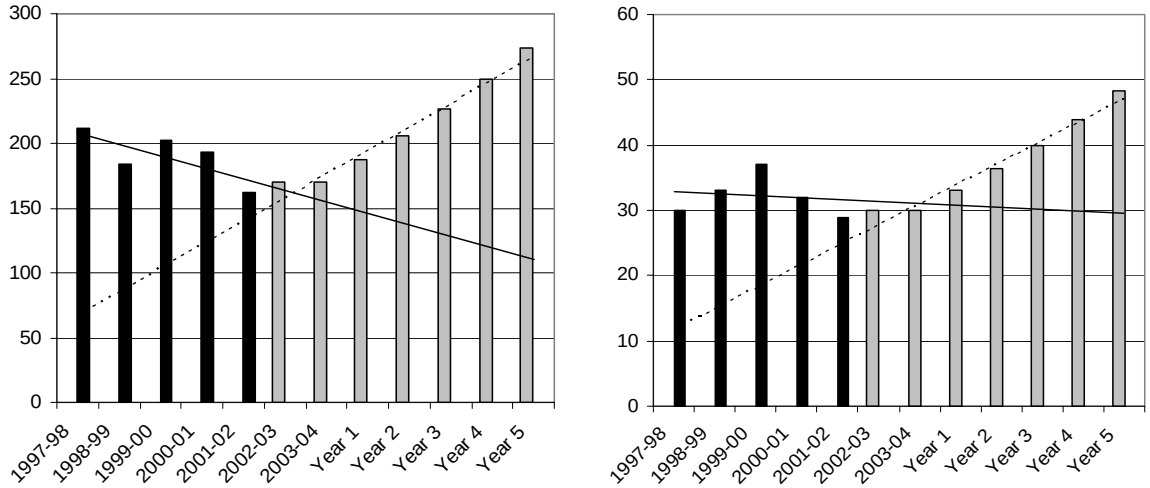
## INTRODUCTION

The primary goal of this proposal is to recruit and retain STEM majors by strengthening the collaboration between the University of Nebraska at Omaha (UNO) and Metropolitan Community College (MCC) in these areas. This grant will support the expansion and adaptation of currently successful activities within and between the two institutions as well as the implementation of new activities. "STEPping" together MCC and UNO will:

- develop agreements for the articulation of complete programs of study between MCC and UNO in STEM disciplines to support the completion of STEM degrees.
- attract and retain students, particularly under-represented and non-traditional students, in STEM disciplines at both institutions through the use of scholarships.
- improve the quality of, and access to, experiential education opportunities and student support services in STEM disciplines by coordinating the efforts of UNO and MCC.
- increase the opportunity for students to train in STEM disciplines through expansion, diversification and incorporation of new STEM degree/certificate options.
- increase outreach and recruitment activities targeting prospective STEM students.

## GOALS AND OBJECTIVES

Over the past five years the number of students enrolled in STEM courses at MCC has increased by 40%,[1] whereas the number transferring to UNO STEM programs has decreased slightly overall and the number graduating with STEM degrees from UNO is down. The immediate goal of this proposal is to stop these downward trends by the end of the first year of the grant. The goal in each subsequent year is to average a 10% increase in the number of STEM transfer students, the number of UNO STEM graduates and the number of minority STEM graduates at UNO. (From 1997-98 to 2001-02, the average number of minority STEM graduates at UNO was 10.4.[2]) See Figure 1 below for the trend in STEM graduates and transfer students in STEM disciplines. It is also the goal of this proposal to increase the number of students receiving STEM degrees from MCC by developing degree programs in math and science (MCC does not yet offer degrees in these areas).




**Left**: **UNO STEM graduates**[2] **Right**: **Transfer students from MCC into UNO STEM disciplines**[3]

**Figure 1:** ■ Historical numbers with trend line and □ Projected numbers with trend line

These projections are reasonable based on the activities outlined in this proposal. For instance, in 1999-2000, 770 students graduated from MCC, but only 19% indicated they would transfer to a four-year institution and only 36% of those indicated they would attend UNO.

Expected Outcomes

1. The number of STEM graduates at MCC will increase as a result of the proposed development of math and science degrees at MCC.
2. The number of STEM transfers from MCC to UNO will increase as a result of the development of complete articulation agreements, the newly generated MCC STEM graduates and the proposed scholarships.
3. The number of UNO STEM graduates will increase as a result of the increased number of STEM students transferring from MCC to UNO, the diversification of STEM degree options at UNO and scholarships.
4. Improvements in student support services and experiential education opportunities as well as the proposed outreach and recruitment activities will enhance the projected increases in all three student populations.

These activities have been identified as successful recruitment/retention strategies.[4]

## RESULTS OF PRIOR RELATED NSF SUPPORT

The remarks in this section pertain to co-PI Hesham Ali for the NSF EPSCoR Grant #EPS-009100, Informatics Center for the Life Sciences, $766,025, 2/1/01 – 1/31/04.

Currently, two UNO departments in the STEM disciplines of computer science and chemistry are in the third year of a funded three-year NSF EPSCoR Infrastructure grant. The grant has been used to develop advanced computational facilities for use by faculty and students. These facilities include a 32-processor 16-node Intel-based computer cluster, which is being used to support research and instructional activities in the areas of bioinformatics, computational chemistry, mobile computing and distributed systems. The cluster is part of a four-campus super-cluster that includes nodes at the University of Nebraska Medical Center (UNMC), the University of Nebraska-Lincoln (UN-L) and Creighton University. The funds have also been used to provide equipment and personnel needed to establish a computational chemistry facility. In addition, a wireless computing lab has been established and equipped with 802.11b connectivity as well as Bluetooth functionality. The lab has allowed UNO students and researchers to work in a mixed mode environment and test various innovative hybrid-mode wireless environments.

The developed infrastructure facilities have also allowed UNO to achieve a number of academic goals including:

1. Strengthening of current programs,
2. Development of new interdisciplinary programs, and
3. Increased activity in seeking local and federal grants.

The participating investigators have been active in submitting the grant proposal, publishing the outcomes[5] of the conducted research and developing new advanced courses in the areas of bioinformatics, wireless networks and mobile computing.

In addition to the research and instruction accomplishments, the developed infrastructure and the available funds have been used to support various outreach activities as well as activities to establish measures for increasing the participation of underrepresented groups. To achieve these goals, UNO has hosted several summer camps and workshops targeting various under-represented groups. Funds have also been used to support students from underrepresented groups to participate in academic activities and research projects.

## CURRENT SITUATION

The University of Nebraska at Omaha (UNO) and Metropolitan Community College (MCC) are the largest institutions of higher education in the greater Omaha metropolitan area, a community of approximately 725,000 and the largest in a 150+ mile radius. UNO and MCC have both undergone rapid growth in recent years and currently serve about 12,300 and 7,500 FTE undergraduate students respectively. Both schools have a diverse student body: minority enrollment is 22% at MCC and 14% at UNO. The majority of students at both institutions live and work off campus and are responsible for their own financial support.

Annually, approximately 26,000 individual students attend MCC but only a very small portion, about 800, actually obtain degrees. A common theme throughout the outlined proposal activities is a focus on encouraging more of those students to complete a STEM degree. MCC offers fourteen associate degree options, eight certificate programs and four different diplomas in the area of technology but does not currently have a certificate or degree option in the areas of math or science.[6]

UNO offers over 100 baccalaureate degree options, including about 20 in the following STEM areas: biology, biotechnology, chemistry, computer science, environmental studies, geography, geology, management information systems, math and physics. Although students at UNO also study and can earn bachelors degrees in engineering, the College of Engineering and Technology is administratively part of the University of Nebraska-Lincoln and, thus, engineering is not discussed in this proposal.

## INSTITUTIONAL VISIONS

MCC – To advance the vision of developing human potential through the power of learning and community, MCC's Educational Services Division focuses on the development and implementation of the following Learning Initiatives:

- Mission driven
- Curriculum focused
- Partnership rich
- Inclusive culture
- Learner-centered

These five Learning Initiatives provide a framework for academic planning in that they allow faculty and staff to actively participate in creating the future together.

UNO – It is the vision of UNO to be a metropolitan university of high distinction, considered among the nation's premier state-supported institutions located in an urban setting.[7]

UNO seeks to:

- Place students at the center of the educational enterprise;
- Be a recognized center for research, scholarship, creative expression, and artistic performance designed to meet the needs of the broader community;
- Provide dynamic leadership to our constituents;
- Expand the educational achievements, intellectual aspirations and horizons of the learners that UNO serves within the city, state, nation, and global communities;
- Be a place of pride, attachment, and participation for students, faculty, staff, and the community;
- Create programs where learning will occur regardless of distance or time;
- Reflect the dynamic and culturally rich nature of the metropolitan area; and
- Be of the metropolitan community, not simply in that community.

## DETAILED PROJECT PLAN

### A. UNO/MCC Articulation Foundation

Creating avenues in the STEM disciplines for student progression and transfer from MCC to UNO is the focal point of this STEP proposal. Although valuable in any discipline, avenues for progression and transfer are especially important in the STEM disciplines because of the inherent hierarchical program structure. Establishing and maintaining strong articulation agreements as a result of regular collegial exchange regarding curriculum review, revision and articulation will provide students with clear academic paths and flexibility in their pursuit of degrees in STEM disciplines.

Although MCC and UNO currently have several course articulation agreements in each of the STEM areas, there are no specific program articulations in any of them. This type of program articulation has yet to be obtained because of the challenge and effort involved in addressing the depth and sequencing of multiple courses and ensuring that students receive a curriculum which flows smoothly between the two institutions. Currently, MCC has a Computer Science Associate Degree that transfers in its entirety to UNO's Computer Science Program, but there are no articulated agreements acknowledging the completion of numerous other computer technology diplomas and certificates offered at MCC which enable students to meld into UNO's computer science curriculum. MCC and UNO faculty will work together through regular meetings and curriculum exchange to articulate new Associate to Bachelor (A→B) programs in computer science and technology based on existing A→B articulated programs in non-STEM areas. Faculty release time and stipends will be integral to the success of establishing and maintaining these program options.

Additional program articulations will follow the pursuit of new degree options at MCC in the areas of math and science. These areas are currently offered only as general education courses at MCC. Courses in these areas will be clustered to create new opportunities for student learning and degree completion. Keeping in mind the need for students to take a full complement of sequential courses to develop complete understanding, especially when working towards transfer to a four-year institution, MCC will create specialist diplomas

which consist of 24-30 hours of concentration in mathematics or science. Designed for students seeking a specific academic focus, the diploma will offer a structured sequence of courses that may be completed in a relatively short time and that designate a specialized area. Students selecting a specialist diploma track will be easier to identify, track, advise and direct to specific activities/opportunities available through the STEM departments at both institutions. A career exploration component of the specialist diploma will be created as a seminar course, highlighting the many career options available to students with backgrounds in mathematics and science. This course will include presentations from faculty and professionals in STEM areas and industries.

For students completing the specialist diploma and seeking an associate degree, MCC will pursue liberal arts degree options in mathematics and science as part of the Liberal Arts Transfer Degree option currently available. A required "capstone" course will be created to provide internship opportunities for students and to assist with the smooth transition from MCC to UNO. This capstone course will provide students with actual industry insight into STEM areas, and it will give area industry leaders an opportunity to become acquainted and involved with students, as well.

As students declare this program of study, both MCC and UNO will continue to track these students and keep them abreast of department activities and opportunities. A special "Bridge Scholarship" will provide financial assistance and incentive for students completing their associate degree at MCC and transfer to UNO in pursuit of their bachelors degree.

## B. Scholarships

MCC Tuition Waiver/Bridge Scholarships

Scholarships not only provide financial assistance to students but can also be used to highlight areas of importance and need within a college/university. The introduction of bridge scholarships or tuition waivers will encourage completion of a degree program at MCC and will assist with the "bridging" of students transferring from MCC to UNO. Establishing these bridge scholarships for STEM students will also further exemplify the partnership between MCC and UNO.

MCC plans to create a program to provide "eligible" degree-seeking students in the STEM disciplines with a student tuition waiver or scholarship. The tuition waiver may be most appropriate and make the biggest impact for students taking the proposed one-hour career development/exploration course while pursuing a specialist diploma. Bridge scholarships will act as incentives for completion of the last quarter of study for students pursuing a degree in the STEM disciplines. Eligible students receiving this final quarter scholarship at MCC will then automatically be eligible for a similar first semester scholarship at UNO upon transfer. A joint MCC/UNO committee will be formed to establish the detailed eligibility requirements.

Adult Learner Access Scholarships

UNO will use a quarter of the STEP scholarship funds to provide adult access awards to prospective STEM majors. This program will be modeled on the University of Toledo scholarships of the same name.[8] Its purpose is to appeal to the many people who have started but not completed their postsecondary education, and for whom returning to finish their degree will be a financial sacrifice.

Scholarships for Underrepresented Students

Funding for need-based, minority student scholarships in computer science and mathematics has already been applied for by UNO in the form of a pending NSF CSEMS grant; however, the CSEMS grant only targets a portion of the financially needy, underrepresented students in all STEM disciplines. Adding biology, chemistry, geology/geography and physics to the UNO CSEMS areas of computer science and mathematics, and including all under-represented students, creates a large pool of financially needy students.

The table below provides a breakdown of entering 2003-2004 UNO freshmen who have indicated a desire to major in one of the STEM disciplines and who have financial need.[9]

| # of students | Bio | Chem | Comp Sci | Geo/Geog | Math | Physics | Total |
|---|---|---|---|---|---|---|---|
| Total number | 88 | 17 | 82 | 1 | 13 | 5 | 206 |
| # w/financial need | 15 | 5 | 4 | 0 | 3 | 0 | 27 |

With a STEP grant, UNO will award approximately twenty scholarships per year to under-represented STEM majors with financial need, at a maximum of $3,125 per person. The development of STEP scholar criteria will be based in part on the model set by the UNO Goodrich Program.[10]

The UNO Goodrich Program offers a three-pronged approach to helping financially needy students to successful degree completion:

1. Financial aid,
2. A specialized curriculum emphasizing the humanities, and
3. A comprehensive program of academic support, counseling and related student services.

The Goodrich Program has received several national awards for its work with students, including the Noel/Levitz Award (1991) and the Hesburgh Award (2001). The program also received the University of Nebraska system-wide departmental teaching award (1996) and boasts an 80% freshman to sophomore retention rate.

The Goodrich Program will also supervise a STEM discipline graduate teaching assistant (GTA) who will provide mentoring for STEP scholars as well as bridge scholars from MCC. An important aspect of the Goodrich plan is for all of these scholars to take a common course together during their first year at UNO. This facet will also be adapted for STEP scholars. Advanced STEP scholars will be encouraged to help tutor and mentor new scholars.

As STEP grant activities develop and expand and as internship/cooperative education programs gain acceptance from students and business leaders, funds will be sought from the local business community to extend the scholarship and internship programs beyond the life of the grant period. The NU Foundation, an experienced and effective fundraiser for University of Nebraska activities, has made a commitment to work with UNO for this purpose.

## C. Experiential Learning Components

Internships and Cooperative Education

An internship experience incorporated into an associate degree capstone course will help students further identify their scholastic path into math, science and technology. MCC's

Office of Cooperative Education will assist with the coordination of opportunities in the math, science and technology areas for student growth and degree completion. Both MCC and UNO will share efforts and community contacts in these areas with each other to provide a smooth transition and continuity of services available to students at these two institutions. While internships are available for all UNO students in the STEM disciplines, only those STEM students within the College of Information Science & Technology (IS&T) currently have access to a formal internship program (provided by the Peter Kiewit Institute of Information Science, Technology and Engineering). Using this internship program as a model, grant funds will be used to provide faculty from each of the other STEM disciplines with the necessary resources to develop internship programs in their departments. The Chemistry Department, in particular, has concrete guidelines[11] from the American Chemical Society for setting up student internships and cooperative education opportunities.

Early undergraduate research

Students will often be attracted to major in a STEM discipline because of the intellectual challenge and interest that it presents. It is important that students attracted by this challenge and excitement not be overwhelmed by the large amount of factual knowledge that must be mastered. An early undergraduate research experience, built into existing courses or as an elective, will help in this respect. Over the last year, for example, the UNO Departments of Chemistry and Geology/Geography have developed an interdisciplinary water quality analysis pilot research project that involves first-year chemistry and geology students. The students work together to reveal the variations in local water quality and the origins of the variation. The project has been well received by students, and expansion of the project is planned. Such a research experience is also useful for a significant group of students who are insufficiently aware or confident of their inherent scientific abilities. Early research experience will give them a clear indication of the personal satisfaction that the study of science can provide. Since UNO faculty can obtain released time for their own research, and this often includes supervision of undergraduate research projects, grant funds will be directed towards encouraging additional undergraduate participation in two ways. First, funds will be used to support research courses directed towards first- and second-year STEM majors. Second, funds will be used to provide supplies to junior and senior STEM majors following their submission of an independent project proposal.

### D. Student Support Services and Resources

MCC has learning centers and math centers on all three of its campuses. In addition to walk-in tutoring, these centers provide mini-course modules that students use to supplement their understanding of background or current course topics. At UNO, the College of IS&T provides walk-in tutoring for students in its elementary programming courses. Tutoring is also provided by the other UNO science departments but on a more limited, sporadic basis. Unfortunately, UNO tutoring services have recently been reduced by University budget cuts. For example, the Mathematics Department provided a walk-in GTA tutor in Fall 2002 for twenty hours per week, but this service was curtailed by budget cuts for Spring 2003.

One of the goals of this proposal is to strengthen the support given to MCC and UNO students in mathematics and science by providing additional resources.

Walk-in tutoring for freshman-level mathematics and science courses

A basic service needed in entry-level mathematics/science courses is an all-day walk-in tutoring room where students can go for help at any time. This project proposes to create a Learning Center in the Durham Science Center (DSC) where the Departments of Chemistry, Geology/Geography, Mathematics and Physics are housed. The DSC Learning Center will be generally modeled on what MCC and IS&T already have in place. By coordinating Learning Center activities, each institution will be able to learn from the other. All-day staffing of the Learning Center will also be important in addressing the accessibility issues of nontraditional students who frequently don't spend much time on campus outside of class.

Full staffing will require two graduate teaching assistants (GTAs) for walk-in tutoring and one computer science GTA to implement internet testing and provide course modules (see next section). To insure that the IS&T and DSC rooms are open sufficient hours to accommodate all students, additional undergraduate student workers from all STEM disciplines will be employed. Attention will be paid to assuring the presence of underrepresented students as tutors and mentors, in order to increase the appeal of these services to underrepresented students, in general.

Internet testing of basic skills in introductory mathematics and science courses

Starting in Fall 2001, UNO's Mathematics Department developed on-line tests[12] of routine basic skills in Calculus I and Calculus II. Students are required to pass a single test in each course (differentiation techniques in Calculus I, integration techniques in Calculus II) at one proctored on-line sitting, with only the use of pencil and paper. Furthermore, answers must be given in mathematical form. (This is what distinguishes this software from general purpose course-development software platforms such as Blackboard™) Students can take unlimited practice tests and repeat the official test multiple times until obtaining a sufficiently high score. A testing room, with 13 PC's, has been set up for this purpose. The lab is staffed by a computer science graduate student supported by the Mathematics Department with a GTA position.

On a limited basis, internet testing has also been developed for intermediate algebra and applied calculus. As funding permits, expansion is planned for the following subjects: trigonometry, elementary statistics, calculus III, differential equations and other mathematics courses. However, the software technology is not limited for use only in mathematics courses. Therefore, it is planned to expand usage to the other STEM disciplines (especially physics) as funding permits.

## E. Interdisciplinary Majors and Courses

One way to encourage more students to major in the STEM disciplines is to provide greater degree program flexibility. In addition to simply having more STEM degree path options, creating additional, interdisciplinary options will also attract more students by embracing recent trends and new fields in the STEM disciplines such as bioinformatics, information security, medicinal chemistry and neuroscience.

Bioinformatics

Despite its importance and potential benefits, the lack of appropriate curricula for education in bioinformatics has recently been identified as one of the major challenges facing the

continued development of the field.[13] Since 1999, the University of Nebraska has offered both an M.S. and a Ph.D. degree in bioinformatics through a joint program offered by the University of Nebraska Medical Center (UNMC), Department of Pathology and Microbiology and UNO's College of Information Science & Technology. Recently, the need for improved undergraduate preparation in this area has become apparent during the training of University of Nebraska bioinformatics graduate students. As a result, UNO and UNMC have recently begun work on the development of an undergraduate degree in bioinformatics. The goal of the degree will be to prepare students for positions in industry and research as well as provide them with the foundation necessary to succeed in bioinformatics and other graduate programs.

An undergraduate degree in bioinformatics at UNO will be one of the first of its kind in the country, and it will represent a natural progression in the evolution of bioinformatics within the University of Nebraska System, following the development of the graduate bioinformatics program. Although the new degree will consist mainly of currently existing courses, a number of specialized courses will be developed for the program.

UNO also sees a need to enhance existing courses and to develop "bridge" courses to help existing STEM majors become cognizant in bioinformatics, and to help non-STEM majors learn about the biological, ethical and social issues related to advances in bioinformatics and especially related to genomics and the human genome project. Such curricular efforts need to be developed at both the introductory and advanced levels, and hence at UNO as well as at MCC. This will encourage existing science and technology majors to consider a career in a new STEM discipline. It will also attract undeclared and non-STEM majors to gain additional fluency in, sometimes to the point of majoring in, STEM disciplines.

Information Assurance

As the world becomes vitally dependent on computers and networks of computers, it is becoming, at the same time, increasingly and dangerously vulnerable to cyber terrorism. Threats range from something as simple as the hacking of a home-based personal computer to the shutting down of a company, a power grid, a communications system, a military operation or an entire government. In spite of the severity and immediacy of the problems, there is today an acute shortage of people and programs to meet these ever increasing, critical challenges. To this end, the College of IS&T at the University of Nebraska at Omaha and the Peter Kiewit Institute have recently founded the Nebraska University Consortium for Information Assurance (NUCIA). (It is important to note that the National Security Agency recently designated UNO as a "Center of Excellence" for Information Assurance.) Included in NUCIA's strategic objectives is the establishment of a strong academic program in Information Assurance (IA). This will occur specifically through the integration of IA concepts throughout the undergraduate and graduate curriculum, as well as through the development of specialized courses in IA. Funds provided by this grant will be used to provide release time for faculty in order to develop these courses.

Medicinal Chemistry

A significant number of UNO entering freshmen declare majors in the pre-health sciences (216 in Fall 2002). These students differ from most pre-med and pre-pharmacy students in that they may only complete two or three years as an undergraduate and thus do not receive a degree. A degree program in medicinal chemistry will provide these students with a clear

intermediate goal in their preparation as health professionals. A major in medicinal chemistry would still require taking many chemistry courses, but will be more attractive to some future health care workers, compared to the traditional chemistry degree, by allowing students to enroll in the most relevant upper-level chemistry, biochemistry and biology courses. At least one new course, Medicinal Chemistry, will be developed for this new program.

The value of the medicinal chemistry program, especially if linked to internship opportunities, will be that it provides students with a new track to jobs in chemistry, laboratory biochemistry and biomedical research. This degree will be an attractive option to students otherwise in pre-health professions and will strengthen their prospects for post-baccalaureate opportunities. The possibility of a degree in medicinal chemistry has been positively received during informal discussions within the Chemistry Department. This approach has successfully increased the number of chemistry graduates at other institutions.[14]

Neuroscience

In the past decade, UNO has developed strength in neuroscience by hiring, in its Departments of Psychology and Biology, multiple faculty with expertise in behavioral, molecular, cognitive or physiological neuroscience. Although these faculty have been very successful at sustaining external funding and mentoring upper-level undergraduate, graduate and post-doctoral students, a concerted effort has not yet been made (at UNO or anywhere in the State of Nebraska) to develop an undergraduate degree program in this area. Such a program will provide students with a solid interdisciplinary foundation that will be attractive for the pursuit of diverse professional goals and very likely attract students from non-STEM majors such as psychology. Since neuroscience is an academic priority at the University of Nebraska Medical Center (UNMC), there is commitment from their faculty to contribute to training (via guest lectures, provision of internship opportunities, etc) of undergraduate students in this area. In addition, efforts in bioinformatics will dovetail with these efforts with the development of neuroinformatics.

All activities in this area involve faculty released time and/or summer fellowships for developing new courses in interdisciplinary areas. As UNO develops courses and majors and publicizes their availability, a special effort will be made to include MCC students.

## F. Recruitment and Outreach

In a broad sense, academic community outreach means engaging in activities which will make higher education, and in particular, programs at UNO and MCC, more appealing to the schools' natural clientele, the citizens of metropolitan Omaha.

STEM Discipline Outreach Coordinator

To enhance MCC's ability to reach out to K-12, especially high schools, to identify students with interest and aptitude in math, science and technology, and to bridge recruitment efforts with those of UNO, MCC's Enrollment Management area will need the equivalent of another staff person to coordinate these targeted efforts. This individual will be part of an MCC/UNO team that works with high school students and counselors to organize activities that peak student interest in the math, science and technology areas and provides information and direction for incoming postsecondary students and transfer students to UNO. MCC will

continue to assess the effectiveness of the ongoing need for a STEM outreach coordinator and will consider making whatever commitment is necessary beyond the grant period to sustain the anticipated enrollment growth.

Promotional Materials

In order to effectively promote the proposed scholarship, tuition waiver and degree options to prospective students and to market these options effectively, coordinated advertising is needed by the institutions. This will include creation, production and dissemination of brochures, posters, forms, applications and websites as well as website maintenance.

Extracurricular Activities

The UNO Math Department has an established activity for its students called the Problem of the Week (POW).[15] In Spring 2002, in connection with Mathematics Awareness Month (MAM), the Math Department expanded upon this activity by holding an on-line problem-solving contest for high school students which attracted eighty participants. In Fall 2002, about eighty high school students again participated with undergraduate mathematics majors operating the website. In April 2003, in connection with MAM observance, twenty-nine high school POW participants visited UNO for an end-of-the-school year math contest.

This type of activity has been shown to increase the number STEM majors.[16] For example, Oklahoma State University in Stillwater has an annual math contest during which over six hundred high school students visit the OSU campus.[17] Also, UNO's interaction with Omaha area high school math clubs is already increasing due to POW activities. Funding is needed to support the expansion of this activity as well as to use it as a model to develop similar activities by the other participating entities. For example, the College of IS&T will develop a "Program of the Month" contest in which participating high schools will compete in a monthly programming contest.

Three undergraduate mathematics majors will operate the Problem of the Week activity under the direction of a faculty supervisor. One undergraduate computer science major will be needed to operate the "Program of the Month" contest.

## G. Timeline

All activities will be initiated in some form during the first grant year, and an effort will be made to institutionalize each activity determined to be successful based on evaluation outcomes. Formation of complete articulation agreements is expected to be well underway at the end of the first grant year. Curricular refinement related to the agreements and general collegial discussion will continue during the life of the grant and beyond. Scholarship and tuition waiver criteria will be finalized quickly so that they can be made for the first grant year. Internship programs, undergraduate research, the learning centers, new courses and outreach activities will all be under development during the first grant year and will become available to students no later than the beginning of the second grant year. It is expected that research and internship activities will continue to expand over the life of the grant.

## H. Project Personnel

Experience and Capability of the Principal Investigators

Hesham H. Ali is a Professor of Computer Science and an Associate Dean for Academic Affairs of UNO's College of IS&T. He is also serving as a deputy director for computational sciences of the newly formed Nebraska Informatics Center for Life Center. He has published two books and a large number of articles in various areas of computer science including scheduling, distributed systems, wireless networks, circuit design and Bioinformatics. He is also a PI or a Co-PI in several other grants funded by NSF, NIH and DoD.

Jack Heidel, Professor and Chair of Mathematics, has been at UNO for the past nineteen years. He is well acquainted with most aspects of campus life and recently has become much better acquainted with MCC.

Brad Morrison, a full-time faculty member, teaches a complement of math courses from developmental to advanced placement at MCC. He also serves as the coordinator of student outcomes and assessment efforts within the Math Department and is actively pursuing additional technology mentoring for development of on-line math course options. His diverse business experience, in conjunction with his ability to work with his colleagues throughout MCC, will provide excellent insights during grant implementation.

Michele O'Connor is the Dean of Math, Science and Health Careers with 14 years of project management experience in education. As an administrator at MCC, she is involved in establishing and maintaining internal and external partnerships for MCC, looking for opportunities to expand services and academic options to students in the community and working with program faculty to ensure the quality and depth of program offerings.

Dana Richter-Egger is an Assistant Professor of Analytical Chemistry at UNO with particular interest in student learning and lab experiences for introductory through advanced undergraduate students. He has published in the Journal of Chemical Education and is involved in the interdisciplinary water quality analysis pilot research project previously mentioned.

Advisory Committee

This oversight committee, chaired by UNO's Vice Chancellor for Academic Affairs and co-chaired by MCCs Vice President for Educational Services, will consist of the UNO Dean of Arts & Sciences, Dean of Education and Dean of Information Science & Technology (IS&T) as well as MCC's Dean of Math, Science and Health Careers and MCC's Dean of Computer Technology and Visual Arts. It will also include the UNO department chairs of Biology, Chemistry, Computer Science, Geography/Geology, Mathematics and Physics, representatives from the corresponding MCC academic areas and all STEP PI, co-PI's and senior personnel not otherwise included.

Project Administrative Structure

The PI, located at UNO, will provide overall coordination of the UNO activities, with the help of the UNO co-PI's, and will work with MCC co-PI's to ensure that activities on both campuses are coordinated. At UNO there will be supervisory assistance as follows:

1. Articulation Supervision

   This individual at UNO will be an Arts and Sciences Associate Dean with background in a STEM discipline. He/she will have UNO responsibility for articulation of individual courses between MCC and UNO as well as development of new A→B (A to B) articulation agreements. MCC currently has an Articulation Coordinator who will assist with the coordination of all articulation proposals and agreements. A history of effective communications between MCC and UNO non-STEM disciplines already exists and will be used as the foundation for building additional STEM discipline articulations.

2. Learning Center/Science Center

   MCC has both Learning Centers and Math Centers already in place which will be used as a model for the addition of an MCC Science Center. Supervision of MCC centers is facilitated by a Center Coordinator working within the developmental education area of the College. A UNO Durham Science Center (DSC) faculty member will be responsible for hiring and supervising the Learning Center staff comprised of GTAs and undergraduate workers on the UNO campus.

3. Scholarship Selection/Mentoring

   A UNO Goodrich Program faculty member will oversee the scholarship selection process and mentoring efforts at UNO and will serve as a member of the joint MCC/UNO scholarship committee which will be formed to establish detailed eligibility requirements for all STEM scholarships and Tuition Waivers. UNO's STEP scholarship activities will thus be under the Goodrich "umbrella," while MCC's scholarship activities will be overseen by MCC's Financial Aid Office and MCC's Co-PI's.

4. STEM Internship Coordination

   This will involve a UNO faculty member from the Departments of Chemistry, Geology/Geography, Mathematics or Physics. He/she will be responsible for setting up internships with local businesses and governmental agencies and selecting students to hold these jobs. MCC's Cooperative Education Coordinator will work with faculty in MCC STEM disciplines to create and coordinate student opportunities. Representatives from both UNO and MCC will work together to coordinate all STEM internship efforts as well as to establish, compile and share internship contacts and resources.

## I. Evaluation Plan

The evaluation plan focuses on the use of four evaluative questions, which will address the primary goals of the project. Both formative and summative evaluation strategies will be used to connect project activities to a series of progress-related benchmarks. Dr. Elliott Ostler, an evaluation specialist and professor of teacher education, will conduct the evaluation with the periodic assistance of external consultants. The evaluation and management personnel will engage in regularly scheduled meetings, at least on a quarterly basis.

The evaluation process will focus on the following four primary evaluation questions that map to student achievement, recruitment and retention, articulation and collaboration, and accessibility. These questions will generally represent the outcomes of project activities and provide insight into sustainability, research and dissemination.

Question 1

*How well are students acquiring important mathematics and science knowledge, skills and concepts as defined by respective curriculum requirements at UNO and MCC?*

The project will examine levels of achievement by course and by college. Data for analysis will initially consist of course grades and general benchmark tests unique to programs within each college. On-line assessments will be added as gaps are noted to give a clearer picture of student achievement dynamics. Additional assessments will be identified by the evaluation team in collaboration with the participating program directors and integrated into the reporting process each year.

Data analysis will measure student success rates in beginning level STEM disciplines for incoming freshmen and transfer students as compared to baseline data, and longitudinal surveys will probe faculty perceptions of readiness to enroll in higher level STEM discipline coursework. This will assist UNO and MCC faculty in their pedagogy by helping them develop uniform assessment tools to measure learning outcomes and identify areas of student need in courses that articulate between MCC and UNO. Other multivariate statistical procedures will be used to examine trends, and eventually additional sources of student achievement data will be the formative assessments that are developed and implemented into MCC and UNO mathematics and science programs. Results from those classroom assessments will become available as the project develops and become integral to the progress of those programs.

Question 2

*Are the STEP activities encouraging higher levels of participation in mathematics and science courses and programs within UNO and MCC?*

Mathematics and science programs within UNO and MCC will submit data each semester on the numbers of students, demographics, and other data related to course enrollment. Much of this data will be collected and maintained through the use of on-line surveys. Interviews with samples of participating UNO and MCC faculty and site visits to a sample of classrooms will also be conducted. Descriptive statistics (totals, frequencies, means) will be used to summarize the participation. Contingency tables of participation broken out by school characteristic, student demographics and implementation method will be created. Interview data will also be coded and used to help illustrate and explain results of the quantitative analyses.

Question 3

*How are program and course offerings within and between UNO and MCC meeting the needs of students in providing effective transitions between the colleges as well as transitions into mathematics and science intensive areas of study?*

Institutional variables are already established for tracking program participation and student retention and recruitment at each institution. This will be monitored carefully

with on-line surveys and partner reporting. Impact of scholarship and transfer credit agreements will also be monitored longitudinally through student, faculty and administrative questionnaires. All data will be analyzed and summarized on-line for rapid feedback into the formative evaluation process, collapsing it each year for summative reports.

Question 4

*How are STEP project activities providing greater accessibility to mathematics and science related areas of study and career opportunities.*

Impact of Bridge Scholarships/tuition waivers, business internships, diploma/certificate options, research capstone courses, on-line academic enhancement programs such as the Problem of the Week (POW), and new degree options such as bioinformatics and medicinal chemistry will all be tracked using on-line surveys and partner reporting. Internships with community business partners will also be tracked both quantitatively and qualitatively through on-line surveys and site visitation interviews.

A summative report will be produced in the final project year that will review what has been learned and will provide guidance for the continuation of the project beyond the NSF funding period.

## J. Dissemination

Using part of the funding for promotional material described above, a STEP website will be jointly developed by MCC and UNO. This will initially describe STEP activities developed with grant support. It will also include evaluation/assessment summaries as they are completed each grant year. Finally, it will describe the ongoing development of grant activities and how they are being modified and adjusted in response to ongoing evaluation.

Faculty participating in STEP activities at both MCC and UNO will be expected to make presentations at appropriate community meetings as well as at regional and national professional meetings concerned with STEM educational issues.

## References


1 Metropolitan Community College, Office of Institutional Research, September, 2002.

2 University of Nebraska at Omaha, Office of Institutional Research, Audit Indicators, Academic Year 2001-2002.

3 University of Nebraska at Omaha, Office of Institutional Research, Graded Data Files, April, 2003.

4 Bhat, C. and Gaglione, O., *Making the Transition from Two-Year to Four-Year Colleges: Successful Minority Recruitment/Retention Strategies*, J. Chem. Ed., **79**(7), p 795, 2002, http://jchemed.chem.wisc.edu.

5 **a)** A. Churbanov, D. Quest, H. Ali, M. Pauley and R. Norgren, *A New Approach for Gene Annotation Using Unambiguous Sequence Joint*, Proceedings of the 2003 IEEE Computer Society Bioinformatics Conference (CSB2003), August 11-14, 2003, San Francisco, USA. **b)** D. Plum and H. Ali, *An Evolutionary Approach to Vehicle Routing Problem with Dynamic Time and Precedence Relations*, Proceedings of the 2003 International Conference on Computer Science, Software Engineering, Information Technology, e-Business, and Applications (CSITeA'03), June 5-7, 2003, Rio de Janeiro, Brazil. **c)** D. Kuyper, H. Ali, A. Mohamed and S. Hinrichs, *Sequence identification Utilizing Curated Custom Databases*, Submitted to the Ninth Pacific Symposium on Biocomputing (PSB) will be held January 6-10, 2004. **d)** A. Churbanov, H. Ali and J. Deogun, *Using Bayesian Paradigm for Splice Site Recognition Enhancement*, Submitted to the Ninth Pacific Symposium on Biocomputing (PSB) will be held January 6-10, 2004.

6 Metropolitan Community College, http://www.mccneb.edu/academics/departments.asp.

7 University of Nebraska at Omaha, Office of Academic Affairs strategic plan, http://www.unomaha.edu/aa/acadplan.htm.

8 University of Toledo Undergraduate Admissions, http://undergradadmission.utoledo.edu/pages/adult_scholarship.asp.

9 Jean Philips, Assistant Director, Scholarships, Office of Financial Aid. University of Nebraska at Omaha.

10 Goodrich Scholarship Program, University of Nebraska at Omaha, http://goodrich.unomaha.edu.

11 Brosz, Martha and Wieskittel, Amy, *Starting and Operating a CO-OP Program in Chemistry*, an American Chemical Society manual produced for a workshop at the joint Southeast/Southwest Regional Meeting, December, 2000.

12 University of Nebraska at Omaha, Department of Mathematics, http://www.unomaha.edu/~wwwmath/faculty/dmatache/dmatache.html.

13 University of Nebraska at Omaha, Department of Mathematics, http://www.unomaha.edu/~wwwmath/faculty/dmatache/dmatache.html.

14 University of Missouri~Columbia, http://www.chem.missouri.edu/undergraduates/degrees.html.

15 University of Nebraska at Omaha, Math Problem of the Week, http://www.unomaha.edu/~wwwmath/.

16 Jones, C., Lister, L. and Polhill, J., *One School's Success in Recruiting Mathematics and Computer Science Majors*, Focus, **23**(5)2003, p 10-11.

17 Oklahoma State University, Department of Mathematics, http://www.math.okstate.edu/~hsc/.