



COLLEGE OF LIBERAL ARTS & SCIENCES INTERDISCIPLINARY SIGNATURE AREA PROPOSAL

Mathematics and Science Education

Key Departments, Centers, and Schools: Biology, Chemistry, Geography, Geology & Environmental Sciences, Mathematical Sciences, Physics, School of Education and Human Development, Center for Applied Science and Mathematics for Innovation and Competitiveness (CASMIC).

Principal Contact: Doris R. Kimbrough, Associate Professor, Chemistry

Proposal Theme: We propose that Mathematics and Science Education (MSE) be recognized as a key Interdisciplinary Signature Area (ISA) for CLAS. The Departments of Biology, Chemistry, Geology, Geography & Environmental Sciences, Mathematical Sciences, and Physics as well as the School of Education and Human Development have historically had significant success in attracting funding, fostering outreach, and recognizing scholarship in non-traditional areas, particularly in educational arenas. The newly launched Center for Applied Science and Mathematics for Innovation and Competitiveness (CASMIC) will provide the unifying energy to build capacity and recognition in this area. We propose that ISA status will build upon established excellence in this area, and that this ISA be encouraged to reach beyond CLAS to incorporate other campus schools and colleges, most notably the College of Engineering and the School of Education and Human Development.

Proposal Rationale: UCDHSC is perfectly poised to become a regional leader in the important area of science and mathematics education. We have already established through the years that we are able to attract significant external funding for research and implementation projects in this area. Recent developments that make this a natural area for ISA status include

- **Rocky Mountain-Middle School Math and Science Partnership (RM-MSMSP)** is a partnership that is funded by a National Science Foundation award of 12.5 million dollars over 5 years. Historically this is the largest grant ever received on the downtown Denver campus of UCDHSC. The partnership has just commenced its third year and has united mathematics and science faculty from several CLAS departments within UCDHSC as well as other higher education partners with faculty in Education to provide
 - Professional development coursework in mathematics and science to middle level teachers in 7 metropolitan Denver partner school districts,
 - Science and mathematics-based outreach to area middle level students,
 - Enhanced pre-service mathematics and science teaching career education and opportunities, and
 - Data gathering and research into a variety of issues surrounding effective professional development implementation for in-service mathematics and science teachers.
- **The Center for Applied Science and Mathematics for Innovation and Competitiveness (CASMIC)** was recently launched as center that unites numerous

schools and colleges on our campus with the common goal of promoting innovation in mathematics and science through education, alliances with public and private sector entities, funding initiatives, and coordination of interdisciplinary efforts in science and mathematics education research. CASMIC has coordinated a number of grant proposal initiatives in science and mathematics education, and although CASMIC bridges both campuses and other schools and colleges, it has a strong CLAS focus in its role and mission. Current and planned proposal submissions are listed in the table below and total to approximately 6.7 million dollars in potential funding.

Grant Working Title	Funding Organization*	Proposed Amount (approximate)	Status
Science, Technology, Engineering, Math	NSF	\$500,000	Funded
GK12	NSF	\$2,700,000	Pending
Math and Science Partnership	CDE	\$200,000	February submission
Workforce Development	Denver Mayor's Office	\$60,000	Pending
STEP	NSF	\$1,000,000	Pending
Informal Science	NSF	\$1,000,000	Spring submission
Middle School Experiential Learning	HHMI	\$750,000	Pending
WIRED bloc grant	U.S. Dept. Labor	\$500,000	2007 submission
	TOTAL	\$6,710,000	

* NSF = National Science Foundation, CDE = Colorado Department of Education, HHMI = Howard Hughes Medical Institute

- **P-20 Education as a Campus Initiative** is established as part of this campus' Academic Master Plan. Building upon this by focusing on science and mathematics education is an clear and logical strategy for the College.
- **The Chemistry Department Focus on Chemical Education** as an area of excellence has resulted in the current search for a department chair whose research emphasis includes chemical education and future searches for junior and senior faculty who focus on chemical education as an area of scholarship. The Chemistry Department has recognized an excellent potential for growth and national recognition in this area.
- **School of Education and Human Development Hires** in Science and Mathematics Education are targeted for this year, as Education focuses expansion efforts on building capacity in these two important areas. Additionally the possibilities of joint appointments across SEHD and CLAS are under discussion.
- **Undergraduate Multidisciplinary Research in the Sciences and Health** has also been proposed for signature area status. If this area is indeed selected, collaborations between the two groups would be an obvious strength to both.
- **The Consolidation of the Downtown Denver Campus with the Health Sciences Center into UCDHSC** has produced much speculation around how CLAS can develop collaborations with our Fitzsimmons colleagues. Fostering our already established

excellence in mathematics, science and technology education through signature status could help to actually realize such a collaboration that would play upon the strengths of both campuses. Many of the discipline-focused projects that are currently funded and calls for proposals by the National Institutes of Health or the National Science Foundation have a requirement for education and/or outreach. Using the strengths on this campus in the realm of science and mathematics education will enable us to partner with groups at the Health Sciences Center Campus who may wish to “farm out” their education/outreach requirements to us.

- **The Urban Location** of our campus in the heart of downtown Denver, which represents the states’ most diverse population as well as a center of private and public sector technology and not-for-profit organizations that focus on educational and cultural enrichment, makes science and mathematics education an obvious and natural interdisciplinary area for “signature” status.
- **The Location in the State’s Capitol** gives us access to legislators and state governmental agencies, such that we can influence and frame policies in the area of science and mathematics education in the P-20 arena at the local, state and national levels.

A more focused and unified effort will improve our already successful efforts in this area and help the campus achieve national recognition, playing upon the aforementioned strengths and fostering collaborations such as those listed below.

- K-12. National, state and local attention is becoming increasingly focused on the improvement of science, math, and technology education in elementary, middle and high school classrooms. Areas for research and development where a CLAS ISA could have a profound impact include teacher content and pedagogical content knowledge, student achievement, and the achievement gap that exists for racial and ethnic minorities. In addition to such science/math education research efforts, discipline-focused research opportunities for teachers and their students, both on and off campus could be better coordinated given ISA status.
- Higher Education. Better educating our higher education baccalaureate and post-baccalaureate students such that they can step up to the challenge of an increasingly technologically-oriented workforce is an area where research is clearly needed. Collaborations could also enhance our industry/higher education partnerships to provide student internships and scholarships in technologically-focused fields.
- Education and Outreach. As mentioned above, both public and private funding agencies are increasingly encouraging and requiring proposed research efforts to include educational and outreach components. A science, mathematics, and technology education ISA would allow more traditional researchers both in CLAS and in other schools and colleges on the downtown and Fitzsimmons campuses to focus on more traditional research efforts while collaborating with researchers in science and mathematical education.
- Informal Education. The Denver metropolitan area supports a rich collection of science and cultural facilities. By virtue of its downtown Denver location, CLAS is perfectly poised to work with these institutions to consult and collaborate about exhibits and performances. Such collaborations are already happening through the CASMIC initiative. A science, mathematics, and technology education ISA will enhance and strengthen those collaborations.

Potential for Funding Opportunities

The Downtown Denver campus of UCDHSC has already established a good record of funding in the area of science and mathematics education through national and local funding agencies, both in the public and private sectors. The CASMIC initiative will ensure that this history of funding continues and expands. Building capacity in this area through faculty hires and signature area status will strengthen CASMIC's ability to leverage funding. In addition to the proposals listed in the table above, funding possibilities include

- From various programs within the National Science Foundation for laboratory equipment upgrades both for teaching and research laboratory instrumentation,
- From various programs within the National Science Foundation to foster interdisciplinary and/or informal science and mathematics education; (informal science education is well-established as a focus area; however, informal mathematics education is an area that represents significant possibilities for growth and application),
- From various programs within NSF and the Research Corporation to foster research experiences for teachers and their students,
- From various programs within the National Institutes of Health that focus on research and technology training and/or education and outreach,
- Other funding agencies that have math and science education as part of their mission,
- Foundation grants and gifts that are explicitly targeted for mathematics and science education, and
- Entrepreneurial efforts to fund existing and expanding programs, such as tuition from camps for kids and money from D-2 course offerings (see below).

There is significant funding to be had to pursue research and implementation in science and mathematics education this campus has an established track record in this area. The enhanced infrastructure that accompanies signature status would foster more proposal initiatives within CLAS and between CLAS and other schools and colleges (e.g. Education & Human Development or Engineering) in this important area.

5-Year Plan

Program Growth: Areas of program growth would leverage upon existing and developing opportunities. New and expanded programs would include:

- Masters Degree in Chemical Education as an interdisciplinary program in cooperation with School of Education & Human Development; this could then serve as a model for similar graduate degrees in other disciplines (NEW)
- Expansion and strengthening of the Masters of Integrated Sciences (MIS) and recruitment of more in-service teachers into the program (EXISTING)
- Expansion of D-2 course offerings beyond the RM-MSMSP courses to include
 - industry-focused courses, where we partner with industrial organizations to provide specific training for their workers (NEW),
 - K-12 focused courses, aimed at high school students in the CU-Succeed model, and additional in-service and pre-service teacher professional development coursework (NEW and EXISTING), and

- Higher education focused courses where we provide short courses to train higher education faculty at community colleges in the up-to-date use and applications of laboratory-focused technology and instrumentation (NEW).
- Undergraduate licensure in the sciences (NEW but builds on previous models)
- Summer camp opportunities in mathematics and science for area middle and high school students (NEW)

Staffing: In order to initiate or grow the programs above, additional faculty would be needed who have research expertise in the areas of mathematics and science education. The possibility of joint appointments with the School of Education and Human Development is discussed above and would be a cornerstone for growth in this area. In addition, the expansion of D-2 courses will require hiring as current faculty move or instructors are hired to teach in these areas. The Masters of Integrated Sciences has never received the staffing that it needs to flourish and is an obvious area for growth. The camp activities would be self-sustaining through charged fees. Proposed hires and staffing initiatives would include:

- Additional hires in chemical education, math education, and at least one additional area in the first year and subsequent hires in the following years. Some of these could/should be joint appointments with Education.
- Full year course release, summer salary, and half-time administrator to strengthen the MIS program
- Full year course release or summer salary for a faculty member to establish industry contacts and initiate courses to meet their needs
- Summer salary for faculty to develop aforementioned courses
- One semester course release or summer salary to develop undergraduate licensure program
- Hiring to accommodate D-2 expansion (faculty and staff)