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Annual Report

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**Science, Technology, Engineering, and Mathematics Teacher Education Collaborative:
STEMTEC**

Annual Report

Year 1

May 18, 1997 (pre-award funding start)-July 31, 1998

I. SUMMARY

Achievements

In the first several months of its first year of funding, STEMTEC has a number of achievements to its credit. The development of a functional educational collaborative which includes the flagship University of Massachusetts, four small liberal arts colleges, three community colleges, and several neighboring public school districts has been the first of these accomplishments. One strength of this Collaborative is its diversity; another is a history of collaboration bearing other fruitful initiatives in educational reform, a history that STEMTEC both builds upon and further promotes. In its first year, STEMTEC has already established a strong presence within the science and math divisions of all eight campuses of the Collaborative. Strategic planning for the next five years aims for this presence to be pervasive, a goal essential to institutionalizing educational reform. The *Annual Report* below describes STEMTEC's organizational structure and functioning in greater detail, as well as some of its strategies for promoting institutionalization.

One of our first major achievements is in the area of faculty development. In its first year, the project has provided a number of workshops aimed at improving classroom teaching practice. The 1997 Summer Institute on Student-Active Learning was held from July 14-25. Forty-two college and 28 K12 faculty (known as STEMTEC "Cycle I") worked in disciplinary teams to redesign selected college science, math and engineering courses. They were aided by local and nationally recognized speakers on education reform. The new STEMTEC Winter Series was inaugurated in January. This series of workshops has offered those college and K12 faculty unable to participate in summer workshops an alternative, academic-year route into STEMTEC. Twenty-three college and 13 K12 faculty have participated in the Winter Series to learn more about ways to incorporate cooperative and investigation-based learning into their science and math courses.

Preliminary data suggest that the investment in faculty development is paying off. In the fall of 1997, and with the help of some \$237,000 in course revision mini-grants from the project, 29 courses were revised by STEMTEC Cycle I faculty. The majority of these were introductory courses reaching a potentially large number of future teachers. Discussions with faculty through focus groups, informal dinners (see below for details about the monthly STEMTEC Roundtable), and follow-up workshops suggest a growing

enthusiasm for the student-active pedagogies advocated by STEMTEC. A number of faculty report that they have been “transformed” by their STEMTEC experiences, that they understand teaching and learning—their purposes and desired outcomes—in whole new ways, and can barely contain their new-found enthusiasm for the classroom. Indeed, they report their enthusiasm and reforms are spreading to classes beyond their single STEMTEC course and infecting non-STEMTEC colleagues as well. Students appear to be beneficiaries of this faculty development. Faculty report improved attendance, livelier classrooms, and higher test scores in some cases. Data from 1,529 student surveys collected in Fall 1997 STEMTEC courses show a significant increase ($p < .05$) in interest in engineering, math, science, and teaching from the beginning of the fall 1997 semester to semester’s end. Approximately 37 revised courses are being taught by STEMTEC Cycle I and Winter Series faculty during the Spring 1998 semester.

In addition to workshops on student-active learning and related issues, STEMTEC is supplementing its faculty development efforts with a range of other activities. The STEMTEC Roundtable, a monthly gathering of STEMTEC college faculty to have dinner and informal conversation about what is and isn’t working in their classrooms, debuted in October 1997. An average of 20 faculty per month attend the Roundtable. STEMTEC also co-sponsors a bi-weekly lecture series on student-active learning. Additionally, on six of the eight campuses, regular meetings of STEMTEC faculty and interested others are taking place, serving as additional support for those facing the challenges of course reform. Finally, the UMass Center for Teaching is offering formative evaluation (midterm assessment) for all STEMTEC faculty. We offer this wide range of faculty support both to reach large numbers of STEMTEC participants and to assess which activities are most productive and useful to continue.

Currently, the three institutions in the Collaborative with teacher preparation programs—UMass, Mount Holyoke and Smith Colleges—produce relatively small numbers of math and science teachers. At the same time, demand for these teachers in Western Massachusetts is growing. Project administrators identified over 80 openings for teachers of math and science during the 1997-98 academic year in Franklin, Hampshire, and Hampden counties alone. Clearly, there is a need for the production of more, as well as better-prepared, science and math teachers in this area.

STEMTEC has made progress in better preparing and increasing the production of future teachers. One of the central objectives of revising introductory science and math courses, of course, is to both attract and better prepare future teachers. Additionally, STEMTEC PI Sternheim played a central role in revising and getting approval for an interdisciplinary science major at UMass in Fall 1997. Although the major is ideal for students interested in becoming middle school teachers or elementary specialists in mathematics or science, few students have traditionally elected the major because requirements were more numerous than for departmental majors. Project administrators anticipate a significant increase in students attracted to future teaching with the addition of a revised science major that allows them to complete certification within four years.

Project administrators have also begun discussions around two other options aimed at teacher enhancement: a Five Colleges Science and Math Teacher Certification program, and a science and math teaching “minor” or “concentration” at some of the participating colleges. The second year of the project will focus extensively on the feasibility of these two options. Already underway at the three community colleges are proposals for transfer options (e.g., an A.A. in Arts and Sciences, with a Science Education Transfer Option) suitable for students wishing to pursue provisional certification in Massachusetts. All of these initiatives have the potential for increasing the production of science and math teachers in the Pioneer Valley, and for institutionalizing the joint mission of STEMTEC and NSF.

These programmatic initiatives are accompanied by other strategies to enhance teacher production and preparation. Central is the incorporation of teaching opportunities for students enrolled in STEMTEC courses. During Fall 1997, eight courses offered teaching opportunities and 88 undergraduates took advantage of them. Sixty-six percent of these students reported the experience as having a positive effect on their plans to pursue a teaching career. The incorporation of these opportunities into STEMTEC courses is facilitated by a web-based system of “want ads” that match college and K12 faculty mutually interested in providing teaching experiences for undergraduates. A full-time graduate assistant (Tarin Weiss) coordinates the teaching experiences component of STEMTEC. Finally, a new course at UMass, “Exploring Teaching in Science and Mathematics,” was approved in Fall 1997 and is being offered for the first time Spring 1998. Co-taught by PIs Feldman and Yuretich as a one-credit seminar, the course offers students readings about effective teaching and hands-on experience in neighboring school districts. The course is open to all Five College students through the consortium’s interchange program.

The recruitment of women and minorities to math and science teaching should receive a boost from a proposal to NSF to fund a merit- and need-based scholarship program. Shepherded by PI Thrasher, and submitted to NSF on January 16, 1998, the proposal requests \$100,000 per year to fund advanced students committed to certification in math and science teaching, returning and community college students, and first-year students recruited from programs supporting those traditionally underrepresented in math and science. Additionally, a plenary meeting of Cycle I and Winter Series participants on February 7, 1998, focused on issues of diversity.

STEMTEC has a strong start on supporting new teachers in their first years in the classroom by organizing two meetings for them (one during Fall 1997, one during Spring 1998) and providing Email accounts and mentors for all new teachers wishing them. A workshop for STEMTEC K12 faculty on mentoring techniques was also held in Fall 1997.

With the project only a few months underway, dissemination efforts are just beginning. They include the production of a video about STEMTEC (directed by PI D’Avanzo), the development of a web site (<http://k12s.phast.umass.edu/~stemtec>), and the debut of a project newsletter, *STEMTREK* (due out the end of March 1998).

The evaluation team has achieved a great deal in the first few months of the project. They have completed formative course evaluations for several STEMTEC faculty, in-depth case studies of effective practices in two STEMTEC courses, initial interviews to document organizational development, formative assessment of STEMTEC workshops, focus groups with faculty attempting course reform, and the collection of demographic and career interest data for students enrolled in STEMTEC courses. This feedback has been critical to revising our strategic planning and providing insight into genuine reforms taking place throughout the Collaborative. More information about the evaluation process is included in the separate *Evaluation Report 1997-1998*.

Problems

The central focus in STEMTEC's faculty development program thus far has been workshops to improve classroom practice through the adoption of student-active learning techniques. As the report by the National Visiting Committee (NVC) suggests (see *Appendix K* for the NVC report), this focus has overshadowed curriculum reform and overall program development. To a certain extent, this has been a calculated oversight: by generating the excitement that comes with changing teaching practice for the better, project administrators hope that faculty will become invested enough to serve as confirmed advocates for broader curriculum reform on their campuses. Also, of course, it is critical for future teachers that they have good models of how to teach. As already suggested, there is some evidence that faculty are becoming excited by the changes wrought by STEMTEC; whether that excitement translates into the enthusiasm required for changing the climate of science and math teaching on all the campuses of the Collaborative is a question that awaits answer. Project administrators have attempted to shift our focus toward curriculum redesign by creating a multi-staged model for summer and follow-up workshops: the first year focuses on student-active teaching techniques, the second on course redesign, the third on curricular change. Additionally, we will attempt to include more the perspectives of those experienced with the principles of educational course design. For more details about this new approach, see *C. Project Analysis and Changes in Long-Range Plans* below.

Also in regard to faculty development, the NVC expresses concerns about the voluntary nature of course evaluations and the lack of genuine, ongoing support for faculty engaged in curriculum reform. Project administrators are addressing these problems in several ways. First, the evaluation team is visiting classes this semester to gauge the extent to which faculty are making progress in their course reform. Additionally, project administrators are trying to learn more about the norms surrounding evaluation on each campus to better tailor evaluation processes. For example, on one campus of the Collaborative, course evaluations are completely voluntary and hence ignored by the majority of students and professors alike. On another campus, student evaluations appear a source of genuine faculty anxiety, possibly because they are central in faculty tenure and promotion decisions. On yet another campus, evaluations are mandatory but appear to have so little to do with faculty and promotion decisions that they're not considered important avenues for feedback. Certainly, resistance to formative evaluation by project participants is fairly high across the board. One generic approach being considered by

project administrators is to place greater emphasis on self-assessment techniques, which would give faculty the control they appear to desire, although admittedly might not address the voluntarism the NVC finds problematic.

The emphasis on faculty development has also overshadowed the teacher enhancement mission of STEMTEC. Project administrators have spent considerable time since the NVC visit discussing how to create a STEMTEC “team jacket” for students—i.e., mechanisms to bring students into the STEMTEC fold, engender their identification with the project, and lead more down the path of teacher certification. As already discussed, several programmatic initiatives (e.g., a 5C Science and Math Teacher Certification program; science and math teaching “minors”) are being explored. Additionally, it is becoming clear that a more systematic, centralized approach to providing teaching experiences will have to be developed; while faculty are becoming increasingly invested in student-active learning, they have not yet fully bought into the teacher enhancement mission of STEMTEC and remain reluctant to build teaching opportunities into their undergraduate courses. Relying purely on individual faculty to provide such opportunities will need to be augmented with greater coordination by and assistance from project administrators, at least in the short run. The newly revised plan to recruit and better prepare future teachers of math and science is described in greater detail below in *C. Project Analysis and Changes in Long-Range Plans*.

The NVC writes that “based on its examination to date, the [Committee sees] little evidence that STEMTEC has a proactive outreach program to recruit minorities into science and mathematics teaching.” At the time of its visit, this was certainly true and due partly to the lack of any program to recruit students into teaching independent of revising introductory courses and offering a few K12 teaching experiences. Rightly or wrongly, project administrators are placing some faith in the ability of the proposed scholarship program to entice women and minority students into science and math teaching. In anticipation of a successful proposal, PIs Feldman and Thrasher, in conjunction with Campus Coordinators, are identifying all minority students majoring in math and science and all support organizations for such students within the Collaborative. Additionally, Feldman is organizing a careers panel featuring several STEMTEC college and K12 faculty, to which all math and science minority students within the Collaborative will be invited. Certainly, the STEMTEC PIs take seriously the NVC’s recommendation that they “develop a comprehensive plan that addresses this critical issue [of needed diversity within the project].” They also appreciate Dr. Terry Woodin’s advice in her notes on the NVC meeting: “There should be more attention to the needs of women and minorities. So far the project does not seem sensitive to their needs either in recruiting or in course design.” Addressing these issues will become key in continued planning for teacher enhancement and faculty development during the second year of the grant.

One final problem this first year has been financial/organizational in nature. The Cooperative Agreement with NSF arrived the end of August 1997, several weeks after the conclusion of the Summer Institute and only a week before the start of fall classes. By the time the lead institution had processed all of the paperwork and loaded the budget into its computer system, fall STEMTEC courses were well underway. This translated

into some ill will from faculty anticipating stipends that eventually came some three months late and course revision funds that didn't come until close to half-way through the fall term (even later for the community colleges with subcontracts that required independent negotiation). These problems have been resolved. Winter Series participants have received their stipends and course revision funds in a timely manner; barring any problems with the second year budget, mechanisms are in place to ensure on-time funds to Cycle II participants as well.

II. ANNUAL REPORT

A. 1. STEMTEC Activities and Impact

STEMTEC Goal #1: Establish a functional educational collaborative

The STEMTEC project grew out of an established nucleus of dedicated college and K12 faculty who are committed to the idea of improving the educational environment in science and mathematics classrooms at all levels. A natural collaborative enterprise already existed prior to the initiation of STEMTEC. Five Colleges, Inc. was formed in 1965 to coordinate academic events and interchange among the campuses in the Connecticut Valley (Amherst College, Hampshire College, Mount Holyoke College, Smith College and the University of Massachusetts). Within this organization, the Five Colleges/Public School Partnership was created in 1984. The specific task of this enterprise is to bring together college and K12 faculty for their mutual benefit in professional development workshops, seminars and teacher training projects.

Several significant projects in science and mathematics education were developed as a result of this infrastructure, including two funded by NSF, SPACEMET (TEP #8850948) and 5C5E (TEP #9150262). A centerpiece of these projects was summer workshops, where K12 and college faculty worked together to undertake research projects that could subsequently be carried out in a K12 classroom setting. The net result was a highly motivated cadre of K12 teachers who could communicate freely and easily with college science and math faculty. The success of these projects provided a model based upon summer institutes and frequent academic-year interactions that was used in the design of STEMTEC.

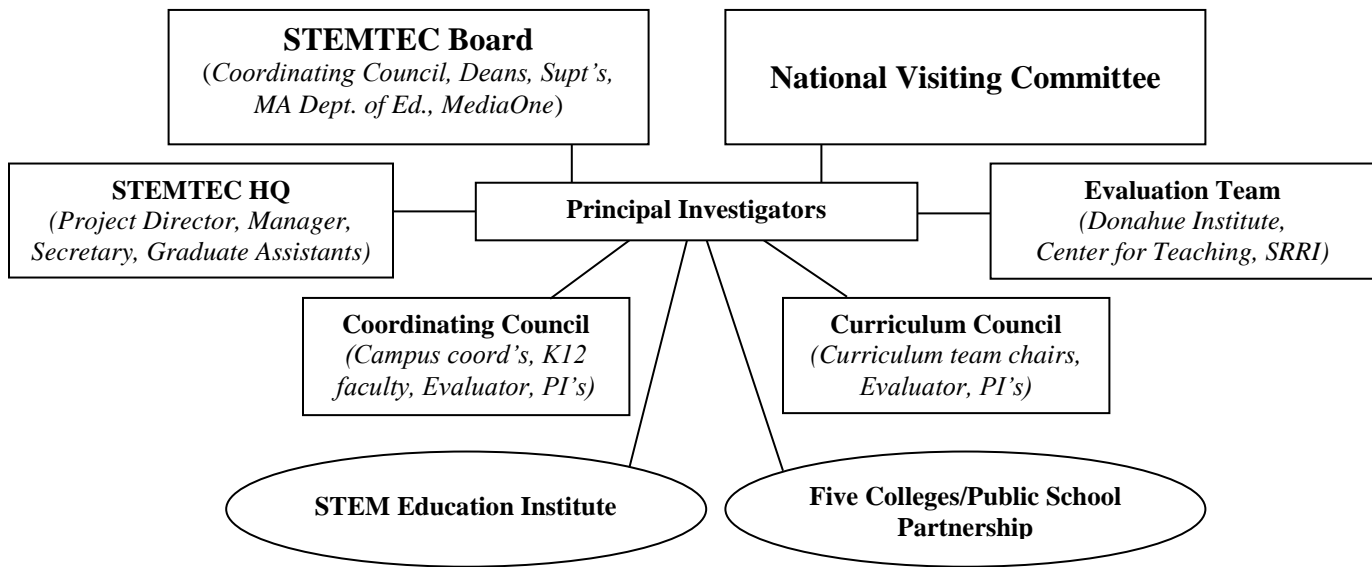
The STEM (Science, Technology, Engineering and Mathematics) Education Institute was born of the need for a permanent entity to promote science and math education at all levels. It forms the basis for the management structure of STEMTEC.

The STEMTEC Management Structure

An organization as large and complex as the STEMTEC collaborative requires a multi-layered organizational structure for effective management of its affairs. Figure 1 is an overview of the layout; each management unit has its own unique role.

1. **STEMTEC BOARD.** Senior administrative officials from the campuses and K12 school districts meet with the STEMTEC Council semi-annually as the STEMTEC Board. Current membership is given in *Appendix A, Table 1*. The Board reviews the progress of the project, assists in the planning and direction of the various components, and plans the institutionalization of the accomplishments beyond the life of the grant. The Board convened twice during 1997: April 23 at the Willits-Hallowell Center at Mount Holyoke College, and December 5 at the Campus Center at University of Massachusetts Amherst. It convenes again on May 5, 1998 at the Alumnae House at Smith College.

Figure 1. Overview of STEMTEC Management Structure



2. STEMTEC NATIONAL VISITING COMMITTEE (NVC). The National Visiting Committee is comprised of recognized leaders in the fields of science, math, and education. It provides advice to STEMTEC’s leadership concerning the organization and programmatic components of the project, offers assistance with program implementation and dissemination, and objectively assesses progress toward project goals. Although it reports to both the project leadership and NSF, it is ultimately responsible to the latter. The NVC meets with project leadership twice during the first year of the grant, once per year in succeeding years.

The membership of the STEMTEC National Visiting Committee consists of nine nationally recognized leaders and appears in *Appendix A, Table 2*. The first meeting of the STEMTEC NVC was November 21-22, 1997 at the University of Massachusetts Amherst. Dr. Terry Woodin, NSF/DUE Program Manager, attended the meeting along with seven NVC members. The NVC’s report, along with Dr. Woodin’s notes from the meeting, are included in Item G below. The second meeting of the STEMTEC NVC will be held April 3-4, 1998.

3. STEMTEC PIE (Principal Investigators and Evaluators) has the primary responsibility for administrative oversight of the project, planning meetings of the participants, measuring progress in the various components of the plan, and making changes as needed in the proposed work. This body meets weekly (during the fall of 1997 and spring of 1998, Wednesday mornings from 8:30-11:30 a.m.). Responsibilities have been further subdivided among the various principal investigators:
 - General Management. Project Director Sternheim is responsible for the overall coordination of the project: serving as Chair of PIE, supervising the Project Manager,

monitoring the evaluation team, overseeing the technology components (Internet, email and instructional technologies) and working with the staff to assure that bookkeeping, reporting, and scheduling tasks are in order.

- Curriculum Development. Principal Investigators Yuretich and D'Avanzo supervise the course redesign process. They assume the principal role in designing and planning workshops on student-active teaching; recruiting and selecting faculty for these workshops; overseeing the academic-year implementation of proposed course changes. In addition, they are the primary contacts for the National Visiting Committee.
- Recruiting and Supporting Teacher Candidates. Principal Investigators Feldman and Thrasher are responsible for monitoring and developing the teaching experiences programs. Specific tasks include recruiting K12 teachers to participate in the course re-design workshops and serve as mentors for future teachers; coordinating alliances between K12 teachers and undergraduates in the STEMTEC courses; providing support for graduates just beginning their teaching careers.
- Dissemination and Outreach. Principal Investigators D'Avanzo and Yuretich coordinate the dissemination of the results. This includes seminars within departments and campuses, publication in professional journals, presentation at regional and national conferences and hosting an international conference to be held at the end of the granting period. Short videos of major project highlights will also be prepared.
- Evaluation. The evaluation team is responsible for this critical component. Principal Investigator Feldman monitors the progress of the evaluation team. There are three principal segments to the evaluation program:
 - ◇ Formative evaluation to identify strengths and weaknesses and enable modifications. This phase of the evaluation is directed by Mary Deane Sorcinelli of the Center for Teaching.
 - ◇ Summative evaluation to track gains in the attainment of project goals. Eric Heller is the leader of this phase.
 - ◇ Case studies and documentation of the project to capture emerging program models. John Clement supervises this segment.

The evaluators also have primary responsibility for maintaining the data bases on student numbers, diversity and the impact of the STEMTEC course re-design process.

4. STEMTEC COORDINATING COUNCIL. This is the primary contact with all the participating campuses. Each campus has a coordinator whose responsibilities are to supervise the implementation of course redesign by participating faculty on that campus; monitor the placement of undergraduates in the teaching experiences program; keep track of the financial aspects of the project related to the campus. The campus coordinators, four participating K12 teachers, a representative from the evaluation team, and the principal investigators comprise the Coordinating Council (*Appendix A, Table 3*), which meets the first Monday evening of each month.
5. CURRICULUM COUNCIL. College faculty are organized into curriculum teams according to discipline, with two K12 faculty as resource personnel. Each Cycle I

team has a chair (*Appendix A, Table 4*) with the overall responsibility of seeing that team members are progressing. The chairs are asked to call periodic meetings of the team members, and the principal investigators meet with the chairs on a semester basis as the Curriculum Council (this body met twice during the fall semester of 1997).

6. STEMTEC HQ. This is the core office which oversees the day-to-day operations of STEMTEC. It is managed by a full-time Staff Associate/Project Manager (Dr. Susan Newton) working directly with the Project Director. The Project Manager is assisted by a full-time secretary and additional graduate and undergraduate project assistants as needed. *Appendix A, Table 5* lists the current staffing. STEMTEC HQ is housed in the Lederle Graduate Research Towers at the University of Massachusetts Amherst.

Responsibilities of STEMTEC HQ are:

- Scheduling and arranging the logistics for workshops, meetings and seminars
- Working with Principal Investigators to develop programs for these events
- Serving as a communications center for the Principal Investigators
- Assisting and supporting the evaluation program
- Preparing brochures, newsletters, publicity and college catalog copy
- Assisting with dissemination efforts locally, regionally and nationally
- Preparing reports as required
- Working with the Five Colleges/Public School Partnership to recruit and track potential teachers
- Maintaining central financial records and purchasing
- Overseeing the subcontracts to Five Colleges, Inc. and the community colleges

Establishing an effective leadership and management structure for our educational collaborative is now complete and one of the first important objectives reached by STEMTEC.

STEMTEC Goal #2: Redesign the science, math, and science/math education curricula on the various campuses of the collaborative to incorporate new pedagogies, and establish mechanisms for supporting faculty in their course redesign.

One of STEMTEC's primary goals is to assist college science and mathematics faculty in redesigning courses that incorporate student-centered learning techniques. STEMTEC has developed a number of strategies for supporting faculty in their course revisions:

1. Offer **workshops** on incorporating cooperative learning, investigation-based teaching, educational technology, alternative assessment, strategies for attracting and retaining underrepresented groups, and teaching opportunities into new and existing math, science, and engineering courses.
2. Provide **mini-grants** for course redesign.
3. Develop **other formal and informal opportunities for faculty to discuss pedagogy and curriculum reform**, including co-sponsoring related activities and lectures on student-active learning.

4. Provide **formative evaluation** in support of course redesign.

In the first several months of the project (May 1997-March 1998), all four of these strategies were employed to support course revision within the Collaborative. These strategies involved the following activities:

- The composition of “Cycle I” disciplinary teams comprised of 42 college faculty from the eight campuses of the Collaborative and 14 K12 faculty from the seven surrounding school districts (see *Appendix B, Table 1* for Cycle I curriculum team composition).
- The STEMTEC 1997 Summer Institute on Student-Active Learning for Cycle I, held July 14-25. This series of workshops acquainted faculty with pedagogical techniques known to increase learning in the classroom. Disciplinary teams comprised of both college and K12 faculty collaborated to discuss issues of pedagogy relevant to their disciplines and assist one another in rethinking individual courses. Fourteen K12 teachers—known as “Mentors”—attended three days of the workshop, serving primarily as point persons in identifying and arranging undergraduate teaching experiences (see *Appendix B, Table 2* for a list of Cycle I Mentors). Additionally, each college faculty member prepared a plan for redesign of an introductory-level course in his or her discipline. See *Appendix C* for a Summer Institute schedule and a synopsis of each session. (Proceedings of the first week of the Summer Institute are available via the STEMTEC web page. All sessions of the Institute were videotaped and are available for viewing at STEMTEC HQ. A five-minute video of the highlights of the Institute is also available.)
- A follow-up one-day workshop on formative evaluation, K-12 teaching experiences, and mentoring for Cycle I faculty, held September 13, 1997 at Greenfield Community College (see *Appendix C* for workshop schedule).
- A follow-up one-day workshop on issues of diversity and course portfolio development for Cycle I faculty, held February 7, 1998 at UMass Amherst (see *Appendix C* for workshop schedule).
- Planning for the Cycle I follow-up Summer Institute to be held July 7-10, 1998 (tentatively on the campus of Amherst College).
- The development in October 1997 of a new STEMTEC Winter Series. This series of workshops was added to the project for the following reasons:
 - 1) Currently, the primary path to participation in STEMTEC is the two-week summer workshop. Many faculty who would like to participate are unable to do so because they can not fulfill both workshop and summer research or other obligations.
 - 2) The original model served a relatively small percentage of the Collaborative’s faculty in the sciences, math, and engineering: less than 10% at UMass, and higher—but still modest—percentages in the other participating colleges.
 - 3) The goal of internal dissemination (within the Collaborative) would be greatly facilitated by additional workshops spread throughout the academic year. In general, our goal is to reach as many faculty on our campuses as possible who are involved in courses likely to be taken by future teachers.
 - 4) A regular academic year workshop series is potentially more sustainable (i.e., could live beyond the life of the grant) than a longer summer workshop.

- 5) An additional workshop model offers opportunities for comparing models for dissemination.
- The composition of Winter Series disciplinary teams comprised of college faculty from seven of the eight campuses of the Collaborative and K12 faculty from the seven surrounding school districts (see *III. NEW STEMTEC PARTICIPANTS* below for a list of Winter Series participants).
 - Winter Series workshops held January 17-19 (on cooperative and problem-based learning), February 7 (a joint plenary with Cycle I on issues of diversity), March 7 (on alternative assessment), and April 25 (forthcoming, on educational technology). In addition to participating in the workshops, each professor will design or redesign a course or part of a course taught during the academic year 1998-99. (See *Appendix C* below for schedules for all but the April 25 workshop.)
 - Twenty-nine courses on the eight campuses of the collaborative were revised and taught during the fall of 1997 by Cycle 1 faculty; another 37 courses are being revised and taught by Cycle 1 and Winter Series faculty during the spring of 1998. The revised syllabi for these courses emerged from work conducted during the Summer Institute and Winter Series, and are now being supported with course development mini-grants. An average of \$8,000 per course has been allocated for a range of student-active revisions in Cycle I courses; \$2,000 per course has been set aside for courses revised by Winter Series participants. A subcommittee of the principal investigators and staff (D'Avanzo, Newton, Sternheim, and Yuretich) review each course development proposal and request for funds, and make recommendations to faculty about proposed course revisions and budgetary allocations. *Appendix D* contains a list of those courses being revised during 1997-98, along with descriptions of course revisions, by discipline.
 - The initiation of the STEMTEC Roundtable, an informal monthly dinner meeting to discuss successes and failures with classroom reform. The Roundtable was kicked off October 20, 1997, with additional dinner meetings November 10, 1997, February 23, March 23, and April 20, 1998. The Roundtable is organized by PIs D'Avanzo and Thrasher.
 - The initiation of campus-based support group meetings for STEMTEC faculty at all but two of the campuses of the Collaborative.
 - Co-sponsoring the STEM Education Institute Lecture Series, which offers lectures pertaining to student-active teaching the first and third Tuesdays of every month at UMass Amherst. The series brings in a range of outside speakers with experience in course redesign and curriculum reform. Steve Nathan, a graduate research assistant with the STEM Institute, organizes the Series. See *Appendix E* for a list of speakers thus far during 1997-98.
 - Co-sponsoring, with the STEM Education Institute and UMassK12, two HTML workshops for college and K12 faculty.
 - Sponsoring a local satellite link to a live, interactive seminar on undergraduate curriculum reform held on November 3, 1997, and organized by the American Chemical Society.
 - Co-sponsoring (with the STEM Education Institute) a workshop by Professor Barbara Tewksbury (Geology, Hamilton College, STEMTEC NVC member) on "Practical

Strategies for Engaging Students in the Classroom and Assessing Their Work,” February 16, 1998, UMass Amherst.

- Co-sponsoring, with the UMass Physics and Astronomy Department, a talk by Mary Ellen Harmon (Boston College) on the Third International Mathematics and Science Study (TIMSS), February 25, 1998, UMass Amherst.
- Sponsoring travel for three STEMTEC math curriculum team members to an MER (Mathematics and Education Reform) Forum on *Developing Leadership in Elementary and Middle School Mathematics Education*, May 8-10, 1998, in Chicago (forthcoming).
- Formative evaluation provided by the UMass Center for Teaching for eight STEMTEC faculty in Fall 1997 (see separate *Evaluation Report 1997-1998* for more about this).
- Planning for the Cycle I recall workshop to be held July 7-10, 1998.
- Planning for a second summer institute to be held July 13-24, 1998, with a new group of approximately 45 college faculty and 15 K12 faculty. This group of faculty and teachers is referred to as “Cycle II.” A number of Cycle I faculty will be principally involved in the planning and operation of the Cycle II summer workshop. Planning and recruiting curriculum teams for Cycle II is currently underway (see *Appendix F* for college and K12 participant agreements).

STEMTEC Goal #3: Improve the preparation of future K12 teachers of mathematics and science.

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

During the first few months of the project (May 1997-March 1998), a number of activities revolved around Goals #3 and #4, recruiting and better preparing future teachers:

- Course redesign in introductory courses taken by significant numbers of future elementary and secondary teachers (approximately 80% of the courses being revised by faculty are below the 200 level; see above for more about course redesign).
- Developing flyers to advertise STEMTEC courses and distributing them to appropriate persons on the various campuses of the Collaborative.
- The incorporation of a range of educational technologies—including simulations, World Wide Web applications, and CD ROM-based virtual field trips—in a number of STEMTEC courses.
- A meeting on November 6, 1997, to discuss the greater incorporation of educational technology into educational methods courses at UMass.
- The development and approval at UMass of NSM/EDU 197A, “Exploring Teaching in Science and Mathematics,” a one-credit seminar co-taught in Spring 1998 by Allan Feldman (School of Education) and Richard Yuretich (Geosciences). This course is cross-listed through the College of Natural Sciences and Mathematics and the School of Education and is available to all Five College students through the consortium’s interchange program. It includes the placement of undergraduate students in K12 teaching situations.

- The completion of a revised interdisciplinary science major at UMass especially appropriate for future middle-school teachers and for elementary teachers preparing to be science or mathematics coordinators or specialists (see *A.5. Modifications to Teacher Preparation Programs* for details about the Science Major).
- The submission of a proposal to NSF for funding a STEMTEC Teaching Scholars Program (January 16, 1998) (see *A.9. Progress Toward Full Participation of Underrepresented Groups* below for additional information about the proposal and *Appendix F* for the narrative of the proposal).
- Meetings with the financial aid officers at the five colleges (March 5-6) and at the three community colleges (March 30, forthcoming) to discuss the STEMTEC Teaching Scholarships and their dispensation by campus.
- The identification of campus-based support groups for women and minorities in science (see *A.9. Progress Toward Full Participation of Underrepresented Groups*).
- For recruitment and retention purposes, ongoing compilation of lists of minority science and math students on the eight campuses.
- A meeting with Vanessa Rivera to discuss collaborations with her Minority Engineering Program at UMass (October 1997).
- A meeting with Floyd Martin, Director of CCEBMS, a UMass organization providing tutoring and counseling for black and minority students, to discuss their services and potential collaboration with STEMTEC (February 1998).
- A meeting with J. Gary Bernhard, Director of UMass University Without Walls, to explore a collaboration with the University Without Walls/Springfield Technical Community College program designed to enable teacher aides to become certified teachers (see *A.5. Modifications to Teacher Preparation Programs* below for details of this program).
- A plenary workshop on diversity (February 7, 1998 at UMass Amherst).
- A workshop on developing teaching experiences as part of STEMTEC courses (September 13, 1997 at Greenfield Community College). During the morning session, geographic groups of college and K12 faculty met to discuss ways to incorporate K12 connections into STEMTEC courses. Potential collaborative ideas included the following: exchanging information regarding student-active pedagogy, allowing college students to develop K12 teaching modules in STEMTEC courses, enhancing the professional development of K12 teachers through participation in college classrooms and mentoring undergraduates, and structuring opportunities for undergraduates to develop K12 lab programs, become E-mail mentors, and work with science fairs or other special programs. In addition to identifying potential areas of collaboration, these sessions also provided a way for K12 and college faculty to discuss some of the obstacles they face in implementing these programs. Some examples cited were: schedules, transportation to participating district schools, issues of liability, and technological compatibility.
- The development of a web-based system of “want-ads” to match college and K12 faculty seeking to structure and provide teaching experiences within local classrooms.
- The incorporation of a teaching experience component into several STEMTEC courses, facilitated by graduate assistant Tarin Weiss (see *Appendix H* for a report on K12 connections thus far).

- Meetings with local leaders (e.g., Dick Stein of the National Plastics Museum in Leominster, MA; the Director of the Hitchcock Center for Environmental Education in Amherst; Lonnie Kaufman and Andrew Churchill of the School to Careers program) to begin discussions of informal science teaching opportunities.

STEMTEC Goal #5: Develop a program to support new science and mathematics teachers in their first years in the classroom

As noted in the Collaborative’s proposal, “Even when provided with exemplary preservice teacher education, new teachers find the first few years in the classroom to be trying experiences. Therefore, in order to better ensure the retention of new teachers, STEMTEC will provide support during their induction into the profession.” Activities to accomplish this goal during the first few months of Year 1 include:

- The compilation of a list of all new math and science teachers in the Pioneer Valley (N=81).
- A workshop for STEMTEC K-12 faculty on mentoring new teachers on September 13 at Greenfield Community College.
- An initial meeting to introduce all new teachers in the Valley to one another, STEMTEC K-12 faculty, and the goals of STEMTEC on October 6 at Holyoke Community College attended by 35 new teachers (see *Appendix C* for workshop schedule).
- A second workshop for new teachers on classroom management held February 12, 1998.
- The pairing of all new math and science teachers in the region who wished with a STEMTEC Mentor or Curriculum Scholar.
- The provision of Internet accounts on UMassK12 for all new math and science teachers in the region who needed access.

STEMTEC Goal #6: Establish dissemination mechanisms

Thus far, on the **internal dissemination** front, we have encouraged faculty who participated in the summer 1997 workshop to use already existing vehicles such as departmental seminars to explain what STEMTEC is about and to describe the reforms they are attempting in their courses. The following are examples of what our participants organized on their own campuses this year:

- Pat O'Hara at Amherst College discussed the overall program and its goals with chemistry faculty during the weekly departmental seminar.
- Merle Bruno, John Reid, and Brian Schultz at Hampshire College have told "STEMTEC stories" about how their teaching has changed during weekly school meetings.
- At Holyoke Community College, Gerry L'Heureux, Erica Bergquist, Kate Maiolatesi, and Win Lavalley presented a workshop titled “Active Learning in the Classroom” for the campus’ Professional Development Day.

Additionally, we have begun a monthly evening roundtable for all STEMTEC and other interested faculty at Five Colleges Inc. The format is informal and includes dinner so that faculty who are changing how they teach have an opportunity to exchange ideas and discuss issues in a supportive group setting.

PIs Thrasher and D'Avanzo are currently working to develop a nucleus of local presenters/facilitators who could give workshops on student-active learning approaches in their department or institution, or at professional meetings. This "train the trainer" model has been used successfully before, and has the potential for widespread dissemination of reforms in science and math teaching at a cost that would be sustainable. Such dissemination strategies are important in institutionalizing educational reforms. The first meeting of individuals potentially interested in becoming local workshop leaders is scheduled for April 7, 1998.

And finally, of course, we have developed the new STEMTEC Winter Series as a key mechanism for dissemination beyond the two cycles of faculty initially proposed to NSF.

External Dissemination at this stage of the project consists of publicity, presentations, workshops and a video that describes the STEMTEC program and the goals underlying the CETP program. During 1997-98 thus far:

- News about STEMTEC's receipt of the grant and the 1997 Summer Institute has appeared in newspapers and newsletters around the state—the local *Daily Hampshire Gazette*, the *Springfield Republican*, the *Boston Globe*, the Five College/Public School Partnership newsletter (produced by Sue Thrasher), the *UMass Chronicle*, etc.
- PI D'Avanzo led a workshop on inquiry-based teaching in introductory ecology courses at the national meeting of the Ecological Society of America (August) and two teaching workshops on student-active teaching in introductory college courses and using the Internet for student investigations at the national meeting of the Estuarine Research Society (October). D'Avanzo also has agreed to co-lead a workshop on student-active teaching in ecology courses for the 1998 annual meeting of the Ecological Society of America.
- PIs Feldman and Sternheim made a half-hour presentation about STEMTEC and led a panel discussion on incorporating curricular frameworks in preparing teachers of science and technology at the Massachusetts Department of Education (MA DOE) conference, "Integrating Curriculum Frameworks and Principles of Effective Teaching into Teacher Preparation" (Mount Holyoke College, October).
- PIs Sternheim and Thrasher met with Franklin County superintendents of schools and other K12 school administrators to describe the project, its impact on K12 faculty, and potential college-K12 collaborations (September).
- Members of the STEMTEC Chemistry Curriculum Team participated in a live, interactive satellite television seminar sponsored by the American Chemical Society and titled "Undergraduate curriculum reform: Its effects on high school and college level teaching." STEMTEC sponsored the satellite link at the University of Massachusetts Amherst. (November).

- PI D'Avanzo has had accepted for publication in the *Journal of College Science Teaching* a paper titled "The K-16 Continuum: What College Science Faculty Can Learn About Change From School Teachers"
- PI Feldman, in collaboration with PALMS (Partnerships Advancing the Learning of Mathematics and Science, the NSF systemic state initiative) and MA DOE, is helping organize an April conference at Worcester State on science education reform.
- Dick Little of Greenfield Community College (Cycle I Geology Team Chair) is organizing the 1998 meeting of the National Association of Geoscience Teachers. The meeting will be held in May at GCC and members of Cycle I and Winter Series geology teams will make presentations about their STEMTEC experience.

Internal/External dissemination efforts thus far include the following:

- Work began in October on developing a project newsletter. The inaugural issue of the STEMTEC Newsletter, *STEMTREK*, is due out at the end of March 1998. STEMTEC graduate assistants Drue Johnson, Steve Nathan, and Johanna Rodrigues are serving as co-editors of this publication.
- The STEMTEC home page is now up and running. It contains STEMTEC curricular materials, want ads to aid college and K12 faculty in developing undergraduate teaching experiences, calendars, lists of conferences for potential presentations, and a number of links to other relevant sites. The STEMTEC home page is located at <http://k12s.phast.umass.edu/~stemtec>.
- In conjunction with developing posters advertising STEMTEC courses and working with graphics design students at UMass on a logo, STEMTEC HQ is currently working on a brochure with inserts for various constituencies or audiences.
- From his footage of the 1997 Summer Institute, a videographer from Greenfield Community College has made a five-minute video for us in which faculty and school teachers describe STEMTEC goals and the excitement of working together on teaching reform. We use this video in workshops and presentations about the program.
- Meetings have already begun with Jamil Simon of Spectrum Media, the company producing the 20-minute STEMTEC video. The video will focus on the process of changing teaching practice and curricula in science and math within the community college classroom, the small liberal arts college, and a large lecture course. The change process will be documented for students, faculty, and institutions alike, and teaching experiences will be explored for their ability to enhance both the production and preparation of future teachers and the curricular goals of faculty.

STEMTEC Goal #7: Conduct strong programs of evaluation and assessment

Please see the separate *Evaluation Report 1997-1998* for a summary of evaluation activities.

A. 2. STEMTEC Accomplishments Compared to Milestones in Strategic Plan

Year 1 projected milestones in most of STEMTEC's project areas—organizational structure, curriculum and faculty development, recruiting and preparing future teachers,

supporting new in-service teachers, evaluation, and dissemination—were met. Milestones yet to be achieved are discussed below.

Collaborative Organization: As discussed above, the work necessary to get the Collaborative up and running has been accomplished. Some areas related to organizational administration continue to want attention, and project administrators are working to remediate these problems: 1) tardiness in getting the community college subcontracts negotiated, and 2) some understaffing at STEMTEC HQ. As remediation, the second-year budgets for the community colleges are being submitted along with the revised UMass and Five Colleges, Inc. budgets, and funds are being requested in Years 2-5 for a graduate assistant to help with the STEMTEC Teaching Scholars program. The Collaborative will expand with the addition of faculty from state colleges around Massachusetts in Years 3 and 4 of the grant. Planning for this expansion will begin in earnest in Fall 1998.

Curriculum and Faculty Development: Most of the milestones listed in the *Strategic Plan* were met. Indeed, with the addition of the Winter Series, STEMTEC has gone beyond its initial proposal to NSF. As the National Visiting Committee suggests in its report to STEMTEC, however, project administrators need to augment their strategic planning by going beyond the enhancement of teaching practice and paying greater attention to course redesign, curricular change, and overall program development. STEMTEC's response to this important challenge is discussed below in *C. Project Analysis and Changes in Long-Range Plans*. Additionally, while formative evaluation services for STEMTEC faculty were fully in place during Year 1, faculty have not taken advantage of these services to the extent anticipated. Again, the *Project Analysis* below describes remediation strategies currently being considered by STEMTEC to better institutionalize formative evaluation for STEMTEC courses.

Recruiting and Preparing Future Teachers: As the NVC notes in its report, faculty development has overshadowed the project's teacher enhancement mission in Year 1. Again, this suggests a flaw in proposed milestones rather than a failure to meet the milestones recommended in the *Strategic Plan*. Continued strategic planning by principal investigators has served to remediate these oversights, it is hoped; the *Project Analysis* and *A.5. Modifications to Teacher Preparation Programs* below suggest how.

Supporting New Teachers: All of the milestones for Year 1 have been met thus far in this project area.

Dissemination: With the addition of the Winter Series, STEMTEC's internal dissemination goals for Year 1 have actually been exceeded. External dissemination has been minimal, as might be expected in any CETP's first year. Milestones not reached in this project area: the fall publication of the first newsletter (it is due out in late March 1998), the development of an identifying project logo, and a more comprehensive public relations and dissemination plan as suggested by a range of proposed activities in the *Plan*. Dissemination will become a central focus for project administrators in Year 2 of the grant.

Evaluation: See the separate *Evaluation Report 1997-1998* for milestones reached.

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

- Inter-Institutional: Collaboration among the five four-year colleges in the Pioneer Valley—Amherst, Hampshire, Mount Holyoke, and Smith Colleges, and UMass Amherst—has an extensive history, signified and facilitated by the Five Colleges consortium. While the consortium provides a collaborative base on which STEMTEC builds, it also requires of projects such as STEMTEC a focus for collaborative activity.

Academic cooperation revolving around science and math currently exists in a number of forms through Five Colleges, Inc., ranging from a Five College Astronomy Department, to a Coastal and Marine Sciences Program, to a Five College Geology Committee comprised of campus departmental chairs. STEMTEC has built upon the extensive activities of these programs, along with those offered through the Five College/Public School Partnership, to develop collaboration specifically around undergraduate math and science education. Preliminary and anecdotal data gathered during the first year of the project suggest that collaboration within STEMTEC workshops and disciplinary teams has enhanced interest in science and math education reform at the five colleges. Innovative student-centered teaching practices which encourage critical thinking, meaningful application, and genuine synthesis of ideas are already beginning to percolate through the various science and math departments on the four-year campuses.

The two-year campuses of the Collaborative have a long history of cooperation as well. As three of 15 community colleges in Massachusetts, Greenfield (GCC), Holyoke (HCC), and Springfield Technical Community Colleges (STCC) are bound by a mutual commitment to open access for a diverse population, low cost, and programs which serve both those seeking terminal associate degrees and the transfer-bound. The three campuses have extensive ties with UMass Amherst through joint admission programs, transfer articulation agreements, and the University Without Walls (a UMass adult bachelor's degree program that in part converts lived experience into academic credit). The administrative ties among the community colleges and with UMass are currently being complemented with stronger curricular ties through the activities and efforts of STEMTEC. In addition to spirited discussions that take place in meetings, by phone, and through Email, specific collaborations are occurring through the connections made via STEMTEC. For example, STCC's Gender Equity Center has joined forces with Jump Start, a GCC pre-college program for women interested in careers in math, science, and technology, to offer "Day in the Lab." This program enables high school students to work in college science labs with female mentors. STEMTEC is looking to such collaborations to advance its goal of attracting traditionally underrepresented groups to science and math, and to provide a pool of potential teaching scholarship recipients.

STEMTEC workshops and collaboration within disciplinary teams have provided a forum for faculty to talk about teaching, something often difficult to locate within one's own department or division, much less among colleagues at institutions very different from one's own. Although preliminary and qualitative in nature, one of the project's central observations in its first year has been that simply providing a space and a structure for talking about good teaching goes a long way toward effecting pedagogical reform. Another observation has been that while faculty find some comfort in talking with others from their own discipline, issues related to effective teaching transcend disciplinary boundaries. Furthermore, exposure to the ideas and methods of other disciplines has seemed liberating to a number of faculty, encouraging them to think in especially innovative and exciting ways about teaching.

Cross-campus collaboration has provided fertile soil for many STEMTEC faculty. Campus diversity is a key feature of the STEMTEC collaborative, a diversity sometimes described in polarities—women's colleges vs. co-ed campuses, privates vs. publics, four-year vs. two-year, liberal arts colleges vs. the research university or the "vocational." What has been surprising to most faculty is that while differences certainly exist among the campuses—in their missions, their student bodies, the reward structure for faculty, campus "cultures"—the campuses share a great deal, and that much can be learned from thoughtful collaboration. For example, some of the elite privates in the Collaborative are studying the "learning communities" established by Holyoke Community College to better understand the possibilities of interdisciplinary course clustering on their campuses. Or another example—the community colleges are storing up ideas from UMass about how to teach large classes as pressure to teach classes with greater than 30 students builds on their campuses. College faculty have also collaborated in providing teaching experiences for their undergraduates. For example, Guliana Davidoff of Mount Holyoke College has regularly been taking students from her Abstract Algebra class to Springfield Technical Community College to serve as mentors and tutors for students in Jim McDonald's developmental math course. One index to the desire for cross-campus conversation is the well-attended STEMTEC Roundtable, which meets once a month over dinner at Five Colleges, Inc., and draws participants from all eight campuses of the Collaborative.

Possibly the most fruitful—and rewarding—collaborations have occurred among college and K12 faculty in the project. Some disciplinary teams have more successfully joined these two faculty types than others, but almost all the teams have agreed that the college/K12 collaboration has greatly enhanced their work on curriculum reform. College faculty, with credentials that designate them "experts," have nevertheless relied heavily on K12 faculty in the project for ideas about how to transform their teaching. Indeed, they have learned a great deal from hearing about and trying techniques that work in K12 science and math classrooms. While college faculty are grateful to the K12 faculty for methods lessons, the K12 faculty have learned additional content from their interactions with college faculty—a form of continuing education for which some actually get graduate credit. A number of

college faculty and K12 mentors are also working together to provide teaching experiences for undergraduates. The college/K12 collaboration has generally been a happy one for STEMTEC, and one that should contribute to more seamless K16 curricula in Western Massachusetts. This use of K12 faculty as “pedagogy experts” is a novel approach we recommend to others working in the area of curriculum reform.

Finally, an important source of inter-institutional collaboration comes from the STEMTEC Board. Comprised of representatives from all eight campuses and the school districts of Hampshire, Hampden, and Franklin counties, the Board supports in literal and figurative ways the collaboration that has become a STEMTEC hallmark. (It is also interesting to note that after the last Board meeting, several members thanked STEMTEC for the opportunity to meet and talk with new colleagues. College administrators were especially grateful for the chance to talk with K12 administrators in the district immediately adjacent to their campus, and vice versa. In fact, Peter Berek, Dean of Faculty at Mount Holyoke College, and Dick Sawyer, Principal of South Hadley Middle School, arranged a follow-up meeting to further discuss collaborations between their two institutions.)

- **Intra-Institutional:** Early reports indicate that STEMTEC is also influencing cooperation within institutions. At the most micro level—within individual courses—the incorporation of student-active learning is getting a boost from STEMTEC faculty teaching different sections of a single course or co-teaching the same course or section. For example, at Holyoke Community College, Win Lavalley and Erica Bergquist are teaching two different sections of HCC’s introductory biology course, sharing resources and ideas for making the course more student-active. At UMass, Introduction to Oceanography, a huge course of 600 per semester, is rotated among four instructors (i.e., one instructor teaches the course every fourth semester). Three of the four faculty currently teaching the course are STEMTEC participants—one a principal investigator, another a Cycle I participant, another a Winter Series participant—so that modifications to the course are being consistently tried and improved upon. One STEMTEC strategy has been to “saturate” introductory courses taken by large numbers of potential teachers with student-active learning strategies. Preliminary evidence from such courses as Lavalley’s and Bergquist’s and Introduction to Oceanography suggests that multiple instructors committed to reform is key to this saturation.

Early data also suggest that STEMTEC is having an influence within and among departments on the participating campuses. With two exceptions, campus coordinators report that STEMTEC faculty are meeting regularly on each campus to talk about their course reforms and get advice from other participants. Several of the campuses formed these groups after meeting with evaluation team member Helen Gibson, who was conducting “focus groups” by campus to learn more about what was and wasn’t working. Participants found these meetings so useful that they have continued them on their own. Other campuses have modeled weekly meetings after those held by Smith College over Friday lunch. A number of coordinators report that non-STEMTEC participants are also attracted to these “support groups”; in some

cases, future participants in STEMTEC have already joined the regular get-togethers on their campuses.

On one of the two campuses where regular meetings are not yet taking place, STCC, STEMTEC is nevertheless influencing collaboration among faculty. Enthusiasm by STCC STEMTEC participants has been so high that many more faculty than the project could accommodate applied for participation in the 1998 Summer Institute. Indeed, the campus coordinator reports that enthusiasm for STEMTEC teaching strategies has spread to other divisions on campus, and that departments in the humanities and social sciences are considering similar workshops for faculty there.

A. 4. Changes in the Vision for Mathematics and Science Education Within the Collaborative

As just suggested, although STEMTEC is only a few months old, the teaching strategies advanced through its workshops, Roundtables, and lecture series already appear to be spreading on the campuses of the Collaborative. The dissemination of student-active learning strategies in math and science classes is only one element in STEMTEC's plan for changing the vision of math and science education on the eight campuses. The transformation of teaching practice should be accompanied by course and curriculum redesign. Ultimately, the enduring impact of STEMTEC will come from transforming the culture of science and math education on the Collaborative's campuses, turning disciplines that currently repel the majority of undergraduates—including our nation's future teachers—into accessible, exciting, and empowering pursuits. STEMTEC's faculty development program, enacted through two cycles of staged workshops held over four summers, is designed to partially accomplish these changes in vision. (The faculty development program is described in detail in *C. Project Analysis and Changes in Long-Range Plans* below.) These changes will also be accomplished through student-centered elements of STEMTEC, particularly the NSF/STEMTEC Teaching Scholars program.

Although the central focus of STEMTEC this year has been on transforming pedagogy and classroom practice, the project has made some headway in course redesign and curriculum reform. Workshop exercises in both the 1997 Summer Institute and the Winter Series asked participants to carefully consider their course objectives and how their current course syllabus met (or didn't meet) those objectives. Participants also identified four to five concepts critical to their discipline and imagined how a course could be redesigned to teach those essential concepts. These exercises were supplemented with other sessions aimed at curriculum redesign and cultural change—e.g., interdisciplinarity, attracting traditionally underrepresented students to math and science, educational technology.

The assessment of vision changes is complicated by their elusive, qualitative, and always partial nature. How to more accurately assess these changes is an issue the project will begin to consider in its second year.

A. 5. Modifications to Teacher Preparation Programs

Three institutions within the Collaborative have teacher preparation programs—Mount Holyoke College, Smith College, and the University of Massachusetts Amherst. The central modification has been at UMass, where plans to revise an interdisciplinary science major especially suited for middle school teachers were completed in the fall of 1997.

For over a decade, UMass has had a Science Major intended to provide the interdisciplinary background needed by middle school science teachers, but few students have elected it because its requirements were more numerous than those for conventional departmental majors. As a byproduct of the work on the STEMTEC proposal, a committee was formed which made a proposal to reduce the Science Major requirements. The UMass College of Natural Sciences and Mathematics (NSM) approved this revision in October 1997.

We anticipate a significant enrollment among students who decide not to pursue professional careers in science, mathematics, and engineering. Every year large numbers of students drop out of these fields and switch to non-science majors. An appealing Science Major will attract some of these students to middle school teaching. This major will also be an attractive option for students who begin or restart their college education at the community colleges. We have already begun to promote this program, and will develop brochures and advising materials.

Although similar Science Major programs are not offered at the other colleges, students have the flexibility of proposing an interdisciplinary major, and the Science Major can be used as a model for prospective middle-school teachers for all members of the Collaborative.

In Massachusetts, prospective elementary teachers may no longer major in education; they must have a content area bachelor's degree. Currently very few major in science or math. The Science Major would be an excellent choice for future elementary teachers, especially the future science or mathematics specialists or coordinators.

The UMass Science Major requires 60 NSM credits. The Foundation Requirement specifies two-semester sequences in biology, chemistry, physics, and mathematics, statistics, or computer science, plus one semester in geology or astronomy. Of the 60 required credits, only those used to satisfy the Foundation Requirement may be at the 100 (freshman) level. Of the remaining credits, 15 credits must be in upper-division courses (numbered 300 and above). The student is required to select a concentration area from among the programs offered in NSM, and must complete at least 15 credits in that concentration area in courses numbered 200 (sophomore level) and above. These 15 credits should include the junior writing course for that area and at least three other upper-division courses. Up to six credits in courses numbered 200 and above from science-related courses in Education, Engineering, etc., may be included with permission.

UMass General Education requirements include a freshman writing course and a minimum of six Social World courses. There is in addition a two-course Diversity requirement, but some Social World courses also carry the Diversity designation. The College of Arts and Sciences also requires up to two years of a college language; students who score well on a placement test may be exempted from part or all of this requirement. A major and a total of 120 credits are also required for graduation.

Certification for a middle school teacher requires approximately one semester of courses and a semester of student teaching. The elementary certification requires two semesters of course work and a semester of student teaching. Note that the science and mathematics methods courses may be accepted as part of the 60 Science Major credits. *Appendix I* includes more detail on the Science Major and certification requirements.

In addition to the revised science major at UMass, an innovative partnership between STEMTEC, Springfield Technical Community College (STCC) and the University Without Walls (UWW) at UMass will offer teacher aides in Springfield an opportunity to become certified as middle school science or math teachers. A FIPSE grant to STCC received in the fall of 1997 will make it possible for these aides, many of whom are members of underrepresented groups, to attend STCC and then UMass. These prospective teachers will be encouraged to consider completing the science major or a math major via UWW. STEMTEC will use some of the scholarship money it has requested from NSF for participants in this program.

UWW is an undergraduate degree program for non-traditional students, and it will provide a flexible vehicle for the aides. It offers some courses in Springfield as well as in Amherst, and students may take regular UMass courses and courses at other colleges. UWW students are adults with a broad range of experience for whom full-time classroom attendance within a traditional program is not practical. UWW students must satisfy all UMass General Education requirements, but they can design an individualized major and earn credit for college-level learning gained through experience. They develop their own degree program with UWW staff and a faculty sponsor from UMass, or Smith, Mount Holyoke, Amherst, or Hampshire College. Plans are currently underway for recruiting, advising, and supporting participants in this program. It will admit its first students for the Fall 1998 semester.

Mount Holyoke and Smith Colleges have made no significant modifications to their teacher preparation programs. However, PIs Thrasher and Feldman are currently in touch with education faculty at the two institutions to plan a meeting to discuss a potential Five College Math and Science Teacher Certification program. This program would draw significantly on curricula in existing teacher preparation programs, and would serve students at Amherst and Hampshire Colleges, as well as those at UMass, Smith and Mount Holyoke Colleges. If enthusiasm and cooperation are forthcoming at this meeting, program development planning will begin in earnest during the spring of 1998.

An additional modification currently being examined by the STEMTEC Coordinating Council is the possibility of teacher education “minors,” “certificates,” or

“concentrations” for science and math majors at the five colleges. These options would consist of selected STEMTEC science and math courses, along with possible educational methods courses, social science courses such as “Education and Society,” and K12 teaching experiences or internships. The Campus Coordinators are currently gauging the structural feasibility and potential student demand for such options. If considered sufficiently feasible, STEMTEC will begin planning for these options in the fall of 1998; the target date for making these options available for students is Fall 1999.

While the cooperating community colleges do not have teacher preparation programs, all three are currently developing transfer options to better prepare students for teaching certification in the sciences and/or math. At Holyoke Community College, STEMTEC faculty have developed an “Arts and Science—Science Education Transfer Option” for students interested in eventually receiving a baccalaureate in biology (teaching Grades 9-12), chemistry (9-12), earth science (5-9, 9-12), general science (5-9), or physics (9-12). The degree awarded would be an A.A., Arts and Science. Their proposal will be presented to the Division of Science, Engineering, and Mathematics for approval on April 8, to the college’s Curriculum Committee on April 15, and to the Faculty Senate on May 6. STEMTEC faculty at Greenfield and Springfield Technical Community Colleges are also in the process of preparing and submitting such proposals for consideration and approval.

A. 6. Strategies for Dissemination and Public Awareness

STEMTEC recognizes two venues for disseminating reforms in teaching undergraduate math and science: within and beyond the Collaborative. **Internal dissemination** is critical both for recruiting participants to future workshops and reaching faculty unable or unwilling to participate in standard STEMTEC activities. Changing the culture of indifferent science and math teaching on the Collaborative’s campuses is critical to the success of STEMTEC, and permanent change is more possible if faculty who have taken our workshops act individually and collectively as change agents on their campuses. **External dissemination**—spreading the various STEMTEC models for reforming science and math teaching beyond the Collaborative—is also a critical charge of the project.

During the last day of the 1997 Summer Institute, faculty participants and principal investigators brainstormed strategies for disseminating both the products and excitement of STEMTEC reform. This session provided a useful guide for developing the dissemination component of our strategic plan. Ideas from that session (along with other strategies described in the initial proposal and ideas newly generated by the Coordinating Council) include:

➤Internal Dissemination

☞--Among faculty:

- The STEMTEC Winter Series
- Making formal presentations about the STEMTEC project to affiliated college departments

- Urging STEMTEC participants to give informal talks about the project at departmental or college-wide meetings and gatherings
- Making dissemination a key focus of the summer follow-up workshops for Cycle I and Cycle II participants, and incorporating a “train the trainer” component to assist participants in organizing their own mini-workshops on the Collaborative’s campuses
- Developing a STEMTEC faculty mentoring program for junior faculty
- Developing a cable television show for UMass-TV

☞--Among academic administrators:

- Raising the awareness of STEMTEC goals by organizing an event for deans and other administrators in which we model our student-active approaches
- Working through the Coordinating Council, helping to change the priorities of tenure committees
- Enlisting the aid of the Board in encouraging faculty and student participation in STEMTEC

☞--Among undergraduates:

- Advertising STEMTEC courses by denoting them in the various campus catalogs; placing posters in strategic locations on campus; leaving brochures in admissions offices
- Representing STEMTEC at first-year orientations, majors fairs, and organizational call-outs
- Helping students find ways to demand more student-active coursework and to initiate cooperative learning groups/experiences on their own

➤**External Dissemination**

- Identifying target audiences
- Showcasing STEMTEC courses, student-centered projects, K12 collaborations in regional newspapers and alumni magazines
- Using STEMTEC travel funds for regional and national conference papers about STEMTEC teaching successes
- At national and regional conferences, offering half-day workshops on student-active teaching and learning
- Submitting articles about STEMTEC to science, math, and engineering disciplinary newsletters
- Publishing articles in college science teaching journals (and/or pedagogy sections of other disciplinary journals)
- Collaborating with other K12/college/state groups interested in curriculum reform (e.g., Massachusetts Association of Science Teachers [MAST], New England Association of Chemistry Teachers [NEACT], JMA DOE, PALMS)
- Supporting faculty from state colleges around Massachusetts to attend workshops held by the Collaborative
- Hosting an international conference during the last year of the grant

➤ **Internal/External Dissemination**

- Publishing a semi-annual STEMTEC newsletter
- Developing a STEMTEC home page, complete with links to the home pages of our member campuses, other CETP collaboratives, and related NSF-sponsored sites
- Developing a multi-purpose brochure (complete with an identifying logo) for distribution to potential STEMTEC faculty and students, and for other interested individuals and organizations
- Producing one 20-minute and two five-minute videos about STEMTEC for use on the member campuses and at regional and national conferences

For a list of dissemination activities during Year 1, refer back to *A. 1. STEMTEC Activities and Impact*.

A. 7. Evaluation Activities and Formative Evaluation Results

See the separate *Evaluation Report 1997-1998* for Year 1 activities and results.

A. 8. Changes to Evaluation Plan

See the separate *Evaluation Report 1997-1998* for changes to evaluation strategies in Year 2.

A. 9. Progress Toward Full Participation of Underrepresented Groups

In Year 1, STEMTEC's major progress toward participation of underrepresented groups has come in the form of a completed proposal to NSF for funding a STEMTEC Teaching Scholars program. The proposal requests \$100,000 per year to fund several "high profile" scholars (advanced students exhibiting superior academic achievement and a firm commitment to science/math teacher certification), community college and returning non-traditional students, and entering first-year students drawn from local programs supporting women and minorities interested in math and science. In supporting students traditionally underrepresented in math and science, the scholarship program will not only enhance progress toward their full participation as future teachers, it will also provide the scaffold for a more student-centered STEMTEC program. Teaching Scholars will be supported through pairing them with faculty mentors, providing opportunities for peer interaction, and showcasing their work and activities in STEMTEC and related publications. At the same time, the Scholars are expected to help institute such activities as department or campus "learning circles" and organizations that provide formal and informal teaching experiences for all students enrolled in STEMTEC science and math courses. These activities will enhance the Scholars' skills as teachers while disseminating teaching opportunities for their peers. STEMTEC is currently awaiting review of its proposal from NSF.

During the fall semester of 1997, STEMTEC courses served a number of women and minorities. At the four-year colleges, 65% of students completing demographic surveys

were female; at the two-year colleges, the number was 60%. Approximately 8% of the students served at the four-year colleges were African American, Latino, or Native American, and 9.5% were Asian. At the two-year colleges, 14.5% of STEMTEC students were African American, Latino, or Native American, and 1.1% were Asian.

Following work he began under an NSF/PALMS grant, PI Feldman is currently compiling a list of all minority students at UMass majoring in math and science. At the March 1998 Coordinating Council meeting, he enlisted the help of campus coordinators to generate similar lists for the other seven participating institutions. These lists will be maintained and continually updated to serve as resources for recruiting potential scholarship applicants and participants in STEMTEC courses and student-centered activities. Feldman and his graduate research assistant, Joyce Bowen, are currently planning a panel on math and science teaching careers and opportunities to be held at UMass in late April or early May 1998. Students identified on all eight campuses as minority math and science majors will be invited to the panel. Feldman and Bowen also met with Floyd Martin, the Director of CCEBMS, an organization that provides tutoring and counseling services to black and minority students, to talk about ways to support our scholarship students and other underrepresented math and science majors within the Collaborative.

Tables 1 and 2 on the succeeding page summarize the representation of women and minorities among STEMTEC faculty participants. As suggested by the data, among college participants thus far, fewer than 1/3 have been women and only eight of the 65 have been minority. Among K12 faculty, 61% overall have been women and less than 10% overall have been minority. The percentages of women and minorities involved as “beneficiaries” in STEMTEC thus far are lower than project administrators would like, but not appreciably lower than the average for all CETPs (see tables). Efforts to recruit more women and minority college faculty have been hampered by their small numbers in math and science departments within the Collaborative. Indeed, STEMTEC has recruited more women and minorities than proportionally represented in those departments. Nevertheless, in recruiting for Cycle II (Summer 1998) faculty, a number of Campus Coordinators are actively pursuing faculty of color on their campuses. Additionally, project administrators made progress in recruiting minority K12 faculty for its Winter Series (four out of 13 were minority), and it looks as though we will be able to sustain that progress in our recruitment for Cycle II K12 faculty.

Table 1. Women and minorities: STEMTEC college faculty

	#	Female	Black	Latino	Nat Am	Asian	Total Minority
STEMTEC Cycle I	42	11 (26%)	2 (4%)	2 (4%)	2 (4%)	0	14%
STEMTEC Winter Series	23	7 (30%)	2 (9%)	0	0	0	9%
STEMTEC Combined	65	18 (28%)	4 (6%)	2 (3%)	2 (3%)	0	12%
CETP average		36.5%					12%

Table 2. Women and minorities: STEMTEC K12 faculty

	#	Female	Black	Latino	Nat Am	Asian	Total Minority
STEMTEC Cycle I	28	16 (57%)	0	0	0	0	0
STEMTEC Winter Series	13	9 (69%)	1 (8%)	3 (23%)	0	0	31%
STEMTEC combined	41	25 (61%)	1 (2%)	3 (7%)	0	0	10%
CETP average		66.9%					15.6%

A. 10. Partnerships and Collaborative Activities

- STEM Education Institute:** The Institute is the Organizational Unit (OU) out of which STEMTEC operates at the University of Massachusetts Amherst. The Institute is an outgrowth of a Science After School Task Force (SAS) established to consider how it might be possible for Western Massachusetts teachers to take science, technology, engineering, and mathematics courses at the University. The task force included faculty and staff from the University and from area schools. SAS soon discovered that there were related issues waiting to be addressed, including preservice teacher education. SAS also learned that there are many members of the University community working in the area of K14 science, technology, engineering, and mathematics education. These groups are spread across the campus in various departments and in many cases are not aware of other local programs related to their own interests.

The Institute was formed to bring these people together, facilitating joint efforts and avoiding unnecessary duplication. Above all, the Institute was formed to play a major role in meeting the University's goals in academic outreach, teaching and learning, research, diversity, and multiculturalism. The effects of coordinating these efforts has increased opportunities to obtain external grants and to allow the University to play a leadership role in the national and state efforts to reform and improve science, technology, engineering, and mathematics education.

The population served by the Institute includes students in elementary and secondary schools and their teachers, community college, college, and university students enrolled in introductory science, technology, engineering, and mathematics courses, college students interested in education or issues concerning learning, and college and university faculty and staff. STEMTEC collaborates with the Institute by co-sponsoring public lecture series and mini-workshops, maintaining an interlocking data base, and sharing some staff.

- **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. The service is provided by the University of Massachusetts Amherst with the assistance of other UMass campuses, the Holyoke Community College, Westfield State College, Mount Holyoke College, and Franklin County Technical School. UMassK12 is available from many dialup access locations around the state.

UMassK12 services and features include:

- Announcements of coming events, courses, etc.
- Electronic mail
- Newsgroups—Internet (usenet) newsgroups, K12Net conferences and projects, Kidlink projects linking over 50 countries, School Net, educational mailing lists
- World Wide Web and gopher connections
- File management tools for personal and ftp files
- Help menus, manuals, workshops, and individual support

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 (40 over 12 years) and academic-year seminar series (122 over 12 years), each of which is planned by teams of school and college faculty who share a common discipline or area of interest. College faculty come from the member institutions of Five Colleges, Incorporated (Amherst, Hampshire, Mount Holyoke, and Smith Colleges and the University of Massachusetts Amherst). School faculty come from urban, suburban, and rural communities in the four western counties.

Additional participants come from faculty at other 4-year colleges, community colleges, adult education programs, youth programs, and staff of cultural institutions.

The Partnership offers programs in a variety of disciplines, focusing on those areas in which both school and college faculty share a common interest, expertise, and need. In 1996 it completed a multi-year project, NSF/5C5E, which provided middle school science teachers with an opportunity to engage in environmental research themselves and to design research opportunities for their students. A handbook for this project is now complete. For the past three years, the Partnership has sponsored a project for school and college faculty in mathematics, science, and education who meet during the academic year to discuss what implications the research in teaching and learning has on their own classrooms (elementary through graduate students). Last year, the group focused on assessment issues, and this year will focus on working with colleagues. This past summer, teachers learned HTML so they could help their students publish their research on the web; chemistry teachers planned their academic year seminar series; and earth science teachers slogged through brush and mosquitoes to map a local border fault.

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. STEMTEC has identified a number of its K-12 participants through the database maintained by Thrasher's office, and the workshops and other activities of the Partnership serve as important programmatic models for STEMTEC.

- **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 MediaOne (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.
- **Other Collaborative Activities:** STEMTEC is interested in pursuing a number of collaborations that will aid its mission, particularly in the areas of minority recruitment and retention and providing teaching experiences for undergraduates in math and science. STEMTEC has identified a number of campus-based support groups for women and minorities—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). The project hopes to collaborate with

these groups in its mission to support traditionally underrepresented students in math and science. Additionally, we have developed contacts with campus-based academic programs that support non-traditional students such as University Without Walls at UMass, the Springfield-UMass Minority Achievement Program (SUMMA), the Ada Comstock Scholars program at Smith College, and the Frances Perkins Scholars Program at Mount Holyoke College. We also have identified organizations or programs in local school districts with which to collaborate around issues of diversity in math and science—e.g., Bridge to the Future, a program for Holyoke High School students.

STEMTEC is also developing collaborations to provide more teaching experiences for undergraduates in the “informal science education” sector. Project administrators have met with staff at the Hitchcock Center, a local environmental educational center, about potential internships for students. We also have met with staff at the National Plastics Museum in Leominster, and staff with the School to Careers program, to talk about possible teaching experiences there. We hope to develop ties with such other groups as the Pratt Museum of Natural History at Amherst College (which houses the Department of Geology and is directed by STEMTEC participant Jack Cheney) and Historic Deerfield, a local complex of restored buildings that serves as an important resource for student research into the material culture of New England.

STEMTEC can also benefit from collaborations with community-based learning offices or organizations. Project administrators have met with staff from the Hampshire County School to Careers Partnership to discuss potential collaborations. Additionally, PI Thrasher and Campus Coordinator O’Hara attended a day-long workshop on community-based learning sponsored by Five Colleges, Inc., and held at Mount Holyoke College, to learn more about possible ways to connect our students to learning opportunities in the schools and communities. The five colleges each have an outreach or community-based learning office with which fruitful contacts might be made.

A. 11. Subcontract Activities

STEMTEC has four major subcontractors—Five Colleges, Inc., and the three community colleges. The central activities of the Five College subcontract have revolved around supporting the work of STEMTEC Principal Investigators Thrasher and D’Avanzo on the project, paying stipends to workshop participants from the four private colleges and the public schools, administering mini-grants for course reform for college faculty from the four privates, and organizing related activities such as the STEMTEC Roundtable. The central activities of the three community college subcontracts have revolved around supporting the work of the Campus Coordinators on each of the campuses, providing funds for K12 teaching experiences to participating faculty, and assisting in the administration of mini-grants for course reform.

B. Demographics Update

No updates to the demographic data submitted to the NSF WWW site on March 2, 1998.

C. Project Analysis and Changes in Long-Range Plans

As noted in the report from the National Visiting Committee (NVC), STEMTEC is “off to a good start in achieving a complex set of interrelated goals.” This has been accomplished partly through an effective organizational structure and well-developed lines of communication. These, in turn, can be attributed to 1) an existing structure of *collaboration* among participating institutions; 2) a *flexible division of labor* among principals and participants that draws on each individual’s or institution’s strengths; and 3) a recognition of all roles and responsibilities as *equally* important.

STEMTEC’s accomplishments thus far can also be attributed to a shared vision concerning the importance of educational reform in math and science. The NVC notes that among the themes emerging in its discussions with participants “was the strong sense of the shared responsibility for learning that imbues the program” and the extent to which participants “have changed their views on how teaching and learning are accomplished.” Indeed, a number of participants have told project administrators that their involvement has been genuinely transformative, generating a love for teaching and working with students that they haven’t felt before. When senior faculty, shaped by years of lecturing and sceptical about the effectiveness of any other pedagogy, tell us, “This student-active stuff works!,” *something* must be going right. Another measure of the project’s success thus far has been the extent to which faculty are employing student-active methods in their non-STEMTEC courses. As one participant told project administrators, “It’s no longer possible for me to think about reform in my one STEMTEC course; this project is influencing what I do in every course I teach and every conversation I have with students and colleagues.” The excitement exhibited by many of our participants has been a sustaining source of gratification for project administrators.

We have learned from our first year that simply providing a sustained structure for faculty and teachers to collaborate around issues of good classroom practice goes a long way toward effecting reform. At the same time, feedback from the National Visiting Committee, Dr. Terry Woodin of the National Science Foundation, the STEMTEC Board and the STEMTEC Coordinating Council has helped us better understand how to turn good intentions into a more effective, integrated program aimed at better preparing future teachers of math and science. Drawing on this feedback, along with preliminary and anecdotal data gathered by project administrators during the first year, we propose changes in the following areas of the project.

STEMTEC Program Design

The National Visiting Committee notes that “up until now, the main emphasis...has been on the design or redesign of individual courses, rather than overall curriculum design” and that “little or no sense of the overall content of the program as yet seems to have been

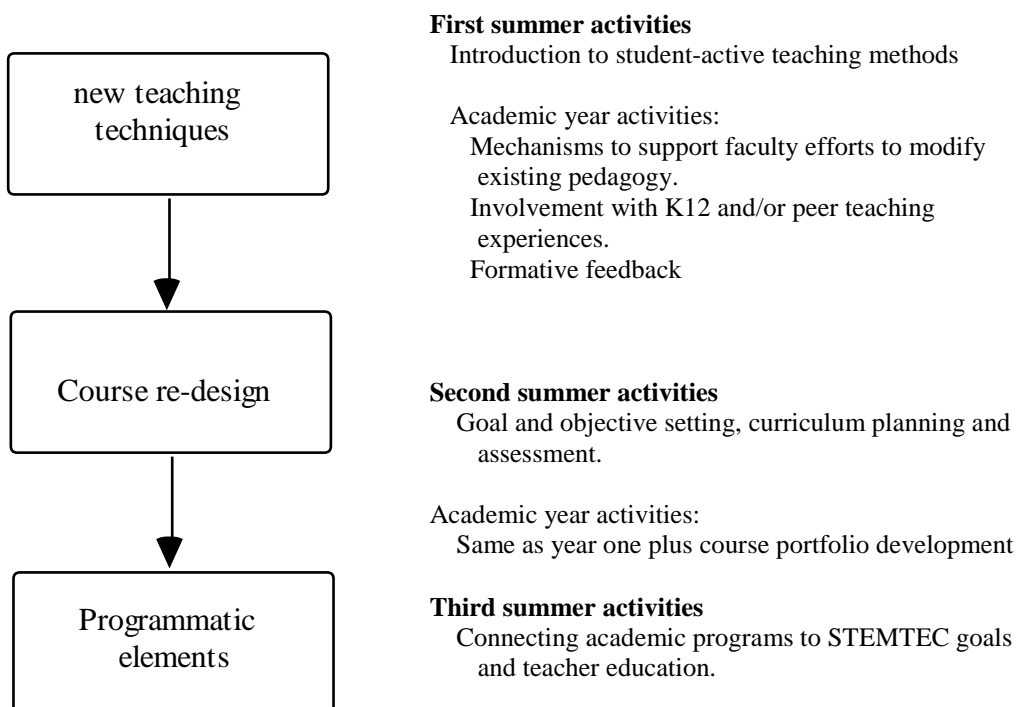
addressed.” Dr. Woodin echoes this concern in her question, “How does letting each faculty member change their courses lead to a coordinated set of programs?”

Since the visit by the NVC, project administrators have been centrally concerned with developing a better-integrated, more comprehensive program for accomplishing its objectives. This rethinking has focused around both faculty development and student integration into the project, and is summarized below.

• ***Professional Development of College and University Faculty***

STEMTEC has envisioned faculty development as a three-stage process (see Figure 2). For STEMTEC to be successful in reaching its goals, the professional development of college and university faculty must be seen as a process that extends over several years. This is due to the significant changes that must occur in faculty conceptions of what constitutes teaching and learning if the effects of STEMTEC are to be long lasting and transferable to other settings. Therefore, we have conceived faculty professional development as a three-stage process: 1) changes in pedagogy: 2) course redesign, and 3) programmatic change.

Figure 2. Development of STEMTEC College and University Faculty



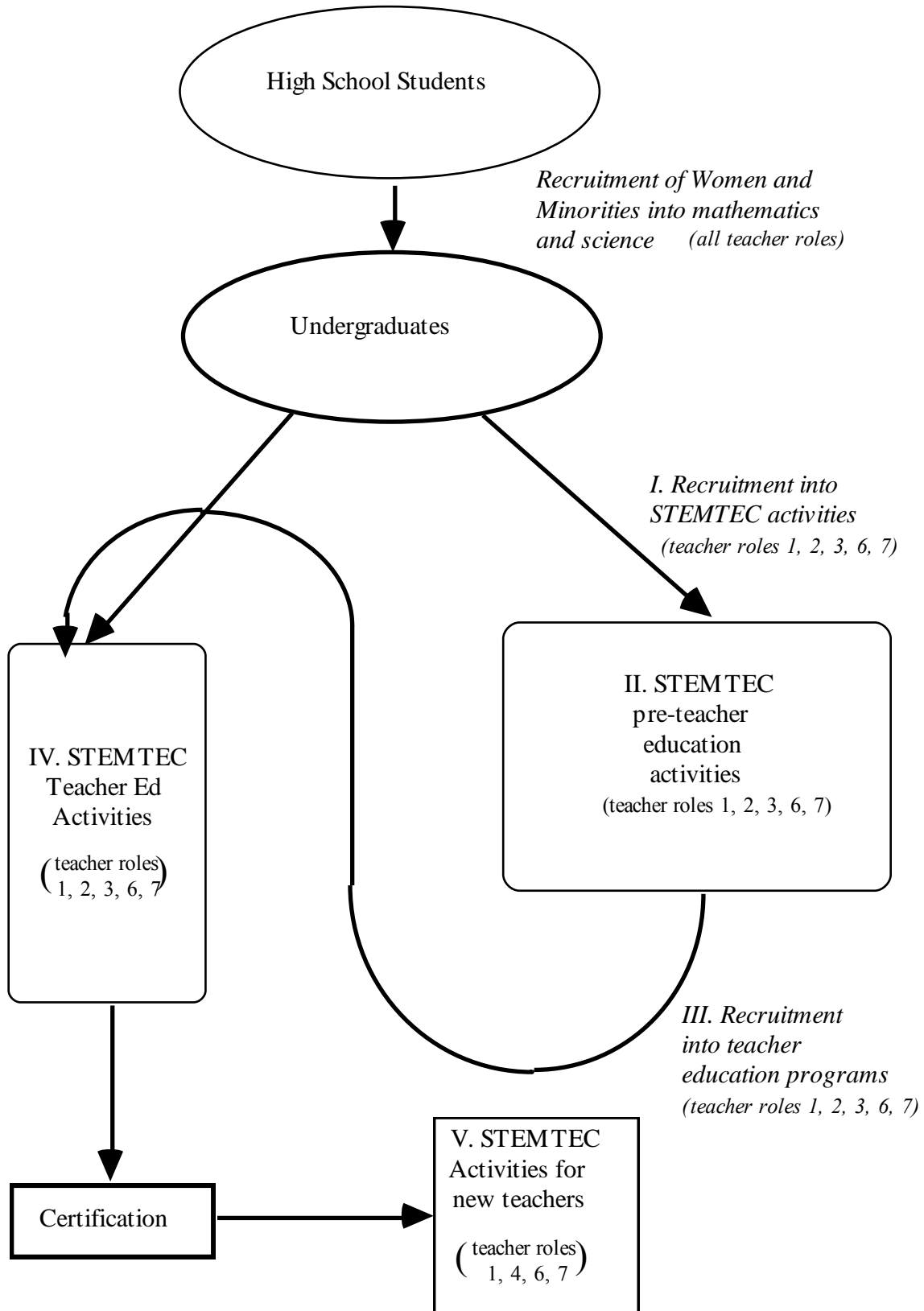
Summer and winter STEMTEC workshops are the principal methods used to introduce faculty to new **teaching methods**. The implementation of these methods are supported with course development funds for each revised or new course, participation in School-College content-area teams and campus-based support groups, and academic year STEMTEC workshops and roundtables. Additionally, faculty receive support for the formative evaluation of their courses. The expected outcome of the first round of workshops will be for faculty to introduce new teaching methods and peer or K12 teaching into their courses.

Those faculty who are participants in either of the two full (summer) cycles of STEMTEC will participate in additional workshops in the two summers that follow their entry into the program. The workshop in the second summer will have as its primary purpose the **redesign of courses**. That is, faculty will be asked to look at their objectives for their courses and to examine the structure of their courses in light of those objectives. In addition, they will be provided with opportunities to review those objectives with respect to STEMTEC goals. The expected outcome for the second round of workshops will be for faculty to redesign their courses from start to finish in light of STEMTEC goals based on research on the learning and teaching of mathematics and sciences. In addition, there will be the expectation that courses will include aspects that help retain underrepresented minorities and women in the majors, and to encourage them to consider teaching as a career.

The third summer's workshop will focus on **academic programs**. Faculty will be asked to examine the educational objectives for their academic departments and to critique them in relation to their efforts to redesign their courses in light of STEMTEC goals. The expected outcome from the third round of workshops will be for faculty to begin the process making programmatic changes that support the institutionalization of the STEMTEC reform. The STEMTEC PIs will support the programmatic changes by working with individual faculty as well as department chairs, deans, provosts, and other administrators.

- ***Integration of Students Into STEMTEC: The Preparation of New Teachers***
STEMTEC seeks to improve the preparation of pre-service teachers to better prepare them to teach mathematics and science, and to use educational technology, in grades K through 12. To do this, the STEMTEC PIs have designed a five-part program to 1) recruit students into STEMTEC activities; 2) develop and implement activities for undergraduates that include courses that model active learning in the content fields and provide them with experiences to teach others; 3) recruit undergraduates into teacher education programs 4) modify their preservice teacher education programs to better prepare them to teach using student-centered active learning methods; and 5) support new teachers as they attempt to use these teaching strategies in schools (see Figure 3). The STEMTEC PIs believe that these five components, which occur at the eight collaborating colleges and the surrounding school districts, add up to be a workable and effective systemic program for the improvement of the preparation in mathematics and science content and pedagogy of new teachers.

Figure 3. The Preparation of New Teachers Through STEMTEC



1) Recruitment into STEMTEC activities

Two different populations are the target of efforts to recruit students into STEMTEC activities. The first population consists of those students already admitted into or enrolled in the eight colleges. They will be recruited into STEMTEC courses and into STEMTEC-sponsored teaching opportunities. This will be done through a variety of methods. Those students who declare that they are interested in becoming elementary school teachers will be advised to enroll in STEMTEC courses to fulfill their mathematics and science requirements. Those students who have either declared a major in math or science, or who are contemplating these majors will enroll in introductory courses for majors that are STEMTEC courses. In both types of introductory courses, students will be given the opportunity to engage in teaching activities, either at the K12 level or with other college students. Other teaching opportunities outside of these courses will be developed and existing opportunities will be linked with the STEMTEC project. All STEMTEC courses will be advertised as such, advisors will be informed of what they offer to students, and all students in the eight colleges who have indicated an interest in a math or science major will be targeted for retention in the majors and recruitment into K12 teaching.

The second population consists of high school students who have been identified as having an interest and/or an aptitude for mathematics or science. Guidance counselors as well as teachers and administrators at the participating high schools will be invited to participate in workshops on careers in mathematics, the sciences, and engineering. Particular emphasis will be placed on informing them of the variety of career opportunities available, including teaching, and of the opportunities available for women and minorities in these fields.

The STEMTEC scholarships will be used to help recruit students into STEMTEC activities. Scholarships will be used to support students just entering college as well as those already enrolled. Scholarship recipients will aid in the recruitment of students from both populations.

2) STEMTEC pre-teacher education activities

A significant part of the STEMTEC program is the reform and development of courses, the establishment of teaching opportunities for undergraduates, and the recruitment and retention of women and minorities into math and science teaching. The core of this component of the STEMTEC program consists of activities planned for STEMTEC Teaching Scholars (recipients of STEMTEC scholarships) and open to other students interested in K12 teaching of mathematics and science.

Course revision is supported through extended workshops in the summer and winter, occasional half and full day workshops, a series of roundtable discussions on new teaching and assessment strategies, a bimonthly seminar series on math and science education, occasional and regular meetings of curriculum teams and campus teams, and through the support of formative evaluation.

Undergraduates will be offered **teaching experiences** in K12 settings and museums, as well as with peers. There are three ways that K12 experiences will be established. One is

through special courses designed to support undergraduates as they develop and implement activities with K12 students. One such course has been developed at UMass. Other courses are being offered at Hampshire College and STCC. A second way is that K12 experiences are offered either as a required or elective part of a content course that has been reformed as part of STEMTEC efforts. Third, undergraduates will have the opportunity to work directly with STEMTEC teaching experience mentors. Undergraduates will also have the opportunity to tutor and teach peers in content areas.

The **recruitment and retention of women and minorities** into mathematics and science teaching at the secondary level is a major goal of STEMTEC. A significant part of this effort is the commitment of the Collaborative's institutions to this goal. STEMTEC will also strengthen the ties between the community colleges (an important source of underrepresented students) and the four-year institutions, and collaborate with extant campus programs for the support and retention of minority students in mathematics and science, and with the community base for outreach and support. In particular these are programs at the collaborating schools that support Hispanic, African-American, Native American, and other underrepresented minorities. In addition, efforts are being made to identify all students from the underrepresented minorities at the eight collaborating institutions who have expressed a desire to major in mathematics or the sciences. These students will be encouraged to participate in all activities for STEMTEC Teaching Scholars, as well as activities that target these students.

3) Recruitment into teacher education programs

In order to reach the STEMTEC goals of producing more and better trained mathematics and science teachers, undergraduates who are majoring in these disciplines must be encouraged to enter teaching. It is also important that majors see that teaching is a viable career and a reason to continue study in the content area. To accomplish this, STEMTEC will actively recruit majors into teaching by giving them opportunities to experience teaching, either at the K12 level or with peers, and by introducing them to the career through special activities with practicing teachers. An important part of this effort will be to educate college faculty about teaching as a career. The STEMTEC Teaching Scholarships will also aid in this recruitment.

4) STEMTEC teacher education activities

Much of the teacher education that occurs as part of the STEMTEC program will be through existing programs. Significant changes will occur in the ways in which the students are taught how to teach mathematics and science, and the ways in which they do field work. Teaching methods courses will reinforce the student-active teaching methods used in STEMTEC courses and help preservice teachers learn how to use them in K12 settings. They will be placed with STEMTEC K12 faculty for both prepracticum and practicum experiences. This will help alleviate the dissonance between the ways in which the STEMTEC preservice teachers are taught to teach and the practices that they see in schools.

The major new effort is the development of a Five College teacher education program in mathematics and sciences. This will have two major goals. The first is to bring together

the resources available at the three institutions currently with teacher education programs (UMass, Mount Holyoke College, and Smith College). We believe that this collaboration will enable these institutions to make better use of limited resources. It will also provide access to a teacher education program for those students in the other two colleges (Amherst and Hampshire Colleges) who wish to become certified to teach. The STEMTEC Coordinating Council is also examining the feasibility of math and/or science teaching “minors” or “concentrations” at the five colleges.

At the completion of the teacher education programs, students will receive the Massachusetts **Provisional Certification with Advanced Standing**. This certificate allows them to teach for five years while they obtain a Master’s degree and pass proficiency exams, at which point they receive the **Standard** level of certification. STEMTEC will be involved in modifying Standard certification programs at the collaborating institutions.

5) Support of new teachers

The final component of the STEMTEC program for the preparation of teachers is the support of new mathematics and science teachers. This component has begun this year. In the late summer and early fall STEMTEC identified the new math and science teachers in the region. (For the 1997-98 school year, that was 81 teachers, some of whom were new to their jobs, but not to teaching.) All new teachers were contacted by mail to inform them of STEMTEC and to invite them to an information meeting in the fall. STEMTEC New Teacher Mentors also attended the meeting. At that time the new teachers were paired with Mentors, and provided with email accounts of UMassK12. Their concerns and needs were solicited. As a result, a workshop on classroom management was held on February 5, 1998 (see *Appendix C* for workshop schedules).

Beginning next year, STEMTEC will offer a course designed to support new math and science teachers, and which will be a component of the Standard Certification program at UMass. This course will focus on STEMTEC goals and ways to help the new teachers meet the challenges of the beginnings of their career.

STEMTEC Workshops

Project administrators learned a number of useful things from developing and implementing the 1997 Summer Institute and the Winter Series. Based on this experience, changes are being made in the following areas:

- **Workshop content**—We have learned that in many ways, less is more. The Summer Institute suffered from trying to cover too many topics in too short a time. Participants generally found the first week of the workshop, with its in-depth focus on cooperative learning philosophies and strategies, very useful. The second week, broken up by a number of 1.5 hour panels on everything from developing K12 connections to the role of interdisciplinarity, was less successful. This feedback has led both to changes in this coming summer’s workshop schedule, as well as the addition of the Winter Series, which has focused in depth on 4-5 key issues in pedagogical reform. Additionally, faculty have told us they need more time built in

to work with their curriculum teams, but that this time needs to be more structured by project administrators. The 1998 Summer Institute for Cycle II faculty will focus in greater detail on a few critical issues in student-active learning, and teams will have more time to discuss the implication of their plenary work for specific courses in their discipline. Finally, Cycle I K12 faculty were especially concerned that the disciplinary language and perspectives of education be better represented in the workshops, a concern that project administrators will take to heart in planning this coming summer's workshops.

- **The role of K12 faculty**—The distinction between Curriculum Scholars and Mentors will be eliminated in Cycle II. Originally, Curriculum Scholars served as members of a disciplinary team, discussing issues of pedagogy relevant to their disciplines and assisting one another in rethinking individual courses. They attended all two weeks of the summer workshop. The Mentors attended only three days during the middle of the workshop, and they were to serve primarily as point persons in identifying and arranging undergraduate teaching experiences during the academic year. However, involving the mentors for such a short time proved awkward: they missed not only key sessions of the workshop, but also the community-building that became so central to the summer's success. Also, it became clear that the initial distinction among K12 faculty was inappropriate: both groups were equally adept at and willing to perform both functions.
- **Sustaining community**—Initially, project administrators expected curriculum teams to provide the foci for academic year meetings and support groups for faculty attempting reform. Certainly, teams have remained active since the summer through interaction at STEMTEC follow-up workshops and through personal communications with one another. However, because of the difficulty of scheduling meetings around various campus and school calendars, and the problem of traveling distances, only one curriculum team has managed to arrange fairly regular get-togethers. Community-building since the summer has come primarily through campus-based teams that span departments. While curriculum teams will remain central to the work of Cycle II participants, the summer workshop will incorporate ways for campuses to begin establishing support groups and common activities that can sustain participants through the academic year.

Recruiting Underrepresented Students to Math and Science

According to the NVC report, “the NVC [sees] little evidence that STEMTEC has a proactive outreach program to recruit minorities into science and mathematics teaching.” The Committee recommends that project administrators address this issue in a more comprehensive way.

Section A.9. *Progress Toward Full Participation of Underrepresented Groups* earlier in this report describes in some detail the progress made in developing a more comprehensive plan to attract minorities. Most important to note here is the proposal to NSF to fund a need- and merit-based scholarship program for students interested in math and science teaching careers. Being able to financially support women and students of color should help substantially in their recruitment. Identifying advanced undergraduates

as scholarship applicants will be accomplished through faculty nominations and contacts with minority and related campus organizations, as well as blanketing the campuses with publicity about the scholarships. Because none of the campuses of the Collaborative have substantial minority populations, substantial work will be done with K12 faculty, counselors, and outreach organizations in such school districts as Holyoke and Springfield, which *do* have substantial numbers of minorities, particularly African Americans and Latinos.

Additionally, STEMTEC will continue to seek advice from the National Visiting Committee and draw on the wisdom of other CETPs with successful programs for recruiting women and minorities into science and mathematics teaching.

Mechanisms for Sustaining Faculty Involvement

A special concern of the National Visiting Committee was the extent to which STEMTEC had support mechanisms beyond the workshops available to faculty. As of this writing, campus-based groups have formed and are regularly meeting on most of the Collaborative's campuses. Feedback suggests that these, along with the Roundtable and periodic follow-up workshops through STEMTEC and the STEM Education Institute, are of tremendous help to faculty struggling through course reform. At the same time, STEMTEC is instituting or considering additional mechanisms for providing sustained support for faculty attempting to transform their teaching:

- **Classroom observations:** The evaluation team is sitting in on STEMTEC courses during the spring semester of 1998 to gather more information on "how things are going." Feedback from their observations will be distributed to faculty and principal investigators alike so that problem areas can be identified and additional support offered to faculty who need it.
- **Self-assessments:** A number of STEMTEC faculty have shied away from evaluations by an outside team. This appears due to a number of reasons: the feeling that they need more "practice" at classroom innovations before they're "judged" on their "performance"; administrations that have sometimes used evaluations in punitive ways; annoyance at the class time required for evaluation; and the feeling that outside evaluations won't provide genuinely useful feedback. Because few faculty have taken advantage of the formative evaluation (MAPs) service offered by the UMass Center for Teaching, the principal investigators and evaluators are examining the feasibility of placing more emphasis on self-assessment. Toward this end, Cycle I participants were introduced at the February 7, 1998 follow-up workshop to the concept of "Course Portfolios." These not only document course changes and aid in dissemination, but also provide an avenue for careful reflection about what is and isn't working in the course. During the summer 1998 follow-up workshop for Cycle I faculty, additional work will be done on constructing a course portfolio. Project administrators are also considering single-day workshops on training faculty in self-assessment methods.
- **"Swat teams":** Members of the National Visiting Committee concerned both about the lack of ongoing support and the voluntary nature of course observations recommended "rescue squads" or "swat teams" that might be able to work with

faculty experiencing difficulties with course reform. Some form of peer assessment seems logical here, with groups of experienced and sympathetic STEMTEC faculty sitting in on classes and giving advice. Project administrators are interested in exploring this idea more, seeking potential models from among the other CETPs.

Evaluation

Please see the separate *Evaluation Report 1997-1998* for analysis of the evaluation plan and changes in long-range plans.

D. Updated Strategic Plan, including Timeline, for 1998

Curriculum and Faculty Development: STEMTEC's curriculum and faculty development activities during 1998 will replicate and extend those of 1997. Specifically, we will:

- Offer approximately 45 revised science and math courses on the eight campuses of the collaborative during the spring semester 1998 (January-May)
- Offer approximately 90 revised science and math courses during the fall semester of 1998 (September-December)
- 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)
- Evaluate the Winter Series and determine its feasibility in future years (May)
- 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 to offer formative evaluation through the UMass Center for Teaching, and to train faculty in self-assessment techniques (January-December)
- Continue weekly, bi-monthly, and monthly campus-based support groups for faculty (January-May, September-December)

Recruiting and Preparing Future Teachers: STEMTEC plans to accelerate its program of teacher recruitment and preparation in 1998. In addition to the curricular and faculty development activities identified above, we plan to recruit and better prepare future teacher through the following activities:

- 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)
- Work with elementary and secondary teacher preparation advisors to guide students toward STEMTEC courses (January-December)
- 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)
- 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)
- Develop a “peer mentoring” workshop for interested students enrolled in STEMTEC courses (September-October)
- 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)

Supporting New In-Service Teachers: Activities to support new teachers in the Pioneer Valley during 1998:

- 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)
- 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)

- 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)

Evaluation: Proposed evaluation activities for 1998 are described in greater detail in the separate *Evaluation Report 1997-1998*. Some highlights from that plan:

- Assess evaluation strategies employed during 1997 for purposes of reformulating evaluation plan (March-May)
- Work with STEMTEC headquarters in developing better strategies for identifying potential future teachers on the different campuses of the Collaborative (May-December)
- Continue formative course evaluations through the UMass Center for Teaching (January-May, September-December)
- 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)

Dissemination: With the project only a few months underway, STEMTEC is already beginning to produce disseminable results. Dissemination will become an important focus in 1998, revolving around the following activities:

- 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 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)

- Begin conceptual and storyboard work on a 20-minute STEMTEC video (February-August)
- Begin production work (filming) for STEMTEC video (September-December)
- Publication of the inaugural issue of the STEMTEC newsletter, *STEMTREK* (March), and next semi-annual issue in Fall 1998
- 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)

For a graphical representation of STEMTEC's 1998 timeline, see *Appendix J*.

E. Major Products

The five-minute video documenting the STEMTEC 1997 Summer Institute on Student-Active Teaching is the major product during Year 1. Several STEMTEC faculty are working on a range of products from CD-ROMs to course readers that should be finalized sometime during Year 2 of the project.

F. Revised Budget

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

G. Summary Reports of Project Meetings

- **National Visiting Committee (see *Appendix K*)**
- **Project Executive Steering Committee (see *Appendix M*)**
- **Major task and project groups (no major task or project groups currently exist in STEMTEC independent of the Principal Investigators and Evaluators; please see the separate *Evaluation Report 1997-1998*)**
- **CETP Workshops, Conferences, Symposia (see *Appendix C*)**

H. Interaction and Overlap with Related and NSF-Supported Science and Mathematics Education Projects in the Region

STEMTEC has a number of links to PALMS, a systemic state initiative funded by the National Science Foundation and supported by the Massachusetts Department of Education. The Five College/Public School Partnership, directed by STEMTEC co-PI Sue Thrasher, is one of three regional providers for PALMS. In this capacity, PI Thrasher works with the developing nucleus of PALMS Teacher-Leaders, District Leadership Teams, and community partners. STEMTEC material is immediately shared with the Western Massachusetts PALMS network. Additionally, a number of K-12

faculty involved in STEMTEC have been recruited from among PALMS Teacher-Leaders, and two Teacher-Leader Coordinators currently participating in the STEMTEC Winter Series—Debra Lawrence (Lincoln Magnet School in Springfield) and Kathi Chlanda (Hadley Elementary School)—are working to recruit additional Teacher-Leaders from among STEMTEC K-12 participants.

Additionally, STEMTEC co-PI Allan Feldman ended a PALMS higher education grant in June 1997 that has benefitted the efforts of STEMTEC. The grant enabled the development and revision of two courses for teachers—Entomology 271/671, Using Insects in the Classroom, and Physics 100/597T, Electricity and Magnetism—that are being further reformed through mini-grants from STEMTEC. It also piloted a program to attract traditionally underrepresented students to the teaching of science and mathematics, activities from which STEMTEC has drawn in its minority recruitment efforts and which STEMTEC is now funding. Feldman is also working with DOE/PALMS Higher Education Coordinator Rob Traver on a PALMS/STEMTEC co-sponsored conference-workshop for Massachusetts faculty who have revised college science or math courses with NSF funding. The conference is scheduled to take place on April 8 at the Four Seasons Sheraton in Leominster, MA.

Finally, STEMTEC maintains close ties with PALMS through interlocking advisory board membership. Currently, four DOE/PALMS Higher Education Coordinators—David Driscoll, Thomas Noonan, Penny Noyce, and Rob Traver—serve on STEMTEC’s Board, while Western Massachusetts PALMS Regional Providers are currently establishing an advisory group that will include STEMTEC PIs Sternheim and Feldman. Currently, Feldman is serving on the Qualified Teacher Task Force, a PALMS committee seeking ways to use data on teacher education programs and their candidates to improve the preparation of new mathematics, science, and technology teachers in Massachusetts.

III. NEW STEMTEC PARTICIPANTS

The significant change to STEMTEC’s collaborative team occurred through the addition of the STEMTEC Winter Series. Twenty-three college and 13 K-12 faculty were added to the STEMTEC roster of participants. Their names, curriculum team membership, and affiliation are given below.

STEMTEC Winter Series Participants and Affiliations (by Curriculum Team)

Team Name, Position	Department	Affiliation
<i>Biology</i>		
Amy Clark, Adjunct Faculty	Biology	Greenfield Community College
Katherine Dorfman, Lab Dir., Unity of Sci.	Geography & Geology	Mount Holyoke College
Curtice Griffin, Assoc. Professor	Forestry & Wildlife Mgt.	Univ. of Massachusetts
Matthew Kelty, Assoc. Professor	Forestry & Wildlife Mgt.	Univ. of Massachusetts
Debra Lawrence, Teacher	Science	Lincoln Magnet School
Ben Oke, Assoc. Professor	Biology	Hampshire College
Ana Valcarcel, Teacher	Biology	Smith Vocational School

Chemistry

Susan Cumberledge, Asst. Professor
 Aida Oquendo, Teacher
 Peter Shaughnessy, Teacher
 Andri Smith, Lecturer
 Diane Stengle, Adjunct Faculty

Biochemistry
 Science
 Chemistry
 Chemistry
 Chemistry

Univ. of Massachusetts
 Holyoke High School
 Northampton High School
 Amherst College
 Holyoke Community College

CS/Engineering

Wayne Bureson, Assoc. Professor
 John Burns, Teacher
 Diana Campbell, Tech. Coord.
 Zahi Haddad, Professor
 William Verts II, Asst. Professor

Elec. & Comp. Engr.
 Technology Education
 Engr/Computer Science
 Computer Science

Univ. of Massachusetts
 Agawam Junior High Schl.
 Frontier School District
 STCC
 Univ. of Massachusetts

Geology

Laurie Brown, Professor
 Kathleen Chlanda, Teacher
 Steve Roof, Asst. Professor
 Mary Santiago, Teacher
 Lauret Savoy, Assoc. Professor

Geoscience
 Math, Science
 Natural Science
 4th Grade
 Geology & Geography

Univ. of Massachusetts
 Hadley Elem. School
 Hampshire College
 Sullivan Elem. School
 Mount Holyoke College

Mathematics

George Avrunin, Professor
 Diane Chapman, Teacher
 Murray Eisenberg, Professor
 David Hayes, Professor
 Barbara Paskov, Grad Student
 Pamela Ann Ravina, Teacher

Mathematics & Statistics
 Science, Math, Health
 Mathematics & Statistics
 Mathematics & Statistics
 Tchr Ed/Curric Studies
 Mathematics, Team 81

Univ. of Massachusetts
 Hopkins Academy
 Univ. of Massachusetts
 Univ. of Massachusetts
 Univ. of Massachusetts
 Westfield Middle School

Physics

Edward Chang, Professor
 Bob Greeney
 Robert Hallock, Professor
 Stanley Hertzbach, Professor
 John Kudukey, Teacher
 William Mullin, Professor
 Kandula Sastry, Professor
 Curtis Turner, Sci. Dept. Chair

Physics & Astronomy
 Astronomy & Physics
 Physics & Astronomy
 Physics & Astronomy
 Physics
 Physics & Astronomy
 Physics & Astronomy
 Physics

Univ. of Massachusetts
 Holyoke Community College
 Univ. of Massachusetts
 Univ. of Massachusetts
 Greenfield High School
 Univ. of Massachusetts
 Univ. of Massachusetts
 Williston Northampton Schl.

Currently participating STEMTEC faculty have had no major changes in institutional assignment, rank, or outside support. One campus coordinator—Karen Sullivan of Hampshire College—anticipates leaving her staff position during the summer of 1998 to complete an advanced degree in her field; another—Margaret Robinson of Mount Holyoke College—will be on sabbatical during the fall of 1998. They will be replaced with appropriate personnel, yet to be appointed.

For other current participants, associates, staff, and advisors, see *Appendix A*.

