

Science and Mathematics Teaching Center (SMTC) Academic Plan III 2009-2014

Section 1: Mission and Aspirations

The University of Wyoming SMTC is an intercollegiate and interdisciplinary unit committed to excellence in K-16 teaching and learning in science, technology, engineering, and mathematics (STEM). The unit is jointly governed and supported by the College of Arts and Sciences and the College of Education, with 70 affiliate faculty members in the Colleges of Agriculture, A&S, Education, and Engineering. The SMTC serves the professional development needs of STEM teachers in the Rocky Mountain Region as a:

- Center for collaboration on grants partnering K-12 schools, the Wyoming Department of Education, Wyoming Community Colleges, and the University of Wyoming
- Provider of Master's programs for STEM teachers, including the Master's of Science in Natural Sciences (MSNS) Middle Level Science Program, the MSNS Middle Level Mathematics Program, Master's of Science in Teaching for secondary level, and the MSNS Teton Science School Program
- Provider of teaching endorsement programs in middle level science and middle level mathematics; collaborates with OTE on secondary biology certificate for TSS students
- Provider of professional development courses and workshops for K-12 teachers
- Center for research-based change in the teaching and learning of K-12 STEM education
- Resource center for STEM teachers

Section 2: Previous Planning and Accomplishments

The SMTC is working to build the depth of the interdisciplinary programs for STEM teachers. The MSNS programs have received final approval from the Wyoming Professional Teaching Standards Board, endorsement options have been added to the MSNS middle level programs, and as part of the Secondary Education post-baccalaureate options a secondary biology certificate option has been added to the MSNS Teton Science Schools degree. The SMTC is pursuing expanding the existing MSNS programs from Wyoming to the Rocky Mountain Region, including discussions with WICHE to create a virtual on-line multi-university Master's for STEM high school teachers. We are currently piloting three on-line courses for regional access to the middle level programs. In addition, the SMTC is supporting efforts to revitalize the Ph.D. programs in science education and mathematics education, through recruiting graduate students and supporting dialogues on restructuring the programs across multiple departments in the Colleges of Education, Arts and Sciences, Agriculture, and Engineering.

The SMTC is pursuing funding to support STEM education through grants and foundations. We have received multiple Mathematics and Science Partnership grants from the Wyoming Department of Education to partner with K-12 school districts throughout the state to improve the teaching and learning of science and mathematics, including the Coordinated Resource Management Project, Project Inquiry, Engineering Approach Project, Carbon County Mathematics Initiative, and the Quantitative Reasoning Initiative. We are in the final

competition for two NSF grants supporting regional and national partnerships to address STEM education issues, and will be submitting a NSF grant to support growth in the STEM pipeline. The SMTC is currently working on STEM education collaborations with the School of Energy Resources, including development of a Wyoming Natural Resources Education Board, collaborating with NCAR on outreach related to the new Super Computer, and outreach associated with the new Berry Center.

The SMTC is instituting a research component to our mission. We are currently conducting research into articulation issues affecting student success as they move from high school to the University of Wyoming. We are investigating affective and cognitive issues impacting student success or failure in beginning undergraduate mathematics, biology, and chemistry courses. The research includes observation of classroom discourse and interviews of both highly successful and moderately successful students.

Section 3: Relevant Institutional Issues

The SMTC programs and projects are strongly connected to the UW Academic Plan III. We are building depth in interdisciplinary programs (Motif 1) through our MSNS programs, supporting the revitalization of the Ph.D. programs in mathematics and science education, and creation of regional master's programs for K-12 teachers. We are reinforcing areas of distinction (Motif 2) in science and technology, environment and natural resources, life sciences, and professions critical to the region; through our outreach programs for teachers across the STEM disciplines. The SMTC promotes access to higher education (Motif 3) through our distance education programs, articulation research on high school to college transitions, creation of a Freshmen Interest Group integrating biology, geology, and mathematics, and the NSF STEP proposal to create a collaborative across school districts, community colleges, and UW to improve the STEM pipeline. We promote excellence (Motif 4) in the critical areas of science and technology through our partnership with SER to create an Energy Education program providing professional development for inservice teachers and curriculum development, the creation of the Wyoming Natural Resources Education Advisory Board to purse the integration of environmental and energy education in K-12 schools, and with NCAR on computational sciences education. We are also pursuing excellence in the Environmental and Natural Resources area of distinction through our partnerships with Teton Science School on place-based education, our work on the outreach component of the Berry Natural History and Environmental Center, and our partnership with PiE, Atmospheric Science, and Computational Science on the EPSCoR proposal for \$14 million. We have assisted in building excellence in human capital in the College of Education through strong participation in hiring an Endowed Chair in Science Education and Mathematics Education, as well as securing an Outreach Professor in Science Education. The SMTC has taken a leadership role (Motif 5) in STEM education through a number of initiatives, including the STEM Teacher Education Innovation Initiative which brought together faculty from both A&S and the College of Education to explore innovations in preservice and inservice teacher professional development. The committee determined six areas in need of innovation: recruitment, retention, induction, curriculum, instruction, and assessment.

Section 4: Action Items

The following constitute action items for the 2009-2014 SMTC Academic Plan. These action items are drawn from current SMTC initiatives related to the University Academic Plan motifs and extended action items from the yearly SMTC academic plan.

- 1. *Assessment:* Develop and implement an assessment plan for the MSNS programs that will measure impact of the program on teachers practice, provide data to improve programs, and indicate areas of need for teachers in Wyoming and the wider Rocky Mountain region
 - determine state needs through web based needs assessment and focus groups
 - conduct a program evaluation through an alumni survey
 - Rationale: A primary SMTC goal is to provide professional development for K-12 STEM teachers; assessment of the impact of current programs and areas of need allows for meaningful pursuit of improved STEM teaching and learning.
- 2. Grants: Seek grants to support professional development and research
 - Submit a minimum of two state grants per year (Mathematics and Science Partnerships, Teacher Quality Grants) with a minimum of one funded
 - Submit a minimum of two national grant proposals per year (NSF, U.S. Department of Education, NIH, foundations) with a goal of successful funding of at least two in five years
 - Submit at least one collaborative proposal with other institutions that serve a regional or national STEM audience
 - Create broader impact modules for NSF and other national STEM grants that provide for meaningful STEM education components that impact teacher practice and student learning, and research the characteristics of successful professional development for STEM inservice teachers
 - Rationale: The SMTC is mandated to pursue grants to fund outreach activities supporting professional development in STEM teaching.
- 3. *Graduate Programs MSNS:* Expand current and explore potential new graduate programs serving inservice STEM teachers
 - Expand the MSNS Middle Level Science and Middle Level Mathematics programs to regional programs by moving components of the program to on-line delivery using cutting edge technology and research based pedagogical implementations
 - Maintain an enrollment of 20 teachers in each of the MSNS Middle level programs
 - Finalize approval of the MSNS Middle Level programs by ensuring all courses have permanent course numbers and PTSB endorsement options are approved
 - Expand the partnership with Teton Science School through admittance of a minimum of five graduate students per year; as well as partnering on state and regional environmental education and place-based learning efforts

- In collaboration with the Colleges of Education and Arts and Sciences create virtual graduate degree programs for STEM K-12 teachers that involve multiple university partners, share course credit, offer courses at instate rates, and serve the Rocky Mountain region for example STEM Elementary Specialist program that integrates science and mathematics and STEM High School master's program for each of Biology, Chemistry, Earth Systems Science, Physics, and Mathematics
- Support revitalization of the Ph.D. programs in science education and mathematics education through participation in college-level restructuring plans and securing a minimum of 10 graduate assistantships through SMTC funding options
- Rationale: Graduate programs for teachers and the Ph.D. programs provide leadership and create capacity for change in STEM education.
- 4. *Research:* Establish a line of research for the SMTC
 - Research that informs UW on issues of articulation of students in the STEM disciplines from high school and community college into college
 - Research that informs the SMTC on how to conduct quality professional development that impacts teacher practice and student learning in STEM disciplines
 - Rationale: Substantial and sustainable change in STEM education requires research to verify both areas of need and change. The SMTC research effort will be based on the need for research to support change.
- 5. *Outreach:* The SMTC mission to improve STEM teaching and learning must expand beyond K-12 schools to include STEM learning for all Wyoming citizens in both formal and informal education settings.
 - Partner with SER, ENR, PiE, the Berry Center for Natural History and Conservation to develop STEM outreach in science education, including expanding roles for the Wyoming Natural Resources Education Advisory Board
 - Partner with NCAR to develop STEM outreach in mathematics and computational sciences, including the creation of a Mathematics and Computational Advisory Board
 - Develop partnerships with Wyoming school districts that are collaborative efforts to provide sustained content-based professional development, using a model based on the Understanding by Design (UbD) framework
 - Sustain efforts to establish the Wyoming Heritage Project by searching out new funding sources and submitting proposals to support the project
 - In partnership with the Colleges of Education and Arts and Sciences grow the capacity of the SMTC to provide support for STEM teaching and learning K-16; hire an Outreach Mathematics Educator to work in collaboration with the Outreach Science Educator on K-12 STEM teacher education in the field and via distance education
 - In partnership with the Colleges of Education, Arts and Sciences, and other UW units, hire a K-12 STEM Competition Coordinator to lead K-12 problem solving competitions such as the State Science Fair and Future Problem Solving

- Rationale: Expanding the SMTC mission to include STEM education in both formal and informal settings will require extensive partnerships, cross-college and unit collaborations, and increased capacity.
- 6. *Articulation K-16 STEM Pipeline:*
 - Continue the STEM Teacher Innovations Initiative with the goal of implementing the action items identified by this collaborative effort
 - Submit proposals for funding expansion of the STEM pipeline through student recruitment and retention efforts, such as resubmittal of the NSF STEP proposal
 - Implement a Freshmen Interest Group with an interdisciplinary STEM focus
 - Rationale: One purpose for improving K-12 STEM education is to increase opportunities for students in STEM areas, including continuing study in the STEM disciplines on the collegiate level. The SMTC will take a role in improving the transition from high school to college in the STEM disciplines.

Section 5: Implementation

The following table is an implementation plan for the SMTC action items.

Action Item	Action	Timeline
Assessment	Summer 2009	Program Evaluation MSNS Middle Level Programs
	Summer 2010	State needs evaluation implemented
Grants	2009-2014	Submittal of minimum 2 MSP and 2 NSF/DoEd grants each year,
		partnership on broader impact component of national grant each
		year, national funded grant in 5 year period
Graduate	2009	Pilot at least 3 courses over internet from MSNS programs
Programs	2010	Finalize approval of all courses/programs MSNS
	2012	One of MSNS programs on-line for regional audience
	2013	TSS program expanded, MSNS programs at 20 per program
		Consider potential for secondary master's virtual program
Research	2009	Articulation research pilot completed
	2010	Establish research program on STEM Education issue in
		collaboration with Endowed Chairs of Science Education and
		Mathematics Education
	2011-2014	SMTC research cadre and grant proposals tied into Ph.D. in
		science and mathematics education
Outreach	2009	Wyoming Natural Resources collaborative established
		Wyoming Heritage Project grant submitted
	2010	Joint CPM request with Department of Secondary Education or
	2012	grant funding supporting Outreach Math Professor
	2009-2014	Establish support for a ¹ / ₂ time Competition Coordinator
		NCAR and Berry Center outreach efforts established
		UbD framework projects with districts conducted
Articulation	2009	STEM Teacher Innovations committee and support
		Resubmit STEP proposal for STEM Pipeline initiative
	2010-2014	Implement STEM FIG