➤**1998 Activities and Impact:** Because prospective teachers in Massachusetts are required to obtain a major in a content field (rather than a major in education), they are often difficult to identify, especially early in their academic careers. This is especially true for math and science majors potentially interested in secondary level teaching. The problem of identifying even prospective early childhood and elementary teachers is compounded by the fact that at most of the institutions within the Collaborative, students don't declare a major until the last semester of their sophomore year. At UMass, of course, the problem is complicated even more by its huge size. However, data collected from the STEMTEC student surveys distributed during 1998 suggest that many students taking STEMTEC introductory courses are interested in teaching as a career. In Spring and Fall 1998, approximately 14% of students completing a course survey indicated an interest in both science (or math) and teaching. This suggests a sizeable number of students available for tracking. Of course, tracking the STEMTEC/NSF scholars is a task that will now begin to occur with the first round of recipients. Strategies for tracking all other students preparing to be teachers within the Collaborative, and monitoring for those who do elect to teach, await development. The leadership team will be working with education departments and central campus administrators to help identify prospective teachers in ways that do not violate student privacy. Additionally, contact will be made with the other CETPs, especially those in states where liberal arts majors are required for certification, about how they track and monitor prospective teachers.

- Recruit heavily from local high schools and among current science, mathematics, engineering and technology majors.

➤**1998 Activities and Impact:** High school recruitment has been accomplished thus far by the high school teachers and administrators involved in our project, who provide information about teaching, certification, and STEMTEC undergraduate courses to other teachers at their high school, guidance counselors, and, of course, students themselves. Several other major activities occurred in 1998, however, to enhance STEMTEC's impact on high school recruitment to careers in math and science education. First, STEMTEC established 10 scholarships of \$1,000 per year to be given to high school students around the region. Because the first scholarship awards were made for the spring semester of 1999 only, no scholarships were awarded for entering college students. However, nominations for, and applications from, potential high school recipients are currently being solicited, and will be for the remaining years of the grant. Second, Student Services Director Palmer provided regional guidance counselors, principals and superintendents, and PALMS teacher-leaders with information about STEMTEC, and special brochures to be distributed at local and regional high school are currently under production. Additionally, information on teaching and the STEMTEC scholarships was made available at the Science Days held at UMass for regional high school students (October 27-29, 1998). During the spring of 1999, current scholarship recipients will be visiting their high schools or high schools in the region to talk about STEMTEC and the teaching scholarships.

- Increase the number of women and minorities preparing to be science and mathematics teachers especially those living in inner cities and poor rural areas. Targets are 20% minority representation in students preparing to be science and mathematics teachers by year 3.

➤**1998 Activities and Impact:** See A.II.9 below.

- Support novice teachers through a system of mentor teachers, PALMS teacher leaders, email and internet access, semiannual meetings of program graduates, and offering a graduate seminar in education for new science and mathematics teachers.

➤**1998 Activities and Impact:** During 1998 and early 1999, all the school districts in the Pioneer Valley were contacted to identify new math and science teachers this fall. Ninety-three new teachers were added to STEMTEC's existing database, bringing the total number of local new teachers identified since Fall 1997 to over 180. All the new teachers identified were sent a mailing with information about STEMTEC and the potential services provided by the project. Mentors and free email accounts were also made available to all new teachers who desired them. Additionally, three workshops were provided for new teachers: 1) on February 12, 1998, Cara Turner, a UMass School of Education doctoral student, led a workshop on classroom management at UMass Amherst; 2) on October 15, 1998, she led another workshop on classroom management and was joined by Shirley Gilfether of the Hampshire Educational Collaborative, who provided the new teachers with information about the PALMS library; and 3) on February 25, 1999, Sandra Rhoades (math professor, Keene State) led a workshop titled "Waking Them Up: Ways to Involve Students During Math Class." Other workshops planned for the spring of 1999 include a session with Judith Young, an astronomy professor at UMass, who will talk about the potential K-12 pedagogical applications of her recent "Sun Wheel Project," and a field trip to the rock park developed by STEMTEC Cycle I participant Dick Little as part of his STEMTEC activities.

Cooperative Agreement Objective #4: Establish mechanisms to enable the science, mathematics and engineering faculty and mentor teachers to continually learn about and implement new techniques in pedagogy. In order to effect these changes, the following activities are planned:

- Establish two cycles of faculty, K-12 workshops in years one and two. Cycle I will have a three-week summer workshop in year 1, academic year follow-up sessions, and one week followup workshops in summers 2 and 3. Cycle 2 will follow a similar sequence one year later. The focus of the workshops is course redesign.
 - Recruiting at a minimum eighty mathematics, science, engineering or technology faculty.
 - Conduct campus-wide and multi-campus seminars, and workshops to encourage faculty to implement STEMTEC findings and successes.

➤**1998 Activities and Impact:** 1998 concluded the establishment of, and induction into, two cycles of faculty participating in summer institutes on course redesign. Cycle I consisted of 42 college and 14 K-12 faculty working in six disciplinary teams (biology, chemistry, geology, math, physics, and technology). This group attended the two-week summer workshop held July 14-25, 1997, and was joined for three days of that workshop by 14 additional K-12 mentors. During the summer of 1998, Cycle I reconvened from July 7-10 at Amherst College for a follow-up workshop. Cycle I also attended one-day follow-up workshops in February 1998, September 1998, and February 1999. Participants in Cycle I are listed in *Appendix A*. The programs for the 1998 summer recall and the academic year follow-ups are included in *Appendix B*.

Cycle II consisted of 43 college and 16 K-12 faculty working in five disciplinary teams (no technology team was recruited for the second cycle). This group attended a two-week summer workshop held July 13-24, 1998, and one-day academic year workshops in September 1998 and February 1999. Participants in Cycle II are listed in III.Changes in STEMTEC Participation, and the workshop programs for the 1998 Summer Institute on Student-Active Learning and follow-ups they attended are included in *Appendix B*.

A third cycle of faculty, not included in the Cooperative Agreement but considered important in spreading STEMTEC reforms to faculty unable to attend summer institutes, was also recruited in 1998. Known as the STEMTEC Winter Series Cycle, this group consisted of 23 college and 13 K-12 faculty. The Winter Series consisted of 6 days of workshops and concluded in April 1998. Participants are listed in *Appendix A*, and the workshop program is included in *Appendix B*.

In all, 108 science, math, technology, and engineering faculty from all eight institutions within the Collaborative have been recruited as participants in STEMTEC. A total of 34 days of workshops have been directly provided by STEMTEC to college faculty, and several other workshops have been indirectly provided through STEMTEC's organizational parent and affiliate, the STEM Education Institute, or another affiliate, UMassK12 (these include workshops on HTML, a workshop by Barbara Tewksbury (NVC member) in February 1998, and a workshop by Sandra Rhoades (Professor of Math, Keene State) in February 1999).

Continuing through 1998 and the first of 1999 are the STEMTEC Roundtables. The Roundtable meets once a month at Five Colleges, Inc. The past several Roundtables have focused on assessment, dissemination, and issues surrounding women and minorities in math and science. The Roundtables are attended by a rotating group of college and K-12 STEMTEC faculty. Attendance ranges from 12-25 per session. In addition to providing a small and supportive environment for faculty to discuss their ideas and problems surrounding reform, working groups (such as a subcommittee on women and minorities in math and science) occasionally develop out of these meetings.

Also continuing are the STEMTalks jointly sponsored with the STEM Education Institute at UMass. These talks are held on alternating Tuesdays and bring a range of speakers to campus to address issues of math and science education reform and teacher preparation. Both college and K-12 faculty attend the talks. Attendance ranges from 15-30 per talk. A list of 1998-99 STEMTalks is included in *Appendix D*.

Finally, a number of seminars designed to disseminate STEMTEC ideas and strategies, developed or co-sponsored by STEMTEC faculty, have occurred on the various campuses of the Collaborative. These campus-based seminars or workshops are viewed as key to institutionalizing STEMTEC on the eight campuses of the Collaborative. With the bulk of centrally-coordinated and -administered STEMTEC workshops now completed, the project leadership will encourage and support such other seminars and workshops. Campus-based seminars are discussed in greater detail in A.II.6. below.

Cooperative Agreement Objective #5: Establish dissemination mechanisms.

- In collaboration with Continental Cable Corporation, produce a video highlighting good teaching practices in science and mathematics.

➤ **1998 Activities and Impact:** In March of 1998, STEMTEC contracted with Spectrum Media of Boston to produce a video highlighting good teaching practices in science and mathematics. (The PIs made the decision to contract with Spectrum Media rather than MediaOne—formerly Continental Cable Corporation—because the former has produced prize-winning science education videos in the past.) The treatment for the video, tentatively titled *How Change Happens*, is included at the beginning of *Appendix J*. The videographers completed three days of shooting in 1998; the two final days of shooting are planned for the spring of 1999. Release of the video is currently planned for late summer or early fall, 1999. For additional information about the video, please see Section II.A.6. below on dissemination and public awareness strategies.

- In years 3 and 4 hold regional and state workshops for faculty and teachers from institutions not, at that time, part of the collaborative.

➤ **1998 Activities and Impact:** Genuine progress in planning for the 1999 STEMTEC/Massachusetts Summer Institute on Student-Active Learning was made in 1998 and early 1999. Three meetings were held to facilitate the planning process: June 3, 1998, at Five Colleges, Inc., Amherst; November 11, 1998, at UMass Medical School, Worcester; and February 15, 1999, at the Publick House, Sturbridge. At the meeting on November 11, one subcommittee was formed to develop and help plan the 1999 summer workshop, and another was formed to think about academic year collaborations. Additionally, several faculty agreed to serve as contacts and/or liaisons for their campus. (Statewide subcommittee members are listed in Section III.) At the February 15 meeting, the summer workshop planning subcommittee met to help finalize a workshop schedule (see *Appendix G* for the current working model). The 1999 summer workshop will be held from July 18-23 at the University of Massachusetts Amherst. STEMTEC participants who meet monthly to talk about best practices in workshop leadership (the group is referred to colloquially as the “train the trainers” group) will help lead sessions of the statewide summer workshop. Additional details about planning for the statewide workshops and their potential impact are provided below in II.A.3. and II.A.6.

While the impact of these activities will be impossible to ascertain until the workshops actually occur, STEMTEC is attempting to include in the workshops teams of faculty from colleges in the state which produce fairly significant numbers of teachers. And while interpreting results of the newly-instituted Massachusetts Teacher Tests (required of all individuals now seeking certification in the state) is problematic, STEMTEC hopes to reach campuses where prospective students are having some difficulty passing the test, particularly the science and math subject tests. (For additional information about the statewide dissemination effort, see II.A.3 below, and *Appendix G*.)

- Host an international conference to highlight best practices developed through STEMTEC.

➤ **1998 Activities and Impact:** The international conference is scheduled for the final summer of the grant. Preliminary planning will begin during the late summer or early fall of 1999.

- Publish in discipline centered periodicals such as Science and The American Scientist and present at the annual meeting of discipline centered professional societies as well as publish in more education oriented publications.

►**1998 Activities and Impact:** Approximately 15 publications or conference presentations were produced by STEMTEC faculty in 1998. These publications and presentations, along with other dissemination activities, are discussed at greater length in II.A.6. below. Now in its second year, STEMTEC is encouraging faculty to disseminate their work by helping identify potential publication outlets and conference sessions on pedagogy, and by providing financial support for travel to conferences.

As publications and presentations outside the Collaborative increase, the leadership team and evaluators will begin to more directly monitor the impact of dissemination efforts by faculty. Anecdotal evidence suggests that the impact is significant, and often has unintended positive consequences. For example, a team of STEMTEC faculty attended the Mathematics Education Reform conference in Chicago in May 1998 to present some of their ideas for course revision. The team was comprised of Margaret Robinson, the 1997-98 STEMTEC campus coordinator from Mount Holyoke and a professor of math; Lauren Brewer, a math professor at Springfield Technical Community College and the chair of the Cycle I math curriculum team; and Amy Wolpin, a 3rd and 4th grade teacher at the local Mark's Meadow elementary school and a STEMTEC Cycle I math team participant. While the audience benefited from the course innovations presented by the STEMTEC team, conference attendees were most intrigued by the team's composition and the collaboration it implied. This kind of partnership—a full professor from a private women's college, a junior faculty member from a community college, and an elementary school teacher—isn't unique within STEMTEC. However, because it's fairly atypical in the larger worlds of higher and K-12 education, the STEMTEC team was able to offer insights into what's necessary for authentic reform along the K-16 continuum. Feedback that STEMTEC faculty and staff are receiving at other conferences suggests the project is beginning to impact educators' views of other things: how inquiry-based learning can be incorporated in even very large lecture classes (Mark Leckie's and Richard Yuretich's October 1998 presentation); how list serves can be effectively used to make courses more student-active (John Clement's and Samia Khan's November 1998 talk); and how field trips which produce data for undergraduate inquiry and research can be taken in a student's own dorm room (Chris Condit's various exhibits of his interactive CD-ROM on the geography and geology of the Connecticut Valley).

II. A. 2. Accomplishments Compared to Strategic Plan Milestones

STEMTEC reached most of the milestones it set for itself in its updated 1998 strategic plan. Below, we list the milestones the project reached during 1998 or early 1999, and then list and discuss those milestones yet to be reached (or not reached in precisely the way we planned).

Curriculum and Faculty Development:

- Offer approximately 45 revised science and math courses on the eight campuses of the collaborative during the spring semester 1998 (January-May)
- Finish recruiting college and K-12 participants for Cycle II (Summer 1998 workshop cycle) (March)
- Hold the introductory meeting for Cycle II participants (April 4)

- Complete the Winter Series workshops (April 25)
- Plan the summer follow-up workshop for Cycle I participants and the two-week Cycle II workshop (March-June)
- Hold the summer follow-up workshop for Cycle I (July 7-10)
- Hold the summer Cycle II workshop (July 13-24)
- Evaluate requests from Cycle II college faculty for course development mini-grants (July-September)
- Hold a fall plenary for Cycle I and Cycle II participants (September 12)
- Continue to hold monthly STEMTEC Roundtables at the Five Colleges consortium (January-May, September-December)
- Continue to co-sponsor with the STEM Education Institute a bi-monthly lecture series and half- and full-day workshops on math and science education for STEMTEC and non-STEMTEC faculty (January-May, September-December)
- Continue weekly, bi-monthly, and monthly campus-based support groups for faculty (January-May, September-December)

Curriculum and Faculty Development Milestones Not Reached

- Offer approximately 90 revised science and math courses during the fall semester of 1998 (September-December). This milestone was inaccurately described in the project's most recent strategic plan. The number 90 was based on the assumption that the addition of approximately 45 Cycle II faculty would double the number of STEMTEC courses offered. This is inaccurate for two reasons: the courses offered by Winter Series faculty weren't included in the calculation, and even the anticipated doubling effect created by the addition of Cycle II courses should have been divided between the fall 1998 and spring 1999 semesters. In fact, 58 STEMTEC courses offered by Cycle I, II, and Winter Series faculty were offered in the fall of 1998 and 51 this spring.
- Evaluate the Winter Series and determine its feasibility in future years (May). The Winter Series was evaluated via PI and staff discussions with several participant focus groups on April 25, 1998 (see the separate evaluation report). Initial analyses of the data suggest that an academic-year series of workshops was a productive use of resources, offering those unable to attend longer summer workshops exposure to recommended pedagogical practices and enhancing the critical mass necessary for transforming departments and institutions. However, the feasibility of holding additional series of academic-year workshops awaits two further accomplishments over the next year or so: analysis of data collected by the new external evaluators that will help determine whether Winter Series faculty were as effective at course redesign as those attending the summer institutes; and continued analysis of budgetary needs and the availability of funds.
- Continue to offer formative evaluation through the UMass Center for Teaching, and to train faculty in self-assessment techniques (January-December). STEMTEC ceased its formal association with the UMass Center for Teaching (CFT) in May 1998, finding that the MAPs (Mid-Term Assessment Project) used by CFT was not sufficient for assisting faculty attempting cutting-edge reforms in their science and math courses. The final report of CFT was included in the *Year 1 Evaluation Report*. Their function has been taken over by PI Feldman and his doctoral student Brenda Capobianco. The services provided by Feldman and Capobianco are described in greater detail in the separate evaluation report, but briefly, ten faculty went through extensive formative evaluations in the fall of 1998, and this spring, 12 are signed up for formative evaluations, with six of those completed as of this writing. Additionally, on January 19, 1999, Feldman and Capobianco offered faculty a workshop on self-assessment techniques. Held at UMass Amherst, and attended by approximately ten faculty from various campuses within the Collaborative, Feldman and Capobianco are offering a second workshop on April 7, 1999.

Recruiting and Preparing Future Teachers:

- Submit proposal to NSF to fund STEMTEC Teaching Scholarships (January)
- Scholarship proposal review decision due from NSF (March)
- Meet with the eight campus financial aid offices to work out details of awarding and administering STEMTEC Teaching Scholarships (March)
- Appoint a STEMTEC Teaching Scholarship Advisory Board (to advise on scholarship policies and serve as selection body for scholarship recipients) (March-May)
- Develop publicity, nomination and application forms for STEMTEC Teaching Scholarships (March-May)
- Select first cohort of STEMTEC Teaching Scholars (September)
- Teach new undergraduate seminar, NSM/EDUC 197A, “Exploring Teaching In Science and Mathematics” (Spring and Fall semesters)
- Continue to work directly with STEMTEC teacher/mentors to provide and advertise teaching experiences not connected to specific STEMTEC courses (January-December)
- Examine the feasibility of a Five College Teacher education program in mathematics and the sciences (March-September)
- Examine the feasibility of concentrations or minors in science and math education at the four-year colleges in the Collaborative (March-September)
- Work with the two-year colleges on individual proposals for “science education transfer options” (March-September)
- Continue to develop connections with local organizations (e.g., science museums, environmental groups, astronomy clubs) that might offer student internships or other “informal” science teaching opportunities (January-December)

Recruiting and Preparing Future Teachers Milestones Not Reached

- Work with elementary and secondary teacher preparation advisors to guide students toward STEMTEC courses (January-December). Significant progress has been made in identifying the relevant advisors with whom STEMTEC should work on the various campuses of the Collaborative, but work remains to be done in meeting with these contacts and providing them with useful advising materials. Currently, all STEMTEC courses are listed on the project’s web page and advertised through a variety of venues on all eight campuses. Preliminary and anecdotal evidence suggests that these methods, along with simple word-of-mouth, have been effective in attracting students to reformed science and math courses. This will continue to be an important objective in 1999.
- Continue to connect STEMTEC college and K-12 faculty interested in incorporating teaching experiences through a system of home page “want ads” and Tarin Weiss, the graduate RA responsible for facilitating STEMTEC teaching experiences (January-December). The “want ads” continue to function as planned, but Tarin Weiss (PI Feldman’s RA) no longer helps facilitate teaching experiences (she is on extended family leave). This is now done by Sharon Palmer, the STEMTEC Student Services Director, and a new graduate assistant, Erica Wilson.
- Develop a “peer mentoring” workshop for interested students enrolled in STEMTEC courses (September-October). This workshop has not yet occurred.

Supporting New In-Service Teachers:

- A workshop on classroom management (February)
- Compilation of a list of all new math and science teachers hired for the 1998-99 academic year (September)
- Continue to provide a mentor for all new math and science teachers who desire a mentor (September-October)

- Continue to provide Internet accounts on UMassK12 for all new teachers who need access (September-October)
- A fall workshop for new teachers (October)
- Compilation and continued maintenance of a list of science and mathematics courses taught at the eight campuses at times when teachers can take them (April-December).

Supporting New In-Service Teachers Milestones Not Reached

- Development and implementation of a new course that relates directly to teachers' current practice and to be part of the Standard Certification program at UMass, "Teaching Science and Mathematics in Schools" (January-May; first offered fall 1998). This course is still in the developmental stages. In the meantime, PI Feldman has modified his EDUC 611: Recent Issues in Science Education as an intermediary step before offering the new course.

Evaluation:

- Assess evaluation strategies employed during 1997 for purposes of reformulating evaluation plan (March-May)
- Develop and implement workshops to assist faculty in conducting their own formative assessment practices (March-December)
- Continue case studies of effective practices, examining in-depth two courses in the spring semester and two in the fall (January-December)
- Continue organizational documentation, analyzing data collected from PI interviews and completing interviews with campus coordinators about their role in STEMTEC (January-December).
- Continue formative assessment of STEMTEC activities (January-December)
- Continue collection of NSF Impact Data (January-December)
- Continue collection and analysis of Student Demographic Information and Career Interest data, using revised survey forms (January-May, September-December)
- Conduct classroom observations in a number of STEMTEC courses (January-May)
- Continue tracking students participating in STEMTEC K-12 teaching opportunities, documenting the impact of such experiences (January-May, September-December)
- Continue distribution to STEMTEC PIs and faculty of summary reports of evaluation team (January-December)

Evaluation Milestones Not Reached

- Work with STEMTEC headquarters in developing better strategies for identifying potential future teachers on the different campuses of the Collaborative (May-December). As discussed in the separate evaluation document, the evaluation manager employed by the UMass Donahue Institute to work directly with STEMTEC was terminated in May 1998, and the services of the Donahue Institute as a whole were terminated in October 1998. While the new external evaluators will not play a central role in developing strategies for identifying potential future teachers in the Collaborative (outside of enrollment in formal programs), this remains an important goal for STEMTEC. Scholarship applications since October 1998 have helped identify talented math and science undergraduates contemplating a K-12 teaching career but not yet involved in certification pathways. However, the project hopes to develop additional strategies in 1999 for targeting individual students who could benefit from enrolling in STEMTEC courses and receiving other STEMTEC services.
- Continue formative course evaluations through the UMass Center for Teaching (January-May, September-December). See Curriculum and Faculty Development Milestones Not Reached above.

Dissemination:

- Workshops on dissemination at the follow-up Summer Institute for Cycle I faculty (July)
- “Train the trainer” workshops to produce local leaders of workshops on math and science education reform (September-December)
- Accelerated distribution of travel funds to regional and national conferences for faculty presenting papers on course redesign and educational reform (July-December)
- Encouraging faculty, and providing support where possible, to submit articles for publication in refereed and non-refereed outlets (January-December)
- Continued development, maintenance, and advertisement of a list of potential outlets for faculty presentations concerning STEMTEC reforms (January-December)
- Begin conceptual and storyboard work on a 20-minute STEMTEC video (February-August)
- Begin production work (filming) for STEMTEC video (September-December)
- Continued maintenance and development of the STEMTEC home page
- Hold a conference co-sponsored with DOE/PALMS on math and science education reform in Massachusetts (April)
- Continued advertisement of STEMTEC courses in student newspapers, admissions offices, and posters on the various campuses of the Collaborative (January-December)

Dissemination Milestones Not Reached

- Publication of the inaugural issue of the STEMTEC newsletter, *STEMTREK* (March), and next semi-annual issue in Fall 1998. Two issues of *STEMTREK* have now appeared (see *Appendix J*) but the second issue was published in March 1999.

II. A. 3. The Nature of Inter-and Intra-Institutional Collaborations Effected

STEMTEC collaborations occur on various levels. The STEMTEC collaborative includes eight colleges and the adjoining school districts. However, Massachusetts has close to 60 public and private colleges that train teachers. To the extent consistent with our resources, STEMTEC is committed to aiding these programs in improving their preparation of science and mathematics teachers. The new statewide program is discussed at the end of this section.

The STEMTEC collaborative is rich in diversity and interconnections. It includes the five colleges that comprise the Five Colleges consortium – the University of Massachusetts Amherst, and Amherst, Hampshire, Mount Holyoke, and Smith Colleges. It also includes the three area community colleges, Greenfield (GCC), Holyoke (HCC), and Springfield Technical Community Colleges (STCC). At the K12 level, it includes the neighboring school districts in Hampshire, Hamden, and Franklin County.

The furthest sites in the collaborative are an hour apart by car, facilitating joint activities. Nevertheless, despite the compact geography, there are greater differences than one might expect. And, despite a long history of cooperation among the participating institutions, making the collaborative function has both rewards and costs.

Five Colleges, Inc. was formally incorporated in 1965, but cooperation among its members began even earlier. Cooperation among four private liberal arts colleges (actually three until the founding of Hampshire College in 1970) and a public research university was then and remains today a beneficial albeit unusual arrangement. The cooperation ranges from Five College departments such as Astronomy to the opportunity for students to cross register, to use all the library resources, and to ride free buses linking the campuses.

It is important to note that each institution has a very distinct identity, with its own traditions and agendas. Amherst is noted for its excellent undergraduate science and math programs. Mount Holyoke and Smith are women's colleges with records of accomplishment in attracting young women to science and mathematics careers. Hampshire was founded as a center for educational innovation and experimentation. It has become a leader in promoting student-active learning and in making science meaningful for all students. UMass Amherst is the largest public university campus in New England, and it has excellent graduate programs in many fields including science, mathematics, engineering, and education; advanced undergraduates have the opportunity to take graduate courses and to be involved in the research programs.

The three community colleges have close ties to the University by virtue of joint admissions and transfer articulation agreements. Although all offer a mix of terminal and transfer programs, they too differ in major ways. Springfield Technical Community College serves an ethnically diverse urban area, and focuses on preparing students for careers in hi-tech and medical services areas. Holyoke Community College is in a city with a large Hispanic population, and has pioneered programs to attract and support these students. Greenfield Community College serves Franklin County, a largely rural area, and enrolls many poor and older students from old mill towns with high unemployment rates; it is the poorest county in Massachusetts.

The school districts also vary considerably in their characteristics. In Springfield and Holyoke, the majority of the students are African American or Hispanic. In Amherst, home of three of the colleges in the consortium, close to half of the students are non-white, with a large component of recent immigrants from Asia and elsewhere. Also, as noted, Franklin County has many low-income residents.

Inter-Institutional Collaboration

In order to make this collaboration work, it has been critical to recognize and respect the autonomy and individuality of the participating institutions. Two bodies are used to facilitate communication and foster cooperation:

- The Coordinating Council consists of coordinators from each campus (except UMass) and four representative K12 faculty members. The PI's meet monthly with this group to share information and ideas, identify problems, and encourage campus and collaborative efforts.
- The STEMTEC Board consists of Deans and School Superintendents from the participating colleges and school districts. It meets twice a year to keep informed on STEMTEC's progress, and to offer support. Board members welcome the opportunity to share ideas with colleagues they would otherwise not be likely to meet. The summer institutes and academic year events bring together STEMTEC participants from all the institutions in an environment that fosters cooperation and mutual understanding.

Some indicators of success at the inter-institutional level associated with the summer institutes and curriculum teams:

- The original STEMTEC model included two cycles of summer institutes on student-active learning with a total of 80 college faculty. There were eight institute positions budgeted for each college except UMass, which is much larger, and was allocated 24. Despite initial misgivings on some campuses, STEMTEC has attracted at least the allocated number of faculty from every institution. With the addition of a shorter winter workshop series,

STEMTEC has directly served a total of 108 college faculty. Many other faculty have been impacted as well by less formal STEMTEC efforts.

- Discipline-based curriculum teams consisting of school and college faculty have worked together very effectively. Despite the differences discussed above, the participants have found the interactions highly valuable. What works well on one campus is usually worth trying on another. The reality of college life is that most professors have little opportunity to engage in serious dialog about teaching on their campuses, even with colleagues in their own departments.
- In most school-college collaborations, the college faculty are the content experts, and they transmit their knowledge to the school teachers. Here the roles are reversed: the K12 faculty members, selected because of their outstanding teaching skills, serve as pedagogy experts for the college people. They know how to use cooperative learning, project-based teaching, alternative or authentic assessment, and so on. Informal feedback as well as formal evaluations have highlighted the value of this probably unique collaboration. The school people were especially valuable in the workshops in addressing the needs of college students in remedial programs; for example, their use of manipulatives in math teaching found a ready audience among the college math faculty. Several pairs of school and college faculty continue to work together improving college courses. We strongly recommend the use of such school-college teams in improving college science and math courses.
- An unanticipated benefit of the curriculum team model came out of the interaction of the community college and Five College participants. Although many of the latter had worked with K12 schools in some fashion, very few had ever had any meaningful contact with the community colleges. They learned that many of the community college faculty members are dedicated and talented people, and that they are making major progress in improving the education of students with diverse needs and backgrounds. The community colleges in many cases are in the lead in improving the educational experiences of their students. Their faculties are frequently more open to trying new ideas and more appreciative of the opportunities that are offered.

Much is happening beyond the summer institutes and course development initiatives in the area of inter-institutional collaboration. UMass, Mount Holyoke, and Smith offer teacher preparation programs, and Hampshire students have had the opportunity to enroll in these as well. However, until recently, Amherst College has not allowed this option for its undergraduates. Amherst and Mount Holyoke have now made formal arrangements that will enable its students to also have this opportunity. In the past, many Amherst graduates went into teaching, but more often than not, they went to the private schools since they were not certified. We should now see some of their talented students teaching in the public schools as well. In this inaugural year of the liaison, 35 students have inquired about participating in the program, 5 students took the January term pre-practicum placement course at Mount Holyoke, and 2 to 4 Juniors seem perched to officially apply to the program on their enrollment date which is April 1st.

A critical question is the sustainability of the STEMTEC initiatives to improve science and math teaching and to better prepare prospective teachers. Hampshire College President Gregory Prince is leading an effort to have the STEMTEC Board create institutional mechanisms for continuing the K-16 collaboration. He views the educational process not as a pyramid with higher education at the top but rather as a circle, in which the colleges take in students from the schools and return their graduates. All segments of the educational system are mutually dependent and need to work

together to improve teaching and learning. STEMTEC is working with Dr. Prince in exploring ways to build permanent cooperative arrangements involving the science, math, and education faculties of the collaborative. The first meeting of a pre-planning group will take place on the evening of March 24, 1999.

Another area of inter-institutional collaboration is K12-college connections at the student level. All eight colleges have a variety of such relationships. A few examples: At Amherst, Pat O'Hara's chemistry students traveled to the nearby Fort River Elementary School to present programs, while Fort River sixth graders went to Amherst for a morning of experiments and demonstrations. At Springfield Technical Community College, some students had an elementary school math teaching internship, and others worked with a bilingual high school biology class. At Greenfield Community College, students bring a portable, inflatable planetarium purchased with STEMTEC funds to area schools. Hampshire College students designed projects on skeletal gender differences for a biology class at Smith Vocational High School. Seventeen Smith math and science students taught in area classes in January. Mount Holyoke students traveled with the research vessel Enviro-Lab III with Mahar 7th graders.

Intra-Institutional Collaborations

During 1998 the institutions within the collaborative moved towards the critical mass that is necessary for a systemic impact. Here are a few examples of what is happening.

At the University, the STEM Education Institute and Dean of Natural Sciences and Mathematics, Linda Slakey, cosponsored a dinner meeting on December 12, 1998 designed to get more faculty members engaged in student-active teaching. The 32 UMass STEMTEC participants and the approximately 12 Lilly teaching fellows plus their mentors were invited, and about 40 people attended. Much of the time was spent working in departmental groups, devising action plans for the individual departments. The STEM Institute also sponsored a daylong workshop entitled "Practical Strategies for Actively Engaging Students in the Classroom and for Assessing Their Work" on February 16, 1998 by Barbara Tewksbury, Professor of Geology at Hamilton College, and New York's Professor of the Year. Approximately 40 faculty attended from many departments. (Sandra Rhoades, Professor of Mathematics, Keene State College, presented a similar workshop in January 1999.) The biweekly STEM seminars reached a large number of faculty interested in improving math and science teaching.

At Smith College, the STEMTEC faculty continue to host weekly lunch meetings attended also by other colleagues; this has been a tradition since the start of STEMTEC. The group discusses accommodating different learning styles by combining lectures with group discussions, lab experiences, field trips, and interactive web pages. They note that by combining teaching techniques, students are more willing to talk and interact, even in lectures.

At Greenfield Community College, where most of the science and math faculty have been STEMTEC participants, the interactions brought on by STEMTEC have led to a rethinking and restructuring of science teaching. Specifically, the several small science departments (1 faculty member in physics, 1 in geology, 3 in chemistry, 7 in biology) have merged into a single science department that is better able to integrate and coordinate its offerings. An important outgrowth of this effort is the creation of the Liberal Arts Associate Degree with Math and Science Teaching concentration, a multi-disciplinary program to lay the foundation for math and science teacher preparation, mentored by STEMTEC faculty.

Holyoke Community College has created an interdisciplinary learning community program that goes well beyond STEMTEC faculty. STEMTEC participants presented college wide workshops on professional development days. STEMTEC faculty and students are planning to be involved in a new Math/Science Upward Bound program if it is funded.

Hampshire College, a leader in the reform of undergraduate teaching, holds a variety of workshops for its faculty. STEMTEC participants played an active role in planning and offering some of these workshops.

Statewide Inter-Institutional Collaborations

As noted, STEMTEC will assist public and private colleges across Massachusetts in improving their math and science teacher preparation. Two major meetings were held in 1998 to begin this program component.

- In cooperation with PALMS, the Massachusetts SSI program, STEMTEC sponsored a meeting in Leominster on April 8, 1998, attended by approximately 35 college math and science faculty members. The primary focus was on sharing teaching innovations and ideas for new and better courses (see *Appendix B* for meeting/workshop agenda and *Appendix I* for proceedings).
- On November 11, approximately 40 math, science, and education faculty members and administrators representing 18 colleges met at the University of Massachusetts Medical School in Worcester. The agenda included an introduction to STEMTEC and its summer institutes and an exploration of the issues that must be addressed to improve the preparation of math and science teachers. Campuses had the opportunity to share their rather diverse models of teacher education. Nobody present had ever attended a similar statewide event involving so many teacher education programs, and they were eager to have similar meetings in the future.
- An important outcome of the November 11 meeting was the formation of three working groups:
 - A planning group for the summer institute (see below)
 - A planning group for future academic year events. There was support for holding one or two annual academic year meetings; if two were held, one would be in the eastern part of the state, and one in the west. Such meetings are inexpensive to hold and can easily be continued after STEMTEC's funding has ended, and will represent a long-lasting forum for sharing ideas and concerns.
 - A list of campus representatives who will facilitate communication between STEMTEC and their faculty and administration.

Planning for the 1999 STEMTEC Statewide Summer Institute has continued via e-mail and a meeting of the planning group was held in Sturbridge on February 18, 1999. It will be held at UMass Amherst, July 18-23. Participants will receive a \$1000 stipend plus meals and lodging for attending the Institute and follow-up academic year meetings.

Application packets have been mailed to the campus representatives at 15 colleges and UMass campuses soliciting applications for teams of four college faculty in math, science, and education plus a K12 teacher who is an expert in modern pedagogy. Individual applicants are asked to explain what courses or programs will be affected by their participation, and the campuses are

also asked to explain their progress and plans for improving their science and math teacher preparation.

We will accept applications from 8 to 10 of these teams; the larger number is contingent on PALMS supporting the K12 participants, which is likely. If there are too many applicants, priority will be given to the larger programs and to those that are most likely to profit from the institute.

Appendix G summarizes the Statewide Summer Institute planning as of March 1, 1999.

II. A. 4. Changes in Vision for Mathematics and Science Education Within the Collaborative Inspired by STEMTEC

Stating with certainty STEMTEC's impact on mathematics and science education within the eight campuses is difficult without more formal and long-term project evaluation. However, STEMTEC is clearly changing the way science, and to some extent, mathematics education is occurring in the Pioneer Valley. Evidence from the student surveys and course observations completed in 1998 shows that almost all faculty involved in the project are experimenting to some extent with the pedagogical practices recommended in STEMTEC workshops. While lecturing remains the most common form of instruction, a growing number of faculty are employing formal and informal group methods in their courses, trying out alternative assessments, introducing inquiry-based labs, and incorporating various forms of educational technology. Even at Hampshire College, where instructors have long been committed to student-centered education that encourages inquiry-based learning in the sciences, faculty say that STEMTEC has provided them with insights and resources they didn't have before, and which have greatly improved their students' ability to learn.

While anecdotal in nature, STEMTEC is clearly changing professors' ideas about how best to educate the next generation. In some cases, as described in II.A.3. above, STEMTEC has provided a mechanism for faculty to collaborate in ways that lead to exciting innovations. At Greenfield Community College, for example, science faculty have long worked alone in several single-person or small departments that provided limited opportunities for collaboration. All but two of their full-time math and science faculty have now participated in STEMTEC. Where before GCC science faculty understood their work in somewhat piecemeal terms, as already discussed, they now recognize the benefits to students of a more coherent, integrated curriculum. That insight is leading to the development of new courses and programs. As another example, at Holyoke Community College, the work being done around "learning communities" (sometimes referred to as "interdisciplinary course clustering") has been exciting but confined to a few faculty. With the collaborative base provided by STEMTEC, commitments to interdisciplinary work are growing at both the faculty and administrative level. At the same time, HCC has provided models for other science and math departments within the Collaborative to follow. At UMass, as already mentioned, STEMTEC is now joining forces with the Lilly Fellows (new faculty supplied with experienced mentors and other resources to enhance their teaching) to help disseminate the importance of good teaching in the sciences and math. And at Mount Holyoke College, the work of Sheila Browne on affective strategies for helping students learn science is encouraging other STEMTEC faculty to think about their classroom and lab environments in whole new ways.

Perhaps the most encouraging change in the vision for science and mathematics locally is the growing idea that K-16 collaboration is critical for authentic educational reform. This idea has grown from a number of STEMTEC-related events and ideas:

- the important work that college and K-12 faculty have been doing together as curriculum team members in the workshops, and the growing mutual respect this has engendered;
- the growing understanding that college and K-12 classrooms are alike in more ways than they differ, and that drawing on those similarities may strengthen our students' abilities to withstand the sometimes disastrous transition;
- the recognition that students learn best when they are teaching others, and that the presence of undergraduates in the K-12 classroom has benefits for everyone involved; and
- the acknowledgment of the role liberal arts faculty play in producing teachers, and their responsibility to K-12 education—a responsibility that comes not in the form of “saving” it, but in creating dynamic and productive partnerships.

As already discussed, this change in vision has encouraged STEMTEC Board member and Hampshire College president to convene a meeting (to be held on March 24, 1999) to discuss long-term strategies for institutionalizing K-16 partnerships in the Pioneer Valley.

II. A. 5. Modifications to Teacher Preparation Programs

STEMTEC envisions teacher education as a process that begins well before formal entry into a teacher education program and as one that continues throughout a teacher's career. Therefore, in STEMTEC K12 teachers, college and university mathematics and science faculty, and education faculty work together to recruit, retain, and educate new teachers.

Table II-A and Figures II-A and II-B help to explain how STEMTEC is different from other efforts to recruit, educate, and retain new teachers. Figure II-A shows the possible pathway of students through STEMTEC activities into teacher education programs and into the profession. Table II-A and Figure II-B are modifications of illustrations developed by Profs. Audrey Champagne and Eileen O'Conner, STEMTEC evaluators. Figure II-B illustrates the ways that the various STEMTEC professional constituents interact to strive to prepare a culturally and ethnically diverse teaching force. Table II-A compares the STEMTEC approach with the traditional approach to teacher education.

As can be seen in the figures and chart, the STEMTEC Collaborative provides students with multiple pathways into teaching. It builds upon existing teacher education programs within the Collaborative at Mt. Holyoke College, Smith College, and the University of Massachusetts (see the advising sheets for UMass students preparing to be math and science teachers in *Appendix F*). STEMTEC aims to improve the mathematics and science preparation of new teachers by collaborating with practicing teachers to support new teachers and to encourage students to major in mathematics and the sciences, and to consider teaching as a career. Once the students have entered one of the eight STEMTEC colleges, they have the opportunity to enroll in STEMTEC courses, participate in STEMTEC teaching activities, and to receive STEMTEC scholarships and become STEMTEC Scholars. STEMTEC courses, teaching activities and scholarships serve to recruit and retain students in mathematics and the sciences, and to encourage them to consider K12 teaching as a career. In addition, STEMTEC activities provide students with opportunities to experience and engage in "standards-based" instructional methods.

It is important to note that the Commonwealth of Massachusetts requires a major in "arts or sciences" in order to receive a certificate to teach. Therefore, all students preparing to be mathematics or science teachers must major in the subject that they intend to teach or have course work that is equivalent to the major. Greenfield, Holyoke, and Springfield Technical Community Colleges have instituted courses of study that begin students working in this direction (see *Appendix F* for descriptions of community college transfer programs or options). Several of the

Figure II-A

Pathways to Initial Teacher Preparation within the STEMTEC Collaborative

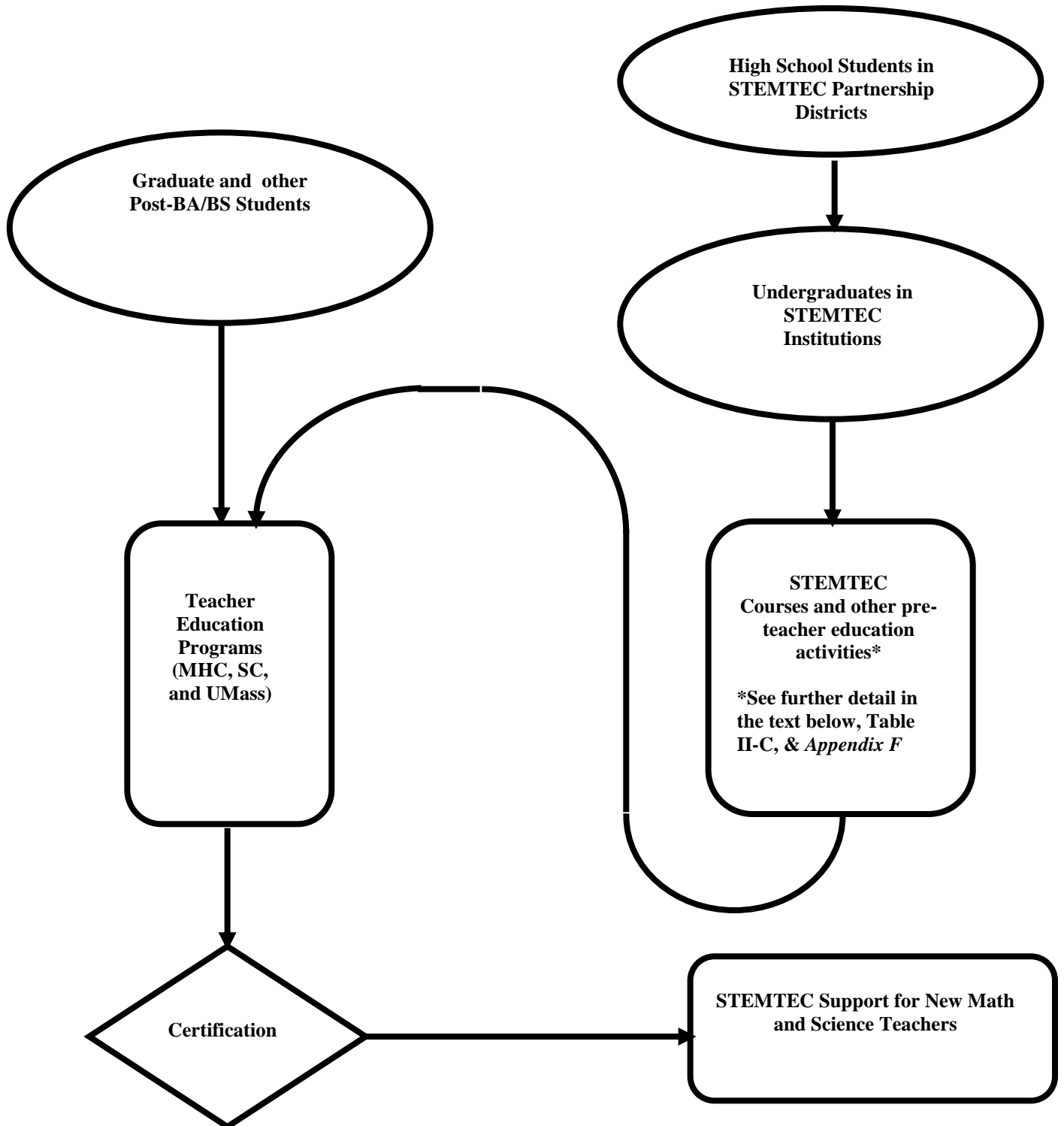


Figure II-B: STEMTEC Approach to Teacher Education

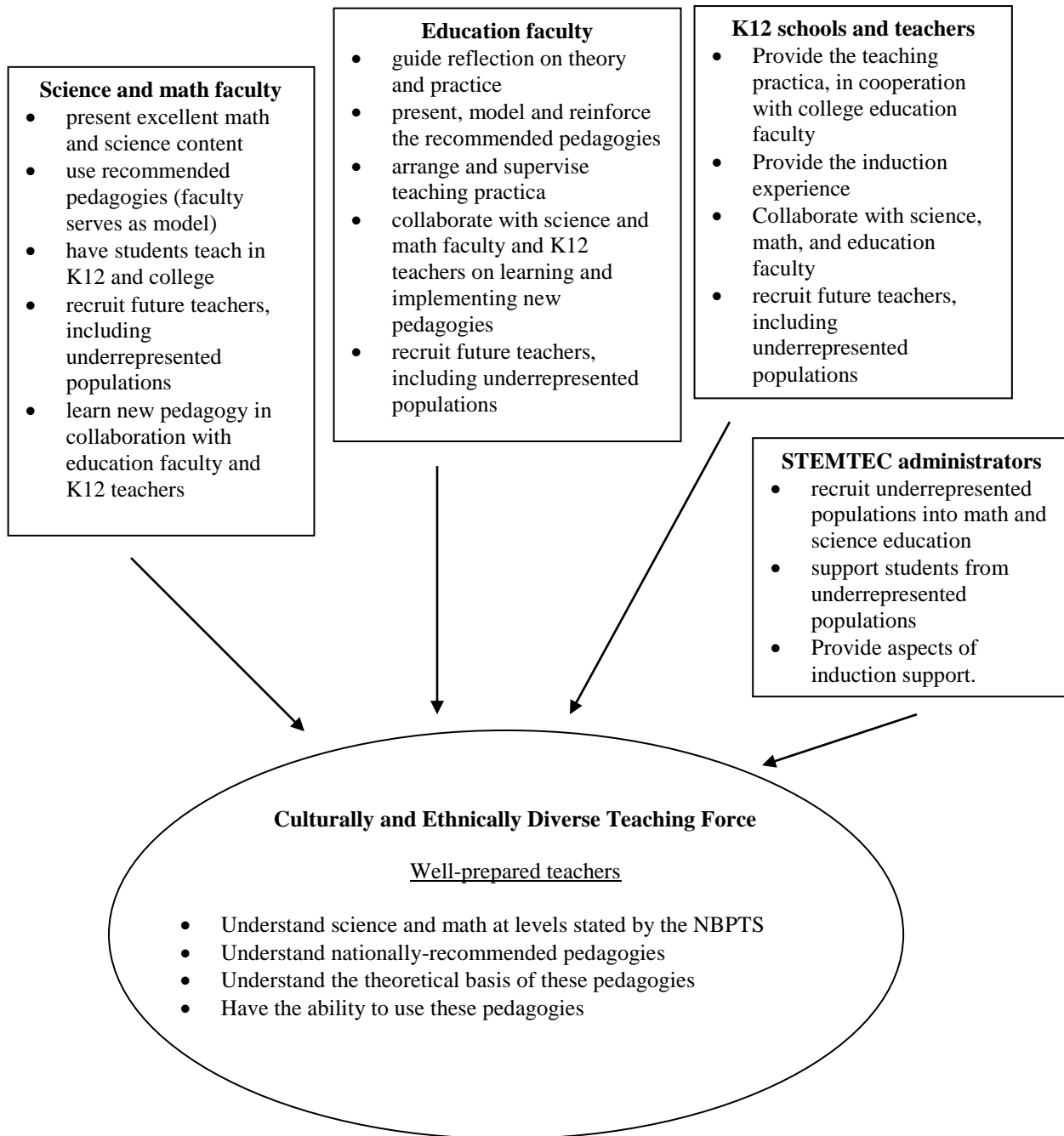


Table II-A: A comparison of conventional and STEMTEC approaches

Comparison of Conventional and STEMTEC Teacher-Education Approaches		
	Conventional	STEMTEC
Science and mathematics content knowledge development	In science and math courses presented by college and university faculty.	In science and math courses presented by college and university faculty, and through teaching experiences.
Science and mathematics pedagogical content knowledge development	In education and social science courses.	In education, social sciences, and science and mathematics content courses, and through teaching experiences.
Recruitment and retention	Within standard recruitment efforts.	College and university science, math and education faculty, STEMTEC administrators, K12 teachers.
Practical experience in K12 classrooms	Responsibility of education faculty often in cooperation with K12 teachers.	As part of science and math content courses, through informal programs and community service learning, and in prepractica and practica arranged as part of the teacher education programs.

science departments at UMass have majors that are especially appropriate for teachers (e.g., Geosciences and Physics), and the University Science major is appropriate for prospective middle school teachers (see *Appendix F* for a copy of the science major requirements).

If students do decide to become teachers, they may choose to enroll in one of the teacher education programs in the STEMTEC Collaborative. This can be done while an undergraduate at MHC, SC, and UMass, or as post-BA/BS or masters degree students at SC and UMass (see *Appendix F* for advising sheets for the UMass program for secondary math and science teachers).

STEMTEC supports innovations in the Early Childhood, Elementary, and Secondary teacher education programs at UMass through reformed teaching methods courses, prepractica and practica with STEMTEC K12 faculty, and though additional coursework that supports standards-based teacher education.

As the previous Figure II-A shows, better preparation for prospective teachers is anticipated partially through their enrollment in STEMTEC courses and other pre-teacher education activities. STEMTEC reform has been primarily aimed at introductory mathematics and science courses, in order to have maximum impact on the maximum numbers of students. Accordingly, to quantify the extent of the effect of STEMTEC reform on the curricula on the various campuses, we looked at the introductory courses. We calculated the percentage of the courses required in the first two years that reflect STEMTEC reform, for the individual science and mathematics majors (the majors for students preparing to teach middle or high school math or science) on each campus, where appropriate (see Table II-B).

Table II-B. Required Introductory Courses for Science and Math Majors Reflecting STEMTEC Reform

Major Campus	Biology	Chem	Comp. Sci	Eng.	Earth Sci.	Math	Physics & Astr	Sci Major	Elem. Ed.
UMass	46%	50%			55%	44%	18%	87%	100% ¹
Amherst C.	29%	63%			38%	14%	17%		
GCC ²	2	1			1	1	2		
Hampshire ^{2,3}	5				2				
HCC ²	6	1					1	1	
MHC	20%	33%			44%	33%			
Smith	29%	20%			20%				
STCC ⁴	38%, 46% ⁵	27%	67%	50% ⁶ , 36% ⁷					75% ⁸

1. Elementary education at UMass is a minor or a second major, and requires a content major. The percentage here refers to the percentage of math and science courses required of an elementary education program, separate from the major requirements.
2. Data given in # of courses reformed by STEMTEC
3. “Majors” at Hampshire College are highly individualized and defined by the student
4. Engineering and Science Transfer Degree Programs
5. Biotechnology option
6. Technical Engineering Option
7. Engineering Transfer Option
8. Education, Early Childhood, or Elementary Transfer Options

Reforming introductory science and math courses taken by prospective teachers are complemented by other pre-teacher education activities. These activities are described in greater detail at the end of *Appendix F*, and summarized below in Table II-C in timeline form. As the table suggests, five major goals shape STEMTEC’s ongoing and pre- and in-service teacher education activities (a sixth, discussed in the full document in *Appendix F*, shapes STEMTEC’s activities surrounding the scholarship program). The five major goals are:

1. Foster an awareness of teaching as a desirable career in science and mathematics.
2. Obtain a commitment from students to engage in science and math teaching.
3. Integrate disciplinary majors with teacher education programs.
4. Support new science and mathematics teachers.
5. Increase the proportion of minorities and women among the students pursuing careers in science and mathematics education.

Table II-C. Timeline for Implementing the Five Goals in STEMTEC’s Pre-Ed Program

Goals	Fall 97	Spr 98	Fall 98	Spr 99	Fall 99	Spr 00	Fal 00	Spr 01	Fall 01	Spr 02
1. Foster an awareness of science and mathematics teaching as a desirable career										
2. Obtain a commitment to engage in science and mathematics teaching										
3. Integrate disciplinary majors with teacher education programs										
4. Support new science and mathematics teachers										
5. Increase the proportion of minorities among prospective science and mathematics teachers										

II. A. 6. Dissemination and Public Awareness Strategies and Activities

Dissemination efforts in our first year were necessarily limited because the program was just beginning. This changed markedly in 1998 after faculty participated in our workshops and began working together in curriculum teams, on the eight campuses, and in schools. The list of their dissemination achievements is impressive, and it is clear that STEMTEC college and K-12 faculty have been actively publicizing information about their courses, interactions, and pre/inservice campus programs. In addition, STEMTEC HQ and the campuses themselves have developed numerous means to inform students and faculty, including web sites and brochures. As in the first annual report, we find it useful to distinguish between internal and external efforts as two venues for dissemination in the STEMTEC program. The list of efforts for 1998 is so lengthy that we have organized them in the outline format below.

Within The Collaborative

1. Within Institutions and departments

a. *Faculty to Faculty* (Workshop content & process of courses revision (student-active approaches, evaluation & assessment methods, student teaching experiences) through one-to-one interactions (informal and formal), informal get together, talks, team teaching).

- Greenfield Community College - STEMTEC faculty showcased recommended pedagogies to non-STEMTEC faculty as part of Professional Day activities
- Hampshire College - monthly brown bag lunches that focus on several faculty revising their courses; monthly faculty presentations in departmental meetings

- Holyoke Community College - STEMTEC faculty led a workshop on recommended pedagogies to non-STEMTEC colleagues at Professional staff/faculty meeting day.
- Smith College - ongoing bimonthly lunch at Faculty club focusing on course reform issues for STEMTEC faculty at the college.
- Springfield Technical Community College – Interactive Mathematics Workshop conducted by STEMTEC math faculty for other math faculty at the college
- UMass - fall evening workshop and dinner for all STEMTEC faculty and Lilly Fellows to share experiences and plan departmental dissemination efforts

b. Institution to Student (Information about K-12 teaching through campus meetings, career fairs)

- STEMTEC/ Holyoke Community College brochure (new ed transfer program at HCC, teaching experiences for students, some course descriptions)
- Hampshire College - new "pre-ed" program brochure (program description, course listings, teaching opportunities)

c. Institution to Community

- STEMTEC Web Site. The web site is discussed in more detail in the products section of the report, but it provides an important mechanism for dissemination to the community at large. <http://k12s.phast.umass.edu/~stemtec>
- Amherst College Web Site. This site was developed by Pat O'Hara, STEMTEC Campus Coordinator at Amherst College, to keep students and faculty there informed of STEMTEC events, teaching opportunities, and courses. It serves as a clearinghouse of information and a conduit to related science/math education and teacher preparation sites. It is also accessible via the general STEMTEC home page. <http://amherst.edu/~pbohara/stemtec>
- Mount Holyoke: Sistahs in Science Web Site. This site was developed by Sheila Browne, STEMTEC Campus Coordinator at Mount Holyoke College, to provide information about mentoring women and students of color in science. The site is in use by STEMTEC faculty and students, and is linked to the STEMTEC home page. <http://www.mtholyoke.edu/courses/sbrowne/sistahs/final/index.shtml>

2. Outside Departments/Institutions

a. Faculty to Faculty & other (Workshop content & process of course revision- student-active approaches, evaluation & assessment methods, student teaching experiences through roundtables, train-the-trainer sessions, discipline teams,

- STEM Education Institute Lecture Series - bimonthly series is one forum for STEMTEC participants (see *Appendix D*)
- STEMTEC Roundtables - monthly dinner conversation allows faculty to discuss their reforms and get support; central foci in 1998 were assessment and women/minorities in science
- STEMTEC train-the-trainer sessions - 12 of our faculty work together in monthly dinner meetings to prepare for workshops at STEMTEC state college summer institute, 1999 and other forums. The overall purpose of the group is to develop a local pool of individuals capable of working with their colleagues to improve teaching and learning in STEM classrooms. The group has been working to identify the qualities of good workshops and workshop leaders in order to improve their own skills and understandings in these areas. Some of the specific skills and understanding they examined during 1998 and early 1999 are: a) clarifying the theoretical underpinnings of student active teaching and learning, b) extending their repertoire of classroom strategies, c) identifying compelling research in teaching and learning, d) learning mentoring skills for improving their own teaching and facilitation skills, and e) identifying simpler strategies to suggest for individuals just starting to think about their practice.

Additionally, all of the web sites previously listed, and the course web sites identified in the products section of this report, are very important tools for disseminating STEMTEC's work outside departments and to institutions regionally and nationally. The manuals and CD-ROMs listed in the products section are also available for dissemination. Strategies for distributing the growing number of STEMTEC products to individuals outside the Collaborative are currently being developed by the PIs and staff.

b. STEMTEC to Collaborative (Workshop information, local talks through web, email, campus mail, brochures)

- The STEMTEC web site was completely reorganized and updated in August 1998. Several new information categories were added, along with links to faculty course web pages and other related science education/K-12 teacher education resources.
- STEMTEC 1998 Summer Institute on Student-Active Learning July, 1998. Participants were over 40 college and 16 K12 faculty
- STEMTEC 1998 Summer Recall - for Cycle I faculty
- STEMTEC Winter series - six January workshops on cooperative learning, minority issues, alternative assessment, educational technology; concluded May 1998; added additional 23 college and 12 K12 faculty
- *STEMTREK* (biannual newsletter) - The biannual newsletter of STEMTEC. The first newsletter appeared in early April 1998; the second newsletter will be distributed by the end of February 1999. The newsletter goes to all STEMTEC participants, Board members, scholarship recipients, NVC members, other CETPs, NSF, state legislators, all SMET department chairs at the collaborating institutions, all principals and superintendents in participating school districts, and various science education reform groups around the U.S. *See Appendix J.*
- STEMTEC brochures (general and student: see *Appendix J*)
- STEM Education Institute Lecture Series - bimonthly series features speakers on pedagogical change in science and math (see *Appendix D*)

Outside Collaborative

a. STEMTEC Faculty to Faculty Elsewhere

Journal articles, publications:

- Bruno, M and N. Chase. "School/College Partnerships". Manual funded by National Institutes of Health. (Cycle I college faculty)
- D'Avanzo, C. in press. The K-16 continuum: what faculty can learn about change from school teachers. *J. Coll. Sci Teach.* (PI)
- O'Hara, P. in press. Pesticides in drinking water: project-based learning within the introductory chemistry curriculum. *J. of Chem. Ed.* (Cycle I college faculty)
- Vining, W. submitted. Designing interactive instructional software: students as educators. *The Chem. Educator.* (Cycle I college faculty)

Talks, workshops:

- Brewer, S. "Scaffolding faculty use of instructional technology." Conference on "Models from the Field: Teaching and Technology in the University." Boxborough MA, April 1998. (Cycle I technology team)
- Browne, S. "The effect of mentoring and changes in teaching science on retention of women and minorities," Materials Research Science and Engineering Center Annual Review, with faculty, graduate students and industrial sponsors, October 20, 1998 (Cycle I college faculty)
- Browne, S. "Retention of minorities in science," Presidential Award for Excellence in

Science, Mathematics, and Engineering in Mentoring Symposium, Washington, D.C., September, 1998.

- Browne, S. "Affective measures and peer mentoring in science classes and labs" (symposium talk) and "What is working at Mount Holyoke College" (panel presentation), Conference on Mentoring in Science, Mathematics, and Engineering for Underrepresented Populations, First Meeting of Presidential Award Winners, Duke University, Nov 16-17, 1998.
- Browne, S. "The use of project based and community learning in science classes," Leadership Steering Committee presentation, Mount Holyoke College, April 1998.
- Browne, S. "The value of mentoring and increased confidence for succeeding in science," Smith College Current Students/Future Scientists and Engineers Workshop Program (for K-12 teachers and guidance councilors in New England), July 14, 1998.
- Browne, S. "Mentoring and enhancing confidence in science courses," Bayer Corporation National Council on Diversity meeting, and participant in round table on increasing diversity at Bayer, West Haven, CT, March 3-4, 1999
- Bruno, M & C. Jarvis. Workshop on Problem-Based Learning (New England Science Faculty Enhancement Collaborative, Hampshire College, June 1998) (Cycle I and Cycle II college faculty)
- Camp, C. "Using active learning strategies to deal with preconceptions in Newtonian mechanics". AAPT workshop. Yale. Fall, 1998 (Cycle II K12 faculty)
- Condit, C. "Dynamic Digital Map Field Trips." Presentation by Chris Condit at "Technology 2008" conference, Boston, MA, November 1998. Cycle I college faculty.
- Condit, C. "Dynamic Digital Map Field Trips: A Hypermedia Based Earth Science Experience." Presentation by Chris Condit at Models from the Field: Teaching and Technology in the University," Boxborough, MA, April 1998. Cycle I college faculty.
- Condit, C. "Dynamic Digital Map Field Trips." Presentation by Chris Condit at the Five Colleges Multimedia Fair. Cycle I college faculty.
- D'Avanzo, C. "Student-active approaches in ecology courses". Ecological Society of America annual meeting, August, Baltimore, MD
- D'Avanzo, C. "Project-based Teaching" Ecological Society of America train-the-trainer program FIRST, Archbold Biological Research Station, Florida
- Davis, K. The authentic integration of computer technology in elementary preservice science teacher education." Northeast regional meeting of the Association of Educators of Teachers of Science, Syracuse, NY, October 1998.
- Gerace, W., W. Leonard, C. Camp, C. and C. Emery. "Aligning perspectives and expectations for physical science curricula in high school and college." Panel presentation by Bill Gerace and Bill Leonard (UMass), Charles Camp and Chris Emery (Amherst Regional High School) at a conference on "The new high school graduate: What colleges can expect." Milford, MA December 1998. Cycle I college and K12 faculty.
- Hart, D. "Software tools for creating interactive computer-based instructional systems." Models from the Field: Teaching and technology in the University, Boxborough, MA, April 1998. Cycle I technology team.
- Khan, S. & J. Clement. "Tracking participation and 'richness' in computer-mediated discourse in a college science course for teachers." Presentation by Samia Khan and John Clement (based on their analysis of the use of a course listserv), at conference on "Creating Alternative Learning Cultures: Culture, Cognition, and Learning," SUNY-New Paltz, November 1998. STEMTEC PI and evaluators.
- Kahn, S., Stoffolono, J., & Thayer, F. "Using insects in the classroom: A distance learning course." Presentation by Samia Khan (STEMTEC grad case study evaluator), John Stoffolano, and Faith Thayer (based on case study of Stoffolano's course "Insects in the Classroom") at

conference on "Models from the field: Teaching and technology in the university," Boxborough, MA, April 1998. Cycle I college faculty, grad assistants.

- Leckie, M. and R. Yuretich. "Inquiry-based teaching in very large enrollment classes: Examples from an oceanography course." Annual meeting of the Geological Society of America, Toronto, October 1998. Cycle I college faculty and PI.
- O'Hara, P. "Service learning in the sciences". Wellesley College, Feb. 1998 . Cycle I faculty.
- Robinson, M., L. Brewer, & A. Wolpin. "The STEMTEC Collaborative." Conference/workshop sponsored by Mathematics and Education Reform, "Developing Leadership and Middle School Mathematics Education." Chicago, IL., May 1998. Cycle I college and K-12 faculty.

b. STEMTEC to Faculty and educational institutions & others elsewhere

- Information about the collaborative, STEMTEC faculty and student successes, our approach and theory re: K12 science/math teacher problem, pre-ed programs, scholarship programs, process of faculty change, faculty development models, evaluation outcomes through workshops at institutions; statewide workshops, talks, posters, workshops at professional meetings; web; journal articles; video
- STEMTEC video (working title "How Change Happens: science and math faculty who break the 'you-teach-as-you-were-taught' cycle for their students" - on schedule (filming begun in fall, 1988 to continue through spring 1999; see *Appendix J* for longer description)
- STEMTEC statewide college workshops - May and October 1998 planning meetings with education and science faculty from 15 state colleges with large numbers of preservice teachers; summer workshop scheduled for July, 1999.
- *STEMTREK* (above)
- STEMTEC brochures (above)
- STEM Education Institute Lecture Series (above)
- Newspapers; articles about STEMTEC were in the Boston Globe, Daily Hampshire Gazette, Springfield Republican (see *Appendix J*)
- STEMTEC workshops for new teachers in the Pioneer Valley (February 12, 1998; October 15, 1998; February 25, 1999)

II. A. 7. Evaluation Activities and Formative Evaluation Results

See the separate evaluation report for Year 2 activities and results.

II. A. 8. Changes to Evaluation Plan

See the separate evaluation report for the many changes to STEMTEC's evaluation plan in Year 2 and beyond.

II. A. 9. Progress Toward Full Participation of Underrepresented Groups

In Year 2, STEMTEC continues to work towards the participation of underrepresented groups in a number of directed ways. These include significant involvement in the Teaching Scholars program, seminars and roundtables on recruiting and retention of women and minorities, a meeting with the directors of on-campus minority programs, and providing information aimed at underrepresented minorities through the web site. In addition, STEMTEC courses continue to serve a number of women and minorities (see Table II-D), and STEMTEC faculty continue to make a particular effort to ensure that students from underrepresented groups fully participate in their courses, and that their interest and performance in these science and mathematics courses is

maintained. Further, group learning and student-active learning techniques, as espoused by the STEMTEC philosophy, have been shown to be inclusive techniques, particular with regards to women and students of underrepresented groups.

Teaching Scholars Program: In all, fifty NSF/STEMTEC Teaching Scholarships were awarded for the 1998-1999 academic year, including seven "Distinguished Teaching Scholarships" (see Table II-D). Of the fifty students, eight (or 16%) self-identified as minority, and twelve (24%) declined to self-identify their race/ethnicity (of these twelve, it is known that there are students from underrepresented minorities). We continue to work towards increasing the participation of underrepresented minorities in the Teaching Scholars Program, and we are hoping that the current participation of minority students will serve to encourage this increased participation. (On each campus, the Teaching Scholars will form the nucleus of "pre-ed" societies that will expand beyond the Teaching Scholars group, as well.) However, it should be noted that, in line with the other CETP programs, the participation of minority students in the Teaching Scholars programs largely mirrors the demographics of the students preparing to be teachers on individual campuses. Of the NSF/STEMTEC Distinguished Teaching Scholars, two (29%) are from underrepresented minorities, a significant improvement over their representation in the Collaborative's institutions as a whole. We continue to target on-campus minority groups—e.g., the Minority Engineering Program (UMass), Sistahs in Science (Mount Holyoke), the Union of Underrepresented Science Students (Smith College), the Drew Achievers (a support group for African American science students, Amherst College), Jump Start (a program to encourage women to enter science, math and technology, Greenfield Community College), and METS (a support group for women interested in math, engineering, technology and science fields, Holyoke Community College). A meeting was held on March 9, 1999 with the faculty advisors/directors of minority organizations on the different campuses in order to enlist their aid in increasing the participation of minority students in the Teaching Scholars program, and in math and science courses in general.

Table II-D. Women and minorities: NSF/STEMTEC Teaching Scholars

	Female ^a	Black, Hispanic, or Nat. Amer.	Asian	Total Minority
STEMTEC Teaching Scholars	84% (42)	12% (6)	4% (2)	16% (8) ^b
STEMTEC Institutions, Teacher Prep ^c	88%	NA	NA	15.4%
STEMTEC 4-Year Institutions, Total ^d	65%	8%	9.5%	17.5%
STEMTEC 2-Year Institutions, Total ^d	60%	14.5%	1.1%	15.6%
CETP Teaching Scholars	73.5%			42.5%
CETP Institutions, Teacher Prep ^c	74.9%			40.6%

- a) Note that two institutions, Mt. Holyoke College and Smith College, are all-women institutions
- b) Twelve Teaching Scholars (24%) declined to provide race/ethnicity data.
- c) Undergraduate students who are preparing to be teachers.
- d) Total school populations

The NSF/STEMTEC Teaching Scholars Program not only provides students with financial aid, but also with other forms of support, including STEMTEC faculty mentors, field trips and group discussions, and information about teaching careers and achieving certification. These activities should ensure the continued interest of the Teaching Scholars not only in pursuing teaching careers, but also in continuing their courses of study to this end. Thus while college and university demographics show a marked decline in the participation of minority students with each year in college, STEMTEC support should encourage and enable minority Teaching Scholars to continue their studies.

Seminars/RoundTables/Student Panels: STEMTEC has held two Roundtables on these topics recently. On November 23, 1998 the topic was "Achieving Gender Equity in Science Classrooms", based on a NECUSE report of the same title. At this talk, an unprecedented number of participants brainstormed on various classroom techniques that encourage the participation of women students. On February 22, 1999 Sheila Browne, Professor of Chemistry at Mount Holyoke, STEMTEC participant, and recipient of the 1998 Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring, led a discussion on recruiting and mentoring minority students. (A summary of the latter Roundtable is included in *Appendix I*.) On November 3, 1998, Kathy Davis, Assistant Professor of Education at UMass Amherst, gave a STEMTalk titled "Scientific Literacy for All: It's An Inside Job," about gender equity in education. Also, on February 26, Professor Browne gave a STEMTalk entitled "Mentoring, Minorities and STEMTEC." Additionally, on the evening of April 23, 1998, STEMTEC hosted a panel at the University titled "Professional Careers in Mathematics and Science" to which ALANA (African-, Latino-, Asian-, and Native-American) students from all eight colleges were invited. Seven faculty of color, all professionals in science and math education, served on the panel.

Faculty Participation: Tables II-E and II-F summarize the representation of women and minorities among STEMTEC college faculty and K-12 participants, respectively. With the addition of summer 1998's Cycle II participants, female and minority representation remained comparable to that of the other CETPs, and proportionally higher than their distributions within the math and science departments on the campuses. Thus, STEMTEC continued to recruit female and minority faculty, but in fact, the small numbers of minority and female faculty limit the number of participants.

Table II-E. Women and minorities: STEMTEC college faculty

	#	Female	Black	Latino	Nat Am	Asian	Total Minority
STEMTEC	108	32 (30%)	5 (5%)	5 (5%)	2 (2%)	1 (1%)	12%
CETP Average		36.5%					12%

Table II-F. Women and minorities: STEMTEC K12 faculty

	#	Female	Black	Latino	Nat Am	Asian	Total Minority
STEMTEC	48	34 (71%)	1 (2%)	5 (10%)	0	0	12.5%
CETP Average		66.9%					15.6%

Other relevant information: On April 23, 1998, STEMTEC sponsored a panel at UMass titled "Professional Careers in Mathematics and Science" for ALANA (African-, Latino-, Asian-, and Native-American) students. Approximately seven mathematicians, scientists, and educators of

color served on the panel, sharing their experiences and interacting with students in the audience. Three students of color developed continuing associations with STEMTEC from this meeting, two as scholarship recipients and the third as a graduate assistant with the project.

The STEMTEC web site has a link to a site at Mt. Holyoke College's web site (posted by Prof. Sheila Browne), containing some information aimed specifically at underrepresented minorities, with information on mentoring and coop information for students:
www.mtholyoke.edu/courses/sbrowne/sistahs/final/title.shtml .

II. A. 10. Partnerships and Collaborative Activities

STEMTEC's partnerships and collaborative activities are described in more detail in II.A.3 above and H. below. Here, however, as in the *Year 1 Annual Report*, we give brief descriptions of those groups with whom STEMTEC has ongoing collaborative relationships.

- **STEM Education Institute:** The Institute, currently directed by STEMTEC PI Sternheim, is the Organizational Unit (OU) out of which STEMTEC operates at the University of Massachusetts Amherst. The Institute was established to facilitate joint efforts among various UMass groups addressing issues related to K-16 science, technology, engineering, and mathematics education and pre-service teacher training. The Institute plays a major role in meeting the University's goals in academic outreach, teaching and learning, research, diversity, and multiculturalism. The Institute has been very effective at obtaining external grants, enabling the University to play a leadership role in national and state efforts to reform SMET education. STEMTEC collaborates with the Institute by co-sponsoring public lecture series and mini-workshops, maintaining an interlocking database, and sharing some staff. *Appendix D* provides information on some of these activities for 1998 and early 1999.
- **UMassK12:** The UMassK12 Project offers Internet services for Massachusetts K12 educators and students. It features access to a huge variety of educational resources with user-friendly interfaces and strong user support services. UMassK12 cooperates with STEMTEC by providing free access for all affiliated teachers and college faculty who want or need Internet accounts.
- **Five College/Public School Partnership:** The Five College/Public School Partnership, created in 1984, serves an average of 800 school teachers and administrators a year from throughout western Massachusetts. The Partnership sponsors summer institutes and academic-year seminar series, each of which is planned by teams of school and college faculty who share a common discipline or area of interest. It also publishes a quarterly newsletter. STEMTEC collaborates with the Five College/Public School Partnership in many ways. Sue Thrasher, STEMTEC co-PI, directs the Partnership, and Five Colleges, Inc., is a major STEMTEC subcontractor. PI Thrasher and the Partnership have been central in identifying excellent K-12 teachers for involvement in STEMTEC. Five Colleges, Inc., is the site for the monthly Roundtable (which Thrasher coordinates) and the train-the-trainer meetings (co-coordinated by PIs D'Avanzo and Thrasher). The Partnership has also re-established the K-16 Math and Science Seminar, a group of college and K-12 faculty (some STEMTEC, some not) who meet regularly to talk about a range of issues related to education, outreach, and scholarship. Finally, PI Sternheim publishes a regular column in the Partnership newsletter about STEMTEC (see *Appendix J*).

- **PALMS:** STEMTEC collaborates with PALMS, the NSF-funded state systemic initiative, in a variety of ways. For more about the nature of their partnership, please see H. Interaction and Overlap with Related and NSF-Supported Science and Mathematics Education Projects in the Region below.
- **MediaOne:** STEMTEC has partnered with Media One (formerly Continental CableVision) to aid in dissemination of the 20-minute STEMTEC video through its community channels. This partnership will activate when the video is finally produced.

II. A. 11. Activities Under the Subcontracts

STEMTEC has four major subcontracts: one with Five Colleges, Inc., and the others with the three community colleges in the Collaborative. Currently, most of STEMTEC's programming is centrally administered through the PIs and Coordinating Council, and the subcontracts function primarily as mechanisms for administering local funds. The subcontract with Five Colleges, Inc., enables the project to administer workshop stipends to faculty at the four privates in the Collaborative and to all K-12 teachers. PI Thrasher, who oversees the Five College subcontract, also manages and tracks the distribution of course revision funds to STEMTEC faculty at the four privates. Because the new student services director is so centrally involved with administering scholarships and arranging teaching experiences for students beyond UMass, her appointment is currently through Five Colleges. Additionally, the contract with Spectrum Media (for producing the video) is being administered through the Five Colleges subcontract, as are funds for mini-grants to teachers, the Roundtables, money to support teaching experiences at the four privates, and most of the upcoming events surrounding statewide dissemination. At the community colleges, faculty receive their course revision funds and the campus coordinators receive their quarterly stipends through the subcontracts. The community college campus coordinators also have a budget line within each subcontract for supporting teaching experiences for the students at their school.

B. Additional Demographic Data

STEMTEC completed its on-line entry of demographic data about the Collaborative and its eight institutions on March 1, 1999. Those data show significant numbers of students enrolled in reformed STEMTEC courses, ongoing collaborations with other regional and national education reform efforts, a growing body of dissemination work (in the form of products, conference papers, and publications), and the meritorious character of the STEMTEC/NSF Teaching Scholars. Here, we describe five data points not accommodated by the NSF data entry forms that shed insight on happenings in the Collaborative:

1. Close to 14% of students completing surveys in STEMTEC reformed courses indicate that they have an interest in both science (or math) and teaching. This number provides some evidence that introductory courses being reformed with NSF support are reaching a significant number of future teachers.
2. During 1998, Amherst College faculty voted to allow Amherst students access to fulfilling the requirements of Mount Holyoke College's approved state certification program. Prior to that vote, Pat O'Hara (STEMTEC campus coordinator and Cycle I participant) surveyed her junior level majors chemistry course (not currently an "official" STEMTEC course), asking how many students were contemplating a K-12 teaching career. Approximately 40% of the students indicated an interest in K-12 teaching, suggesting that even at institutions within the Collaborative historically not heavily involved in teacher preparation, significant numbers of science and math majors may be interested in pursuing certification. O'Hara's informal

discussions with Amherst's alumni office suggest that quite a few Amherst graduates currently go on to K-12 careers. However, until now, because they lacked a means for formal certification, these exceptionally trained students typically end up teaching in private schools. With the new certification arrangements in place, more may end up in the public schools. According to additional information provided by O'Hara, 35 students have inquired about the new certification arrangements in only a few months.

3. At Mount Holyoke College, Sheila Browne (STEMTEC campus coordinator and Cycle I participant) examined the transcripts of the 24 students receiving certification in 1998. She found that while only two of the students majored in math, the majority of the students being certified had taken more—several of them significantly more—than the required math and science credits for graduation.
4. At UMass, PI and education professor Feldman reports that during the early spring of 1999, a dozen students have applied for acceptance to the secondary science and math certification program, almost triple the number in previous years.
5. As already mentioned in the narrative above, faculty reforming courses through their participation in STEMTEC report that they have not stopped at their “official” STEMTEC course (the course which they initially proposed for reform and for which they're eligible for course revision funds). Additionally, STEMTEC faculty are impacting non-STEMTEC faculty in their departments and divisions, and beginning to push for some changes in science and math curricula at their schools. Hence, while the demographic data reported on March 1 show significant numbers of courses being directly impacted by STEMTEC, the indirect effect of the project on course (and to some extent, curriculum) reform is much greater than reported.

C. Project Analysis

As noted by the National Visiting Committee in its third site visit report, “In general the NVC feels that the project is making good to excellent progress on most fronts and has effectively dealt with a number of concerns that the Committee raised in earlier meetings.” STEMTEC's leadership team is gratified by this assessment and looks forward to feedback from the NVC and NSF that will continue to strengthen the project's administration and programming.

With the project's second year coming to a close, STEMTEC is moving to a new phase in its development. While the first two years by necessity focused on workshops for science and math faculty attempting course reform, the years ahead will focus on several things needed to sustain its early efforts:

1. the continual development of support mechanisms for faculty, such as the formative evaluation workshops being conducted by PI Feldman;
2. strategies for attracting students, especially prospective teachers, to STEMTEC reformed courses;
3. the development of student support services (such as information sessions on certification, opportunities for quality pre-practicum experiences, and workshops on student-active pedagogy) for the scholarship students and other prospective teachers in the Collaborative;
4. exploration of new avenues for teacher preparation, such as campus minors and a five college collaborative program;
5. increased attention to disseminating the work of the project regionally and nationally;
6. institutionalization of science and math education reform on the eight campuses of the Collaborative, enabling authentic transformations in existing curricula that will outlive STEMTEC;
7. assistance with statewide efforts to better prepare prospective teachers; and
8. reliance on rich formative and summative feedback from the external evaluators.

At its site visit scheduled on April 10, 1999, the NVC will focus on two issues related to the project's continuing progress: evaluation and STEMTEC's teacher preparation program. With the guidance of the NVC, STEMTEC has appointed a new evaluation team headed by former NVC member Audrey Champagne. The team has already drafted a sophisticated and ambitious evaluation plan. While still in the revision stage, the plan is exciting to STEMTEC management not only because of its potentially fertile impact on STEMTEC's programming and progress, but also because it may offer a national model for others to follow. Champagne and O'Connor have already shaped the thinking of the PIs in significant ways, suggesting how national standards can be used in the assessment of educational reform and highlighting the differences between STEMTEC's model of teacher preparation and more conventional models. Their evaluation plan has also offered new directions for assessing the overall effectiveness of the eight-institution collaborative and better learning by students of content knowledge (see the separate evaluation report).

Of course, project evaluation has been continuing through the transition to a new evaluation team. PI Feldman coordinated evaluation efforts during the fall of 1998, surveying students in 46 STEMTEC courses and completing observations of approximately 23. He also examined data collected by the Donahue Institute prior to then. His analyses show that many good things are happening in STEMTEC courses, although there is room for continued course development (again, see the separate evaluation report for greater detail). Specific areas that require attention and that will shape STEMTEC's long-range planning are:

1. the availability of K-12 teaching experiences, which Feldman finds is not as great as it could be;
2. mathematics education reform (although the data are somewhat resistant to interpretation, Feldman finds that STEMTEC math faculty may be lagging behind science faculty in their attempts at reform); and
3. the experience of women and minorities (while again the finding is preliminary, student surveys show that African Americans experience less cooperative learning in their STEMTEC courses than their majority counterparts, and that courses at the two women's colleges exhibit less cooperative learning than at the other).

Budget and staff changes reflect changes in STEMTEC's long-range planning. To enhance the development of STEMTEC's student/teacher preparation program, a new Director of Student Services, Sharon Palmer, was hired in September 1998. She spent much of the fall of 1998 helping create the scholarship program, generating application and publicity materials, meeting with students on all eight STEMTEC campuses, contacting minority support groups, etc. In the coming months, she will be developing support programs for the scholars and other STEMTEC students, create recruiting materials for science and math education students, and coordinate the formation of pre-education minors and concentrations (see section II.A.5 above for additional details about the emerging student program).

Additionally, funds for a new part-time staff position to help with documentation, dissemination, and institutionalizing STEMTEC are included in the most recent budget revision (see *Appendix H*). The position currently held by Project Manager Susan Newton will be split in two, with a new full-time hire taking responsibility for the recall and statewide workshops, executive meetings, and fiscal and office management aspects of the project. Newton will take responsibility for continued reporting to NSF, the production of the newsletter, overseeing dissemination efforts by faculty and the Collaborative as a whole, writing new grant proposals, etc. The new position, titled "Director of Special Projects," will enable more focused attention on activities important in achieving the project's long-range goals.

Other budget changes also reflect STEMTEC's commitment to various long-term goals. Acknowledging that stipends may be a necessary inducement to attracting faculty statewide to summer workshops, \$80,000 (\$1,000 per participant) has been taken from existing budget lines and added to a line for statewide summer stipends for Years 3 and 4. Also, funds have been set aside to help co-sponsor statewide education reform efforts (such as two workshops offered by faculty at UMass Boston on interdisciplinary science education reform). Additionally, STEMTEC K-12 faculty have been especially thoughtful about ways to offer diverse, quality teaching experiences for undergraduates. Beginning in Year 3, \$10,000 per year has been set aside to support competitive proposals from K-12 faculty for developing such experiences. A student services budget of \$5,000 per year has now been built into the budget to support other teacher preparation activities for STEMTEC students and teaching scholars. Monies have also been set aside to enhance dissemination efforts through the production of higher-quality brochures and flyers. And finally, although funds have not been allocated for this purpose, the management team has been discussing competitive mini-grants to the eight campuses for innovative proposals supporting the institutionalization of reform efforts. Additional funds through new grants may be sought for this activity to effect long-range change. These competitive mini-grants, along with a new subcommittee structure for the advisory board, may help to sustain STEMTEC's reforms long after the grant money is spent.

D. Updated Strategic Plan, including Timeline, for 1999

It is clearest to organize the strategic plan by program areas. The overlapping connections of these areas to the project goals will be noted. For convenience, we list these goals again:

Goal 1: Establish a functional educational collaborative

Goal 2: Redesign the science and math curricula on the campuses of the Collaborative to incorporate new pedagogies and establish mechanisms for supporting faculty in their course redesign.

Goal 3: Improve the preparation of future K-12 teachers of mathematics and science

Goal 4: Recruit and retain promising students into the teaching profession, with special attention to underrepresented groups

Goal 5: Develop a program to support new science and math teachers in their first year in the classroom

Goal 6: Establish dissemination mechanisms

Goal 7: Conduct strong programs of evaluation and assessment

Supporting the Collaborative (Goal 1): As discussed before, the core STEMTEC collaborative includes eight colleges and the neighboring school districts. Over 160 college and K12 faculty have participated in the STEMTEC workshops. Activities designed to support and enhance the collaboration include:

- Monthly meetings with the STEMTEC Council. This group includes the campus coordinators from the seven colleges other than UMass, four representative K12 teachers, and the PI's.

This group is critical to communication and maintaining the collaboration (February - May, September - December)

- Semi-annual meetings of the STEMTEC Advisory Board (April, October). The Board will be asked to form working groups focussing on four sustainability issues:
 - Faculty Development – What can campuses do to expand and encourage the process of course and curriculum re-design in science and mathematics?
 - Pre-education Programs – What steps can be taken to integrate teacher education more completely into science and mathematics disciplines? How can teaching experiences be provided that meet the needs and the schedules of undergraduates?
 - Supporting New Teachers -- What can our schools and colleges do to help new teachers survive that critical first year?
 - Beyond 2002 -- What structures need to be established and maintained to foster the K16 collaboration initiated by STEMTEC?Initial reports should be available by October 1999.
- Ongoing communication via e-mail, telephone, newsletters, and web sites (January - December)

Expanding the collaborative beyond the original institutions is discussed below under "Statewide Summer Institute."

Curriculum and Faculty Development (Goals 2-3): During 1997 and 1998, 108 college and 48 K12 faculty participated in institutes that focussed on student-active learning and improving science and math teacher preparation. STEMTEC's curriculum and faculty development activities during 1999 and beyond will extend this program. Specifically, we will:

- Offer approximately 100 courses revised as a formal part of the STEMTEC program on the eight campuses of the collaborative once or more annually. (Each participant was asked to designate one or possibly two STEMTEC courses that would be modified. These are the courses that will be covered by the project evaluation.)
- Offer a larger number of additional courses in 1999 and later years that are not officially part of the program but have been impacted by STEMTEC. This includes other courses taught by participants in our summer or winter institutes. Typically, a professor who has had success with STEMTEC teaching practices will use them in every course, not just in his or her official STEMTEC course. Also, some courses that are taught in successive semesters or in multiple sections by colleagues of STEMTEC participants have been substantially modified.
- Plan and hold the annual winter plenary for institute participants (Saturday in February, annually)
- Plan the 1999 follow-up summer institute for Cycle I and II (February - May)
- Invite the winter institute participants to attend; their original commitment had ended in April 1998. (February)
- Hold the 1999 follow-up summer institute (June 28-30)
- Hold the annual fall plenary for institute participants (Saturday in September, annually.)
- Plan and hold the 2000 follow-up summer institute.
- Hold monthly STEMTEC Roundtables at the Five Colleges consortium (February-May, September-December)
- Continue to co-sponsor with the STEM Education Institute a bimonthly lecture series and half- and full-day workshops on math and science education for STEMTEC and non-STEMTEC faculty (January-May, September-December)

- Offer formative evaluation through PI Allan Feldman and his graduate assistant, and train faculty in self-assessment techniques (January-December)
- Keep participants informed via e-mail, web site, newsletter (year round)
- Continue weekly, bimonthly, and monthly campus-based support groups for faculty (January-May, September-December)

Statewide summer institute (Goals 1-3; 6): STEMTEC is committed to helping other public and private colleges in Massachusetts to improve their science and math teacher preparation. A planning process began with two meetings in April and November 1998 that are described in section A.3. In the next two years we will:

- Meet with a representative committee to plan the summer institute (February 1999)
- Continue planning via e-mail (March - May 1999)
- Distribute information and team application packets to campus representatives at 18 colleges (March 1999)
- Select participating colleges and faculty (April 1999)
- Meet with another representative committee to plan a fall recall (May 1999)
- Hold summer institute at UMass Amherst (July 18-23, 1999)
- Plan fall recall meeting (May - September 1999)
- Hold fall recall meeting (November 1999)
- Plan spring recall meeting (December 1999 - February 2000)
- Hold spring recall meeting (April 2000)

A similar cycle of planning and events will occur in 2000. The recall events will be open to the general academic community, and will be continued beyond the two years of NSF funding.

Recruiting and Preparing Future Teachers (Goals 3-4): STEMTEC accelerated its program of teacher recruitment and preparation in 1998. Below we summarize our activities and plans in several areas.

1. Scholarships: This was a major area of effort in 1998, and will continue to be so. A proposal was submitted to NSF in January (and eventually approved) to fund STEMTEC Teaching Scholarships. We met with the eight campus financial aid offices to plan the administration of the awards. We hired a Student Services Director (Dr. Sharon Palmer) and developed information materials and application forms. We formed a STEMTEC Teaching Scholarship Advisory Board to advise on scholarship policies and serve as selection body for scholarship recipients. During 1999 and later years, we will

- Award the first scholarships in January 1999. (Funding was received too late to make awards for the fall 1998 semester.)
- Contact STEMTEC participants, high school and college advisers, minority support groups, and other student groups to encourage applications (January - March annually)
- Hold information sessions on all eight campuses (March annually)
- Hold award banquet for scholarship recipients (February 1999; September 1999 and later years)
- Collect applications up to the April 15 deadline
- Select scholarship recipients and announce awards (April - June annually)
- Hold monthly events for Scholars (academic year, annually)

2. Awareness: STEMTEC has ongoing programs designed to foster an awareness of science and mathematics teaching as a desirable career. Some specifics:

- STEMTEC faculty talk about teaching in their classes (throughout project)
- STEMTEC faculty use teaching methods demonstrated to support women and underrepresented groups (throughout project)
- STEMTEC courses model good teaching (throughout project)
- STEMTEC courses advertised separately from other science and math courses (April and November annually)
- Brochures available about science and math teaching as a career (April 1999)
- STEMTEC participates actively in campus majors and career fairs (each semester)
- Information sheets and meetings with advisors in science, mathematics, and engineering to inform them on career options and certification requirements (each semester)
- Information on teaching career options sent to high school guidance counselors (each fall)

3. Teaching Experiences: STEMTEC encourages math and science majors to do some kind of teaching either in the schools or on the college campus as a way to improve their own understanding as well as a way to test their interest in teaching as a career.

- Continue to connect STEMTEC college and K-12 faculty interested in incorporating teaching experiences through a system of home page “want ads” and the Student Services Director (January-December)
- Continue to work directly with STEMTEC teacher/mentors to provide and advertise teaching experiences not connected to specific STEMTEC courses (January-December)
- Continue to work to develop connections with local organizations (e.g., science museums, environmental groups, astronomy clubs) that might offer student internships or other “informal” science teaching opportunities (January-December)
- Continue to offer NSM/EDUC 197A “Exploring Math and Science Teaching” at UMass (each semester)
- Continue to collaborate with the winter term school internship program, Smith College (each January)
- Continue to offer MATH 300: Teaching Experience in Mathematics, Springfield Technical Community College (each fall semester)
- Continue to work with the other colleges (e.g., HCC) to help develop teaching experience seminars similar to those at UMass and STCC (January-December)

4. Integration of disciplinary majors with teacher education: STEMTEC is fostering cooperation between the science and math faculty and the teacher education program. Specific examples include:

- Develop and continue the joint teaching of courses by SMET and Education faculty (e.g. at UMass, MSM/EDUC 197A) (every semester)
- Develop and continue the joint teaching of courses by SMET and K12 teachers (At UMass, “Theories of Teaching and Learning,” Physics Honors 04; “Electricity and Magnetism for Teachers”, Physics 100/597T) (both, every spring semester)
- Continue to promote the Science Major re-designed in 1998 at UMass for middle school science teachers (January - December)
- Continue to promote a revised physics major at UMass intended to better serve potential physics teachers (January - December)

- Continue to promote an earth systems major in the Geosciences Department at UMass designed for prospective earth science teachers. (January - December)
- Continue to offer at UMass, GEO 497A "Geoscience Teaching" (each semester)

5. Improved teacher training: New options have been or will soon be established on several campuses, and several STEMTEC activities are in place to support the science and math preparation of all teachers. Some specific activities for 1999 and beyond include:

- Continue to promote Liberal arts / science and math teaching transfer programs approved at Greenfield and Holyoke Community Colleges in 1998. These programs are particularly important in improving the diversity of the prospective teachers. (January - December)
- Promote the science / math teacher education option at Amherst College approved in 1998. Science and math majors can now complete secondary teacher education requirements at Mount Holyoke College. Science and math faculty at Amherst will join with Mount Holyoke education faculty in supervising student teachers (January - December)
- Develop and promote a new shorter (one year) science teacher certification program to be established at UMass (May 1999)
- Continue to work with elementary and secondary teacher preparation advisors to guide students toward STEMTEC courses (every semester)
- Prepare and distribute a Five College list of Education and related courses for prospective science and math teachers to facilitate inter-campus registration (every semester)
- Obtain approval for a UMass minor in science and math education (late 1999 or 2000).

Supporting New In-Service Teachers (Goal 5): Activities to support new teachers in the Pioneer Valley during 1999 and beyond are extensions of similar activities in earlier years. Specifics:

- Two workshops each semester (February, April, September, November)
 - A workshop on active learning in the math class (February 1999)
 - A workshop on teaching astronomy with a sun wheel (April 1999)
- Compilation of a list of all new math and science teachers hired for the academic year (September each year)
- Continue to provide a mentor for all new math and science teachers who desire a mentor (September-October)
- Continue to provide Internet accounts on UMassK12 for all new teachers who need access (September-October)
- Continue to offer a new course that relates directly to teachers' current practice and to be part of the Standard Certification program at UMass (each fall semester)
- Compilation and continued maintenance of a list of science and mathematics courses taught at the eight campuses at times when teachers can take them (April-December)

Dissemination (Goal 6): Dissemination became an important focus in 1998, with an extensive and varied list of presentations, papers, and products that appears elsewhere. Our efforts in support of this dissemination include the following activities:

- Workshops on dissemination at the follow-up summer institute (June 1999)
- Continuation of "Train the trainer" workshops to produce local leaders of workshops on math and science education reform (January-December)
- Continued distribution of travel funds to regional and national conferences for faculty presenting papers on course redesign and educational reform (January-December)

- Continuation of encouraging faculty, and providing support where possible, to submit articles for publication in referred and non-referred outlets (January-December)
- Continued development, maintenance, and advertisement of a list of potential outlets for faculty presentations concerning STEMTEC reforms (January-December)
- Completion of the STEMTEC video and initial distribution (August 1999)
- Publication of the second issue of the STEMTEC newsletter, *STEMTREK* (March 1999), and next semi-annual issue in fall 1999.
- Continued maintenance and development of the STEMTEC home page with its extensive links to project materials and other educational resources
- Planning and holding a summer institute for other Massachusetts colleges on improving math and science teacher preparation (July 1999 and July 2000)
- Planning and holding a statewide meeting as a follow-up to the summer institute but open to the general academic community (November 1999).
- Planning similar semiannual meetings for later years.
- Continued advertisement of STEMTEC courses in student newspapers, admissions offices, and posters on the various campuses of the Collaborative (January-December)

Evaluation (Goal 7): Late in 1998, a new evaluation team replaced the original evaluators. This team is developing a comprehensive evaluation plan that will eventually deal with many project components. The present draft evaluation plan appears elsewhere in this report, as does the interim report for 1998 prepared by PI Feldman.

At this time, the plan is only complete through July 1999, the end of the second year of the STEMTEC project. The intent for now is to focus efforts on evaluation of the faculty professional development program and course improvements.

1. 1998 interim report: PI Feldman will analyze the data collected by the previous evaluators in the spring 1998 semester and by his assistants in the fall; his results are summarized in the separate evaluation documents (January - March 1999)

2. Case studies: Continue case studies of effective practices, examining in-depth two courses in the spring semester and two in the fall (February - May, September - December)

3. Formative evaluation: Formative evaluation will continue to be conducted by Feldman and the STEMTEC staff. As noted earlier in this Updated Strategic Plan, with the aid of a graduate student, he will offer faculty formative course evaluations and workshops on formative evaluation. Staff will also conduct formative evaluations of workshops and other activities. (January - December 1999)

4. Other activities:

- Continue organizational documentation (January - December)
- Continue collection of *NSF Impact Data* (January-December)
- Continue collection and analysis of *Student Demographic Information and Career Interest* data, using revised survey forms (January-May, September-December)
- Conduct classroom observations in a number of STEMTEC courses (January-May)
- Continue tracking students participating in STEMTEC K-12 teaching opportunities, documenting the impact of such experiences (January-May, September-December)
- Continue distribution to STEMTEC PIs and faculty of summary reports of evaluation team (January-December)

5. Draft evaluation plan: Here are the major elements of the evaluators' draft plan and the associated timeline:

Interim Measures: As proposed by the new team.

- Interim plan developed (December 1998 - April 1999)
- Baseline surveys provided (December 1998 - February 1999)

Formal Evaluation

- Articulating evaluation strategy (December 1998 - January 1999)
- Reaching consensus (January - February 1999)
- Formalizing plan (February 1999)
- Creating instruments (February - March 1999)
- Establishing criteria (March 1999)
- Gathering data (April - May 1999)
- Analyzing data (May - July 1999)
- Writing reports (July 1999)

E. Major Products

Participants in the STEMTEC project have been generating a wide range of published documents, CD-ROMs, computer software and related items. These are listed below, along with some descriptions of the items. Copies of all available, tangible products are being sent separately.

CD-ROM Media

1. **“Refrigerator Tutor.”** Produced by Professor Karl Stephan, Department of Mechanical Engineering, University of Massachusetts.

This CD-ROM is used in his course ENGIN 190E “Engineering: The Human Enterprise” that he modified as a result of his participation in the STEMTEC Cycle 1 summer institute. This CD-ROM permits students to build their own refrigerator as an investigative tool to understand how the technical processes work.

2. **“Dynamic Digital Map of New England.”** Produced by Professor Christopher Condit, Department of Geosciences, University of Massachusetts.

This is an interactive program that allows students to visit geology field trip sites that are usually a part of course trips in GEO 101 “Earth.” It can also be used for other interactive explorations of local geological phenomena.

3. **“Technology and Learning.”** Produced by Professor Al Rudnitsky, Education and Child Studies, Smith College.

This CD contains the semester projects of students who used technology to amplify and illustrate their semester projects in various topics related to history, science and education.

4. **"Chemistry 122 Animations."** Produced by students in Bill Vining's UMass general chemistry course.

Students worked with animation programs and technicians to produce small "films" about chemical principles and procedures. In addition to becoming better acquainted with the pedagogical uses of the technology, students, in their role as "teacher," came to understand chemical principles and laboratory methods better themselves.

OWL: A Web-based Interactive Learning Environment. Provided by David Hart, Center for Computer-Based Instruction; Technology, University of Massachusetts.

A number of STEMTEC classes have used or are beginning to use the OWL (Online Web-based Learning) electronic homework system in their classes. OWL was created almost three years ago at UMass to help manage the administration of regular homework in large enrollment courses. It is currently spreading to new departments and is also being enhanced to make it a more powerful learning environment.

The UMass Chemistry Department began a collaboration in 1996 with the University's Center for Computer-Based Instructional Technology (CCBIT) to replace an antiquated electronic homework system with a Web-based version, OWL. By adopting Web technology, OWL provides a platform-independent delivery system that is available all day from any web-linked computer a student or instructor can work. It also allows developers to incorporate large off-the-shelf software components for web service, databases and middleware. The OWL system was used in Chemistry for the first time in the spring of 1997, and has been used successfully ever since. In a typical semester over 50,000 Chemistry quizzes are taken, with more than 5000 in one day during peak usage periods. 75% of these quizzes are taken outside the Chemistry Resource Center (i.e. in students' rooms or other labs on campus). Student surveys administered each semester show a high degree of satisfaction with OWL, including a recognition that OWL helps students learn the material and keep up with the class. STEMTEC faculty in Chemistry whose students use OWL include Bill Vining (UMass) and Ana Gaillat (GCC).

OWL is now used in five Physics & Astronomy classes with almost 1000 students each semester. Like Chemistry, Physics has been able to eliminate discussion sections and TA time spent on grading. In one class, TA requirements were halved while the amount of graded homework for each student increased nine times over the previous, non-OWL semester. In this particular class, the instructor (Jose Mestre of STEMTEC) was able to measure a significant increase in student performance over the previous semester (a 6-8 point increase in mean scores for each of three mid-terms and one final exam), some of which can be attributed to the increased time spent on homework assignments - students reported a doubling of the time spent weekly on homework assignments from one semester to the next. Other STEMTEC faculty using OWL in Physics & Astronomy courses are Monroe Rabin and Ed Chang.

In the academic year 1999 OWL will be used in a wide variety of departments, including many by STEMTEC faculty, including: Geosciences (L. Brown, R. Yuretich, M. Leckie), Engineering (W. Burleson), Biochemistry (J. Normanly) and Entomology (J. Stofolano) and Mathematics (T. Cook).

The basic OWL is now being extended to become an interactive learning environment through the incorporation of guided discovery exercises and intelligent tutoring - all web-based. OWL's open architecture allows the incorporation of these new resources by simply treating them as additional quizzes or homework assignments, all delivered over the Web. Students are assigned

to work with a guided discovery exercise or intelligent tutor that is embedded in OWL, using it to engage in a learning activity much like an online laboratory. Once the student finishes the exercise, control is returned to OWL and the exercise results are stored with the student's permanent record in OWL's database. This allows instructors to assign active learning tasks in addition to quizzes and track students' progress in completing them.

Guided discovery exercises allow students to interact with a multimedia simulation or visualization activity, using leading questions to guide them to the "discovery" of basic laws and concepts such as gas laws or electromagnetic radiation. This technique has been used successfully in the classroom for many years by one of the authors, Vining (a STEMTEC faculty member). He has created a library of 40 or more such exercises, collectively called Chemland, that are being re-coded in Java to run under OWL's control. Thirty-three of these have been ported to Java, and they are now being fully integrated into OWL.

Intelligent tutors customize their instructional strategies to the needs of the individual student. They vary the pace of instruction, presenting problems in such a way as to challenge the student at the appropriate level. Students are required by the tutor to interact with the instructional material to demonstrate facility with it. OWL is being extended to incorporate intelligent tutors including two already developed. A Stoichiometry Tutor has just undergone large-scale evaluation during the fall semester. Results, which were very positive: 859 students scored between 6 and 11 percentage points better on Stoichiometry questions on their final exam. A Lewis Structures Tutor has also been developed and undergone initial formative evaluation. Results suggest it can be effective but has several small, correctable flaws that will make it more so. Large scale testing of this tutor will occur in the spring. Tutor development for OWL is supported by external funding. 15-20 tutors will be created and incorporated into OWL in the next two years.

Project/Course Websites

1. **STEMTEC Website.** The web site was completed reorganized and updated in August 1998 to make it more user-friendly and aesthetically appealing. Several new categories of information were added, along with links to faculty course web pages and other related science education/K-12 teacher education resources.
<http://k12s.phast.umass.edu/~stemtec>
2. **STEMTEC/Amherst College Web Site.** This site was developed by Pat O'Hara, STEMTEC Campus Coordinator at Amherst College, to keep students and faculty there informed of STEMTEC events, teaching opportunities, and courses. It serves as a clearinghouse of information and a conduit to related science/math education and teacher preparation sites. It is also accessible via the general STEMTEC home page.
<http://amherst.edu/~pbohara/stemtec>
3. **Sistahs in Science Web Site.** This site was developed by Sheila Browne, STEMTEC Campus Coordinator at Mount Holyoke College, to provide information about mentoring women and students of color in science. The site is in use by STEMTEC faculty and students, and is linked to the STEMTEC home page.
<http://www.mtholyoke.edu/courses/sbrowne/sistahs/final/index.shtml>
4. **Problem-Based Learning Web Site/On-Line Course.** This web site/future on-line course was co-developed by Steve Brewer and Joe Kunkel (Biology, UMass) and Betsy Koscher (Chapin Street School) and Cathy Wilkins (Greenfield High School) out of their collaboration during the 1998 Summer Institute on Student-Active Learning. It proposes problem-based lessons and provides a place for collecting and analyzing problem-based learning situations.

- <http://bcrc.bio.umass.edu/courses/fall98/biol/biol597t/>
5. **AST 100 Web Site.** This web site was developed by Ed Chang, UMass Amherst, for use in his introductory astronomy course. In addition to course materials, it contains links to other astronomy websites for students who wish to explore beyond the text.
<http://www-astro.phast.umass.edu/~chang/astro100.html>
 6. **BIO 111a Web Site.** This site was developed by Dick Briggs, Graham Kent, and Esteban Monserrate, Smith College, for their collaboratively revised STEMTEC course on introductory biology.
<http://131.229.114.77/bio111a>
 7. **UMass Biology Lab Web Site.** This page was developed by Steve Brewer, UMass Amherst. Brewer coordinates all of the introductory biology labs, which have become increasingly student-active under his direction.
<http://bcrc.bio.umass.edu/courses/spring98/biol101/brewer>
Also <http://bcrc.bio.umass.edu/intro>
 8. **BIO 312 Web Site.** This web site was developed by Joe Kunkel, UMass, for the STEMTEC course he teaches on writing in biology/science. His first round of modifications to the course is described on the home page.
<http://bcrc.bio.umass.edu/courses/fall98/biol/biol312k>
 9. **BIOC 565 Web Site.** This web site was developed by Jennifer Normanly, who teaches biochemistry at UMass Amherst. The site is a prototype version of a project titled "Virtual Molecular Lab", a web-based teaching resource for teachers, pertaining to the subject of molecular biology. This project is in collaboration with Beverly Woolf (CCBIT, UMass), and a proposal for further support is pending at NSF/DUE.
http://www-unix.oit.umass.edu/~bioc565/interactive/index_lessons.html
 10. **GEO 111 Web Site.** This site was developed by Bob Newton, Smith College, for his revised STEMTEC course on introductory geology.
<http://www.science.smith.edu/geology/intro>
 11. **ENGIN 191 Web Site.** This site was developed by Wayne Burleson, UMass Amherst, for his revised STEMTEC course, and is connected to the UMass OWL system, and electronic interactive homework system pioneered by STEMTEC participant Dave Hart.
<http://www.ecs.umass.edu/ece/hill/engin191.html>
 12. **ENGIN 191D Web Site.** This web site was developed by Aura Ganz, UMass Amherst, for use by students in her revised STEMTEC course.
<http://www.ecs.umass.edu/ece/eng191d>
 13. **NRS 100 Web Site.** This web site was developed by Curt Griffin, UMass Amherst, for use in "The Environment and Society."
<http://www-unix.oit.umass.edu/~earth/BIO.HTM>
 14. **PHYS 131 Web Site.** This web site was developed by Stan Hertzbach, UMass Amherst, for use in his introductory physics course. Contains course materials, links to interesting physics web sites and sites re: the teaching of physics.
<http://www-unix.oit.umass.edu/~phys131/>
 15. **PHYS 114 Web Site.** This web site was developed by Bill Mullin, UMass Amherst, for use in his course on the physics of sound, a general education course.
<http://www-unix.oit.umass.edu/~phys114/>
 16. **PHYS 139 Web Site.** This web site was developed by Bob Hallock, UMass Amherst, for use in his introductory physics course.
<http://skye.phast.umass.edu/physics139/p139.htm>

Printed Resources

1. "Investigations and Inquiries into the Oceans." Produced by Mark Leckie and Richard Yuretich, Department of Geosciences, University of Massachusetts. This is an interactive course manual that contains over two-dozen exercises and investigations designed to be completed collaboratively during class sessions of this large class. In addition, the book contains summary diagrams and outlines which are used to amplify the basic information in the textbook, and can serve as the basis for developing more elaborate and quantitative questions.
2. Programs and worksheets for "Mathematica." Produced by Murray Eisenberg, Department of Mathematics and Statistics, University of Massachusetts.
3. BIO 103: Biology Today I, Holyoke Community College Lab Manual. Produced by Gerry L'Heureux, HCC, the manual contains a number of student-active learning laboratory exercises.
4. SEM 130: Topics in Science, Holyoke Community College Lab Manual. Produced by Gerry L'Heureux, HCC, this manual also contains a number of student-active learning laboratory exercises.
5. BIOCHEM 421 Lab manual. Produced by Susan Cumberledge, University of Massachusetts Amherst.
6. Introductory Physics Lab Manual. Produced by Ken Langley, UMass Amherst. It contains a number of "workshops," exercises lead by the lab TAs and designed to help students acquire needed skills not formerly taught in the lab courses, or to supplement the lab experiments. Examples include how to write an abstract, understanding graphs of velocity and acceleration, plotting and analyzing data on the computer, designing a rope bridge. Activities are set up for use in formal groups and involve presentations and peer review of collective results.
7. Electronics Kit. Developed by Steve Murray and Chris Emery for use in their UMass course for teachers, "Electricity and Magnetism."

Other Products

Dick Little, STEMTEC Cycle I geology team chair, has developed a rock park at Greenfield Community College for use by geology students at GCC, and K-16 students and researchers across the region. See *Appendix J* for newspaper articles about the rock park.

II. F. Revised Budget

See *Appendix H* for revised NSF Forms 1030 and companion narratives. Signed versions are being sent separately to NSF by the Office of Grants and Contracts Administration (OGCA) at the University of Massachusetts Amherst.

II. G. Meeting Summaries

Reports from the two site visits of the National Visiting Committee during 1998 are included in *Appendix I*, along with reports from NSF representatives and responses to reports by the STEMTEC leadership team.

The STEMTEC PIs usually meet weekly during the academic year, and at other times when the need arises. Summaries of their meetings are included in *Appendix I*. Meeting minutes are also included for the Coordinating Council and different task groups.

II. H. Interaction/Overlap with Related Science/Mathematics Education Projects

The Five College Public School Partnership has a fourteen-year history of working with faculty members at the Five Colleges and public schools in the four Western Massachusetts counties. STEMTEC Principal Investigator Sue Thrasher, in her capacity as the Coordinator of the Partnership works directly with a number of math, science, and technology education initiatives in the Western Massachusetts area. Two other NSF funded major initiatives in math and science education (PALMS and TEAMS) in Western Mass are particularly important for the STEMTEC Collaborative.

PALMS

Partnerships to Advance Learnings in Math and Science (PALMS), the statewide systemic initiative in math and science education is now in its seventh year. Dr. Thrasher is one of three Regional Providers for the Western Mass region, and in that capacity works closely with the Massachusetts Department of Education and PALMS PIs. The majority of school districts in Western Mass are PALMS districts. Beginning in 1999-2000, all school districts will be asked to develop a district wide plan for math, science, and technology education.

PALMS Teacher Leaders, certified by the state, provide a cadre of skilled math and science educators for the region. Currently, there are sixty Teacher Leaders in the four counties; an additional fifteen are expected to be certified by the fall of 1999. Ten PALMS Teacher Leaders have participated in STEMTEC Curriculum Teams and currently, a number of participating K12 teachers are in the process of becoming Teacher Leaders.

PALMS established a regional curriculum library of NSF standards based curriculum in the Spring of 1997, and added a Curriculum Implementation Advisor to the regional staff in the same year. The library is housed at the Hampshire Educational Collaborative in Northampton, with long term loans made available to hub sites in the region. The materials in the library were selected based on their appropriate correlation to the NCTM Standards, the Massachusetts State Frameworks in Mathematics and Science and Technology, and the Massachusetts Comprehensive Assessment System (MCAS). Selected classroom kits, student textbooks, teacher guides, videotapes, and other materials are available. In addition to maintaining the library as a resource for area teachers, the Curriculum Implementation Advisor conducts extensive workshops in the region on standards based curriculum. Information on the PALMS Regional Library has been made available to all STEMTEC faculty, with a special effort to reach pre-service teachers. In 1998-99, the University of Massachusetts School of Education and the Department of Education at Mount Holyoke College received funding from PALMS to establish smaller collections of standards based curriculum materials for use by pre-service teachers.

One of the primary concerns of PALMS has been the involvement of parents and the larger community in math, science, and technology education. PALMS initiated the Parent Involvement Project (PIP) at the beginning of Phase II in 1998. The Western Mass region currently has six PIP sites with active parent and community coalitions at the district level. Activities at the six sites range from curriculum development involving teams of teachers and parents to district-wide math and science events, including picnics, fairs, and field trips.

STEMTEC interaction will be further intensified through a PALMS-funded grant recently awarded to PI Feldman and STEMTEC Cycle II participant, Kathleen Davis. Titled "Orchestrating Learning in Science and Mathematics for All," the project will focus on 1) exploring ways to integrate frameworks-based curricula in preservice teacher education; 2) developing a data system for better assessing preservice teacher preparation and early teaching experiences of graduates in the Pioneer Valley; and 3) implementing a pilot program for placing preservice teachers in pre-practicum experiences with PALMS Teacher Leaders. (See the end of *Appendix D* for the proposal funded by PALMS.)

TEAMS

Shortly after the STEMTEC project began, the Springfield Public Schools received an NSF award for promoting partnerships for minority student achievement. Teachers Emphasizing Achievement in Math and Science (TEAMS) is now in its second year. High among the goals of TEAMS is the establishment of a standards based math and science curriculum, content-based professional development for teachers, and outreach to parents and community. Principal Investigator Thrasher serves as a member of the TEAMS Advisory Board, working closely with Dr. Deborah Gendreau, Coordinator of TEAMS, Dr. Linda Abbott, Coordinator of Mathematics Education, and Erlene Provost, Coordinator of Science Education.

The level of collaboration among these various projects is perhaps best illustrated in the fact that Dr. Linda Abbott was appointed by School Superintendent Dr. Peter Negroni to represent the Springfield Public Schools on the STEMTEC Advisory Board. In addition, she is an active member of the STEMTEC Teaching Scholars Advisory Board and regional PALMS activities. Six K12 Teachers from the Springfield Public Schools have been active participants in STEMTEC Curriculum Teams, three of whom are PALMS Teacher Leaders. Another example is the College/School Math and Science Seminar begun under the sponsorship of the Five College Partnership and Project PALMS in 1994. This K16 collaborative effort has consistently provided a forum for K12 and higher education faculty to address issues of teaching math, science, and technology. The 1999 K16 Math and Science Seminar is now co-sponsored by the Partnership, PALMS, STEMTEC, and TEAMS.

Other Affiliated Projects

STEMTEC has close links to a project funded by a grant from **NASA's Mission to Planet Earth (MPTE) Program**. PIs Sternheim and Yuretich received NASA funds in 1998 to develop and support the UMass Planet Earth Education Program. The program provides summer workshops for preservice and inservice teachers (Grades 4-9), for which they receive three graduate credits. The program also requires attendance at four academic year meetings. The workshops are built around the idea that the best way to learn science is to do science, that is, to do original research. Workshop participants use the earth as a laboratory to design an elementary or middle school classroom that encourages cognitive thinking and inspires challenging experiences. During the one-week workshop held in August 1998 at UMass Amherst, participants explored the environment of our home planet. Specific activities included: 1) gaining hands-on knowledge of earth systems such as weather, climate, the ocean and rivers, and how they are all connected; 2) learning to use the Internet for electronic mail, information searching on the World Wide Web, accessing NASA databases and other earth-systems resources including remote sensing data; 3) conducting team research and investigations using computer technology and field experiences; 4) presenting research findings; and 5) exploring pedagogic strategies for teaching science. Research teams of four participants planned and carried out brief investigations in earth systems areas that combine NASA's online data with field or laboratory studies. This experience modeled the studies the participants' own students will undertake. Approximately 20 pre- and in-service

teachers participated in the 1998 workshop. A second Planet Earth workshop will take place in August 1999.

Another federally-funded project with which STEMTEC interacts operates out of the UMass biology department. Funded by OEB-DOE, the project funds seven **GAANN (Graduate Assistance in Areas of National Need) Fellows** required to have a semester-long teaching experience as part of their graduate fellowship. During this multi-year grant, the GAANN Fellows plan to collaborate with STEMTEC K-12 faculty, interacting with students and producing curriculum materials. They may also participate in STEMTEC-sponsored pedagogy workshops. Grant author Elizabeth Jakob meets periodically with PI Sternheim and Student Services Director Palmer, and a link to the project's web site is on STEMTEC's home page.

STEMTEC has also collaborated in submitting a proposal to **NSF's Undergraduate Mentoring in Environmental Biology (UMEB) program**. The proposal was submitted in January; proposed PIs are Elizabeth Brainerd (UMass Biology), Francis Jaunes (UMass Forestry and Wildlife), Sue Prattis (Hampshire College, STEMTEC Cycle II participant), and Elizabeth Jakob (UMass Entomology). If funded, the proposal would support mentoring and internships for biology undergraduates (primarily from traditionally underrepresented populations) from UMass and three community colleges. Students would participate in a range of activities, rotating through labs, working on field projects with professors and graduate students, attending regular meetings, and completing an independent research project.

Finally, STEMTEC has collaborated in submitting a proposal to **NSF's Graduate Teaching Fellows in K-12 Education program**. The proposal will be submitted soon, with Julian Tyson (UMass Chemistry) and Kathy Davis (UMass Education), both STEMTEC Cycle II participants, serving as PIs. The grant would fund graduate students in science and math to work with schools.

II. I. Newsletters, Newsclippings, Published Articles, Etc.

See *Appendix J* for several disseminable items of general interest.

III. Changes in STEMTEC Participation

A major change to STEMTEC's collaborative team came through the addition of 59 new faculty (43 college, 16 K-12) through their participation in the 1998 summer institute. Their names, curriculum team membership, and institutional affiliation are listed in Table III-A below.

Table III-A. STEMTEC Cycle II Participants

Team Name, Position	Department	Affiliation
Biology		
Donna Canuel-Browne, Teacher	Biology/Anatomy	Northampton High School
Judy Cotter, Asst. Professor	Microbiology	Holyoke Community College
Kathleen Davis, Asst. Professor	Education	Univ. of Massachusetts
David Demers, Instructor	Biology	STCC
Robert Dickerman, Instructor	Biology	STCC
Elizabeth Flores-Cotte, Teacher	Biology/Chem/Physics	Commerce High School
Sarah Fowler, Instructor	Biology	Holyoke Community College
Anna Gallo, Professor	Biology	STCC
Alan Goodman, Professor	Natural Science	Hampshire College
Sue Ellen Gruber, Professor	Biological Sciences	Mount Holyoke College
Christopher Jarvis,	Natural Science	Hampshire College
Graham Kent, Lab Instr./Supervisor	Biology	Smith College
Jeffrey Knight, Asso. Professor	Biological Sciences	Mount Holyoke College
Joseph Kunkel, Professor	Biology	Univ. of Massachusetts
Debra Martin, Professor	Natural Science	Hampshire College
Esteban Monserrate, Asst. Professor	Biology	Smith College
Susan Prattis, Asst. Professor	Natural Science	Hampshire College
Michael Quinlan, Teacher	Earth Sci./Biology	Smith Vocational School
Nancy Rapoport, Professor	Biology	STCC
Gail Schumann, Assoc. Professor	Microbiology	Univ. of Massachusetts
Catherine Wilkins, Teacher	Science	Greenfield High School
Chemistry		
Jack Barocas, Division Dean	Chemistry	STCC
Stanley Dunny, Professor	Chemistry	Holyoke Community College
Richard Fink, Professor	Chemistry	Amherst College
Ana Gaillat, Professor	Chemistry	Greenfield Community College
Michael Gerber, Teacher	Science	Hampshire Reg. High School
Betsy Koscher, Teacher	Grade 4	Chapin Street School
Allen Kropf, Professor	Chemistry	Amherst College
Jennifer Normanly, Asst. Professor	Biochemistry	Univ. of Massachusetts
Julian Tyson, Professor	Chemistry	Univ. of Massachusetts
Christine Wheeler, Teacher	Chemistry/Physics	Mohawk Trail Reg. High School
CS/Engineering		
Aura Ganz, Assoc. Professor	Elec. & Comp. Engr.	Univ. of Massachusetts
Antonio Silvestri, Professor	Engr & Science Transfer	STCC
Maria Silvestri, Teacher/Tech Coord		Holy Cross School
Geology		
John Brady, Dept. Chair	Geology	Smith College
Steve Dunn, Assoc. Professor	Geography & Geology	Mount Holyoke College
Sylvia Jamros, Science Teacher	Science	Mahar Reg. Middle School
William McCoy, Assoc. Professor	Geosciences	Univ. of Massachusetts
Mark McMenamin, Professor	Geography & Geology	Mount Holyoke College
Thomas Millette, Assoc. Professor	Geography & Geology	Mount Holyoke College
Lynn Stopen, Teacher	Science	Athol-Royalston High School

Mathematics		
Donna Bedinelli, Lecturer	Mathematics & Statistics	Univ. of Massachusetts
Norman Beebe, Adjunct Instructor	Mathematics	Greenfield Community College
Edward Connors, Professor	Mathematics & Statistics	Univ. of Massachusetts
Thurlow Cook, Professor	Mathematics & Statistics	Univ. of Massachusetts
Irene Czerwec, G/T Teacher	Interdisciplinary	Bellamy Middle School
Jan DeMers, Teacher	Grade 1	Crocker Farm Elem. School
Katherine Fenton, Math Teacher	Mathematics	High School of Sci/Tech
Melinda Gougeon, Associate Professor	Mathematics	Greenfield Community College
Leonard Groeneveld, Professor	Mathematics & Statistics	STCC
Liliana Klass, Teacher	Grade 5	Fort River Elem. School
Thomas McChesney, Professor	Mathematics	Holyoke Community College
Jim Morrow, Director	Mathematics	Mount Holyoke College
Daniel Radin, Instructor	Mathematics	Greenfield Community College
Jon Sicks, Professor	Mathematics & Statistics	Univ. of Massachusetts
Physics		
Charles Camp, Teacher	Physics	Amherst Reg. High School
Gary Charpentier, Gen. Sci. Teacher	Science	High School of Sci/Tech
Monroe Rabin, Professor	Physics & Astronomy	Univ. of Massachusetts
Toby Sutton, Professor	DAT/Science	Greenfield Community College

One faculty member (Stephanie Dunson, Cycle I Math Curriculum Team Member) left STEMTEC as a result of her resignation from Mount Holyoke College. Her departure eliminated one STEMTEC course offering, “Teaching Methods for Science and Math TA’s.” College and K-12 faculty members remaining in Cycle I and the Winter Series are listed in *Appendix A*.

Faculty from public and private colleges around Massachusetts were also contacted as potential participants in STEMTEC’s statewide efforts. Their names, institutional affiliations, and planning committee assignments are listed in Table III-B.

Table III-B. Statewide STEMTEC Planning Participants

<i>Institution</i> Name, Position	Department	STEMTEC Committee
<i>Bridgewater State College</i>		
John Johoda, Professor/Dept. Chair*	Biology	Academic Year
James Moir	Earth Science and Geography	
Maureen Moir	Education	
Farideh Oboodiat	Education	
Mary Lou Thornburg	Education	
Jeffrey Williams, Dept. Chair	Physics	Summer Workshop
<i>Massachusetts Department of Education</i>		
David Bouvier, Tech. Ed. Coord.	PALMS	Summer Workshop
Thomas Noonan, Director	Office of Math and Science	
Rob Traver, Higher Ed. Coord.	PALMS	
<i>Elms College</i>		
Dennis Drake, Professor*	Chemistry	Summer Workshop
Walter Breau	Biology	
Douglas Kimball, Adjunct Professor	Science Education	
Jan Stetson	Education	
<i>Fitchburg State College</i>		
Daniel Nomishan, Assoc. Professor*	Education	Academic Year
Stanley Bucholc	Industrial Technology	
Robert Champlin	Physical Science	

Framingham State		
Joe Caruso*	Education	
Claire Graham	Education	
Lesley		
Judy McVarish*	Mathematics Education	
Massachusetts College of Liberal Arts		
Freda Bennett, Assoc. Professor*	Mathematics	Academic Year
Melvin Band, Dept. Chair	Mathematics	
Ellen Barber	Education	
Ed Filiault,		
Salem State College		
Sandra Locke, Biology/2 ^o Ed. Coord.*	Biology	
Roda Amaria	Education	
Susan Bayard, PALMS Preserv. Pgm. Coord.	Education	
Marylou Breitborde	Education	
Anita Shea, Dean	School of Arts and Sciences	
Springfield College		
Bob Barkman*	Mathematics	Summer Workshop
Holly Dolan-Rourke, Asst. Professor	Education	
Mary Healy		
Zerobia Lojewska, Assoc. Professor	Mathematics/ Physics/CS	
Peter Polito, Professor/Dept. Chair	Physics/CS	
Tufts University		
Linda Garrant*	Mathematics	
Kathleen Camara	Education	
Marion Reynolds	Mathematics Education	
Anna Lucia Schliemann, Professor	Education	
UMass Boston		
Joan Lukas*	Mathematics	
Judy Clark	Education	
Maura Mast, Asst. Professor	Mathematics	
Martin Posner	Physics	
Robert Seeley, Professor	Mathematics	
Naresh Shah	Physics	
Peter Taylor, Asst. Professor	Education	
UMass Dartmouth		
John Russell*	Physics	
Maria Blanton, Asst. Professor	Mathematics Education	
Renate Crawford	Physics	
Jim Kaput	Mathematics	
UMass Lowell		
Paul Jablon, Assoc. Professor	Science Education	
Anita Greenwood	Education	
Ken Le Vasseur	Mathematical Sciences	
Regina Panasuk, Professor	Education	
Marvin Stick	Mathematical Sciences	
UMass Worcester		
Sandra Mayrand, Director of Science Ed.	Minority Student Affairs	
Wellesley		
Ken Hawes	Education	
Westfield State		
Maureen Bardwell, Professor/Dept. Chair*	Mathematics	Academic Year
Julian Fleron	Mathematics	
Frank Giuliano, Asst. Professor	Physical Science	
Warren Hill	Mathematics	
Phillip Hotchkiss, Asst. Professor	Mathematics	

Wheelock Jeff Winokur*		
Worcester State David Quist*	Education	
Raynold Lewis, Asst. Professor	Education	Summer Workshop

Additionally, a new advisory board was created to help administer the scholarship program. The STEMTEC Scholarship Advisory Board membership is presented in Table III-C below; an asterick (*) indicates those individuals who have not previously been affiliated with STEMTEC.

Table III-C. Scholarship Advisory Board, 1998-99

Name, Position	Department	Affiliation
Jane Abbott, Dir. of Financial Aid*		Greenfield Community College
Linda Abbott, Dir. of Math/Tech		Springfield Public Schools
Burt Batty, Dir. of Financial Aid*	Financial Aid	Univ. of Massachusetts
Diana Blazis, Assoc. Dean	Natural Science & Mathematics	Univ. of Massachusetts
Sheila Browne, Professor	Chemistry	Mount Holyoke College
Sidonia Dalby, Assoc. Director*	Ada Comstock Scholars Program	Smith College
Karen Derouin, Dir. of Financial Aid*	Financial Aid	Holyoke Community College
Allen Forsythe, Dean of Sci, Engr & Math	Science, Engr & Math	Holyoke Community College
Ana Gaillat, Professor	Chemistry	Greenfield Community College
Bailey Jackson, Dean of Education	Education	Univ. of Massachusetts
Erika Laquer, Director*	Ada Comstock Scholars Program	Smith College
Kathleen Methot, Dir. of Financial Aid*	Financial Aid	Hampshire College
Patricia O'Hara, Professor	Chemistry	Amherst College
Anne Peramba, Asso. Dir. Financial Aid*	Financial Aid	Univ. of Massachusetts
Nancy Rapoport, Professor	Biology	STCC
Vanessa Rivera, Dir., Minority Ed.	Engineering	Univ. of Massachusetts
Mary Santiago, Teacher	Grade 4	Sullivan Elem. School
Anthony Serio, Superintendent		Gill-Montague Reg. Schl. Dist.
Linda Slakey, Dean of NSM	Natural Sciences & Math	Univ. of Massachusetts
Sue Thrasher, Coordinator		Five Colleges, Inc.

The STEMTEC general advisory board also saw some changes, mostly due to administrators leaving their post. The current composition of the STEMTEC Board is listed in Table III-D. The names of new additions are indicated with an asterick (*), and the individual replaced is included below each new addition in parens.

Table III-D. STEMTEC Board Members, 1998-99

Name, Position	Affiliation
Linda Abbott, Dir. of Math/Tech	Springfield Public Schools
Jack Barocas, Division Dean*	STCC
David Bartley, President	Holyoke Community College
Donald Baumer, Dean for Acad. Dev.	Smith College
Aaron Berman, Dean of Faculty* (e. fran White)	Hampshire College
David Driscoll, Commissioner	Mass. Dept. of Ed.
John Dunn, Exec. VP/Dean of Fac.	STCC
David Entin, VP for Acad. Affs.* (Anthony Pelligrino)	Holyoke Community College
Anne Finck, Superintendent	Hadley Schools

Allen Forsythe, Dean of Sci, Engr & Math
 Paula Gastenveld, Dean of Acad. Affairs*
 (Linda Cavanaugh)
 Tom Gerety, President
 Bob Hanna, Tech. Coord.
 Bailey Jackson, Dean of Education
 Thomas Litwin, Director*
 Cora Marrett, Vice Chancellor Acad. Affrs.
 James McDonnell, Superintendent
 Jim McKeever, Manager
 Peter Negroni, Superintendent
 Thomas Noonan, PALMS Higher Ed. Coord.
 Penny Noyce, Co-PI, PALMS
 Donal O'Shea, Dean of Fac./Provost*
 (Peter Berek)
 Lorna Peterson, Coordinator
 Gregory Prince, President
 Lisa Raskin, Dean and Acting President
 Peter Rosnick, Interim Dean
 Dick Sawyer, Principal
 Gus Sayer, Superintendent
 Donna Scanlon, Curric. Supervisor
 Anthony Serio, Superintendent
 Ruth Simmons, President
 Linda Slakey, Dean of NSM
 James Tierney, Acting Superintendent*
 (Cynthia Seidel)
 Robert Traver, PALMS Higher Ed. Coord.
 Charles Wall, President
 Bruce Willard, Superintendent

Holyoke
 Greenfield Community College

 Amherst College
 Northampton Public Schools
 Univ. of Massachusetts
 Smith College
 Univ. of Massachusetts
 Holyoke Public Schools
 MediaOne
 Springfield Public Schools
 Mass. Dept. of Ed.
 Mass. Dept. of Ed.
 Mount Holyoke College

 Five Colleges, Inc.
 Hampshire College
 Amherst College
 Greenfield Community College
 South Hadley Middle School
 Amherst Schools
 Holyoke Public Schools
 Gill-Montague Reg. Schl. Dist.
 Smith College
 Univ. of Massachusetts
 South Hadley Public Schools

 Mass. Dept. of Ed.
 Greenfield Community College
 Northampton Public Schools

Several changes took place in the STEMTEC Coordinating Council. Jeff Kenney and Diana Campbell, two K-12 representatives on the Council, had to step down for personal and/or professional reasons. They are being replaced by two other K-12 faculty: Deb Lawrence, Milton Bradley Elementary School, Springfield, MA; and Jack Czajkowski, Great Falls Middle School, Turners Falls, MA. Two campus coordinators also stepped down: Margaret Robinson, Mount Holyoke College, and Karen Sullivan, Hampshire College. They were replaced respectively by Sheila Browne (professor of chemistry and Cycle I participant) and Kate Harris (Hampshire College's Science Education Program Coordinator). The current membership of the STEMTEC Coordinating Council is listed in Table III-E.

Table III-E. STEMTEC 1998-99 Coordinating Council

Name, Position	Affiliation
Sheila Browne, Chemistry Professor	Mount Holyoke College
Casey Clark, Sci. Inreach/Outreach Coord.	Smith College
Jack Czajkowski, Science Teacher	Great Falls Middle School
Chris Emery, Physics Teacher	Amherst Reg. High School
Ana Gaillat, Chemistry Professor	Greenfield Community College
Kate Harris, Science Ed. Program Coord.	Hampshire College
Gerard L'Heureux, Chemistry Professor	Holyoke Community College
Debra Lawrence, Science Teacher	Milton Bradley School
Patricia O'Hara, Chemistry Professor	Amherst College
Linda Selleck, Science Teacher	South Hadley Middle School
Georgena Van Strat, Dir. of Special Acad. Proj.	STCC

Significant changes were made to the evaluation team. As indicated elsewhere in this report, the evaluation services of the Donahue Institute (i.e., Eric Heller and Helen Gibson) were terminated in October 1998. They were replaced in December 1998 by Audrey Champagne and Eileen O'Connor. Short bios of the two new evaluators are offered below:

Audrey Champagne is currently Professor in the Department of Educational Theory and Practice and the Department of Chemistry at SUNY-Albany. She was active in the development of the National Research Council of the National Academy of Science, Engineering and Medicine's *National Science Education Standards*. She served as chair of the Assessment Working Group of the NRC's Committee on Science Education Standards and Assessment, and was one of a team of five individuals responsible for drafting the final standards document. She also serves on the National Assessment of Educational Progress Science and Mathematics Advisory Committee. She has advised on the development of the test frameworks and items for the NAEP and TIMSS, participated in setting the proficiency levels for NAEP Science, and was co-author of a national report on proficiency levels. Champagne is a fellow of the American Association for the Advancement of Science, a member of the American Chemical Society, the American Educational Research Association, the National Science Teachers Association (where she served as Board member), and the National Association for Research in Science Teaching, which she served as President in 1997. Before agreeing to serve as an external evaluator for STEMTEC, Champagne served as a member of STEMTEC's National Visiting Committee.

Eileen O'Connor is currently a faculty member at both the SUNY-Albany and SUNY-Oneonta campuses, teaching courses and conducting research on the use of instructional technology in science education. Her recent dissertation on students' use of computer molecular models in learning chemistry won a Distinguished Dissertation Award from SUNY-Albany. She has worked in industry as a business and computer consultant, a financial analyst and technical writer, and an environmental chemist, and in education as a K-8 science teacher. She has served on a number of advisory committees on implementing distance learning and computers in college and K-12 settings in New York state, and recently completed an evaluation of a pilot program to integrate laptop computers into secondary science education courses.

As a result of Champagne's agreement to serve as external evaluator, she resigned her position on the National Visiting Committee. The current composition of that committee is given in Table III-F.

Table III-F. STEMTEC National Visiting Committee

Name, Position	Affiliation
Angelo Collins, Professor	Vanderbilt University
Julia Cothron, Director	Mathematics & Science Center
Leo Hickey, Geology & Geophysics Professor	Yale University
Paul Irish, Teacher	Champlain Valley Union H.S.
John Layman, Physics Professor	Univ. of Maryland
Arnold Ostebee, Mathematics Professor	St. Olaf College
Judith Ramaley, President	Univ. of Vermont
Barbara Tewksbury, Geology Professor	Hamilton College

Also leaving the evaluation team was Mary Deane Sorcinelli, Director of the UMass Center for Teaching (CFT), who provided formative evaluation services for college faculty. As described in other parts of this document, that function is now being performed by PI Feldman and his doctoral student, Brenda Capobianco.

Finally, the STEMTEC leadership team has been supplemented by the addition of Sharon Palmer, STEMTEC Student Services Director, who oversees programs for students. Sharon has a bachelors in chemistry from UC-Berkeley, a doctorate in chemistry from Northwestern University, and has taught at such prestigious colleges as Smith and Williams. At Smith in particular, she had extensive experience with K-12 outreach programs and attracting women to science and science education.