



**Maine Center for Research in STEM Education  
(RiSE Center)  
Annual Report  
July 1, 2016 – June 30, 2017**



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## Executive Summary

The Maine Center for Research in STEM Education (RiSE Center), with its twenty faculty members and over thirty graduate students in the Master of Science in Teaching (MST) Program, has had an outstanding year of research productivity, with twenty-nine refereed journal articles and conference proceedings published and over ninety research presentations at conferences and other venues. Graduate and undergraduate students are integral to the center's research and, in the past year, six Master's theses, one doctoral thesis in discipline-based education research, and six honors theses and senior capstone research projects were completed mentored by RiSE faculty members. Six MST degrees were awarded through the RiSE Center. In addition, RiSE faculty are Principal Investigator or Co-Principal Investigator on eight new and twenty-four continuing external grants, totaling over \$25 million, and three internal Research Reinvestment Fund grants seeding collaborations with other University of Maine System (UMS) campuses.

The RiSE Center has taken important steps to sustaining its grant-funded partnerships with elementary, middle and secondary teachers as support for the Maine Physical Sciences Partnership (from the National Science Foundation) and the Maine Elementary Sciences Partnership (from the Maine Department of Education) end. To sustain these valuable partnerships, involving over 700 Maine science and mathematics teachers and impacting over 25,000 students, these two partnerships have merged to form the Maine STEM Partnership at the RiSE Center. This new partnership also includes the Faculty Course Modification Incentive Grant – Maine Learning Assistant (FIG – MLA) Program which, in the past year, involved 24 University of Maine faculty in science, technology, engineering, and mathematics, the STEM disciplines, and expanded to courses with total enrollment of approximately 4,275 students. Thus, the Maine STEM Partnership at the RiSE Center is the start of a state-wide improvement community for STEM teaching and learning over the grade span PK-16+.

This year marked the launch of the prestigious NSF Teaching Fellowship Program, designed to support new science and mathematics teachers from the MST Program as they begin their careers teaching in rural high-need Maine districts. Fifteen of the twenty-two fellowship positions have been awarded in this first year of the program. Fellows are supported in their transition from student to teacher by a pool of leading science and mathematics mentor teachers, who are connected with them to provide guidance in all aspects of their classroom practice and their new professional role.

The RiSE Center, now sixteen years old, held two strategic planning retreats during the past year, to consider the center's successes, revisit its vision, and identify areas for improvement. The first retreat led to the formation of four working committees: vision and communication, community and inclusivity, MST curriculum and assessment, and professional staffing. Each of these committees provided an update of their work for discussion at the second retreat and is developing action steps. A major outcome was to affirm the strength and value of both basic and applied discipline-based education research as the foundation of RiSE Center activities.

## I. Overview

**Overview.** The Maine Center for Research in STEM Education (RiSE Center) is an interdisciplinary research center organized to conduct research, graduate education, and professional development, and to build community partnerships focused on improving the research and research-based practice of STEM education at all levels of instruction. Members of the RiSE Center include faculty, staff, and graduate students engaged in education research across multiple STEM departments and the College of Education at the University of Maine. RiSE faculty, staff, students, and collaborators contribute to knowledge of teaching and learning across STEM subject areas, with significant national and international contributions in Biology, Chemistry, Earth Sciences, Education, Marine Sciences, Mathematics, and Physics. The RiSE Center provides education and professional development for emerging educators through undergraduate, graduate and postdoctoral opportunities, including teaching and research assistantships, a Master of Science in Teaching degree with a teacher certification option, and an interdisciplinary STEM Education PhD program. RiSE faculty and staff run all aspects of the University of Maine Faculty Course Modification Incentive Grant – Maine Learning Assistant Program (FIG – MLA), designed to improve teaching and learning at the undergraduate level in STEM, through a community of faculty working to implement research-supported practices in their courses. The RiSE Center also facilitates community partnerships with PK-12 schools and school districts, teachers, university faculty, and other organizational partners in Maine and beyond to improve STEM education and teacher preparation through research-supported practices.

**Mission.** To advance the research and practice of teaching and learning in science, technology, engineering, and mathematics – the STEM disciplines.

**Vision and Strategic Plan.** The RiSE Center was founded as an interdisciplinary research center bringing together a research community focused on investigations of teaching and learning in science and mathematics. This group of researchers has developed a strong national and international reputation, and contributes basic knowledge in discipline-based education research to the field. It also provides applications of this knowledge in professional development for STEM educators PK-12 and at the University of Maine. A guiding part of the vision is to build a culture of evidence, guiding improvements in science and mathematics teaching and learning by research findings. Investigations conducted by RiSE faculty members and their collaborators continue to improve understanding of student reasoning, lead to evidence-guided development of instructional materials, identify knowledge required by educators for teaching, and shed light on strategies for teacher preparation and growth.

A major part of the RiSE Center's original strategic plan was to develop and sustain the MST Program, a content-rich, research-based opportunity for graduate study for recent graduates or career changers in STEM seeking preparation and certification for secondary science or mathematics teaching, for experienced teachers desiring to return to school for full or part-time study, and for those interested in studying, at the Master's level, teaching and learning in STEM. The MST Program, initially offered in 2003, has developed into a nationally recognized model, attracting applicants from across the United States and internationally, and has grown from its original size of 15 students to a current enrollment of 31 students, 23 full-time and 8 part-time.

Coupled with the MST program has been the enhancement of introductory courses in science and mathematics, with some of these courses serving as laboratories for MST thesis research.

Another part of the vision of the RiSE Center has been the development of strong, symbiotic relationships between RiSE, the University's STEM Departments and College of Education and Human Development, and PK-12 partners. The development of these partnerships has been strongly enhanced by over \$16 million in external funding from the National Science Foundation and the Maine Department of Education during the last seven years.

With these accomplishments to build upon, the RiSE Center is embarking upon development of a new strategic plan, guided by UMaine's strategic plan and the current vision of faculty members within the center. Faculty members have provided input to this process through interviews and surveys, and the group has met for two working retreats during the past year. The plan is to develop the revised strategic plan during 2017-2018, for presentation and discussion with the RiSE Advisory Board and other stakeholders in spring of 2018.

***Administration and Staffing Structure.*** The RiSE Center is led by founding director Professor Susan McKay, who calls regular faculty meetings (approximately monthly) for discussion of issues related to the faculty as a whole. Faculty and staff also meet as needed to handle issues requiring shared decision making. Decisions related to the MST Program (admissions, application of policies, etc.) are made through a three-faculty interdisciplinary program committee chaired by the director. The Maine STEM Partnership at the RiSE Center is run by a 15-person leadership team that meets monthly and includes faculty, staff, teachers, and administrators involved in this evidence-guided STEM education improvement community. The only staff member currently fully base-budgeted in the RiSE Center is the financial and personnel manager. An assistant director and a research and evaluation coordinator are crucial in order to meet the basic needs of the center and ensure compliance with MST Program accreditation, IRB, FERPA and requirements for data storage and data management. Strategies to ensure ongoing base-budget funding of these positions are under discussion with the Vice President for Research (VPR). Additional professional staff positions are externally funded to coordinate grant- or school-funded programs, and the RiSE office is staffed by work study students, who also assist with events run by RiSE. The NSF Teaching Fellowship Program Coordinator is supported by a cost-share commitment made by the VPR. In total, RiSE currently has eight professional staff and twenty faculty members.

## II. Serving Maine

***Community Engagement.*** The Maine STEM Partnership at the RiSE Center is a prime example of community engagement. PK-12 members of this partnership work with RiSE faculty and staff to set priorities for professional development, select high quality instruction resources through a task force evaluation process, and develop a shared vision and plan for science and mathematics educational improvement in Maine. Members of this community gathered at Point Lookout in Northport, ME in the fall of 2016 to share their work and develop plans for the coming year. During the past year, this community has impacted 700 teachers with 11,000 hours of professional development, reaching 101 Maine school districts. Approximately 25,000 Maine students, PK-12, had a teacher during the last year who participated in this community. The Maine STEM Partnership also includes twenty-four STEM faculty who have received incentive

grants to bring research-based practices into their courses and 103 Maine Learning Assistants who have been part of these course improvements.

***Economic and Workforce Development.*** The RiSE Center contributes to Maine’s economic and workforce development through its improvements in STEM education at both the PK-12 and postsecondary levels. STEM taught well not only builds disciplinary content and practice knowledge, but also supports the development of essential workplace skills, such as oral and written communication, problem solving, and teamwork. By providing a highly regarded research center in STEM Education, the RiSE Center contributes to Maine’s reputation as a place that cares about excellence in education, particularly in STEM disciplines, which is important for attracting new businesses. Its STEM teacher preparation and professional development leads to improvements in teaching and learning in these disciplines. (Please see Appendices G and H.) The RiSE Center uses Maine sites for its annual summit (150 participants), annual conference (160 participants), and field work professional development conferences (51 participants). These events require catering, lodging, and hosting of out-of-state presenters in our communities, thus supporting the local economy.

***Collaborations with UMaine System Campuses.*** The RiSE Center has used Research Reinvestment Funds to build strong connections with other University of Maine System (UMS) campuses. Associate Professor Michelle Smith received seed grant funding for “Workforce Development: Helping UMaine Faculty Develop Classroom Activities that Prepare Students for Skills Needed in Maine’s Science Careers”, involving biology faculty from all seven UMS campuses, as well as the Jackson Laboratory, James W. Sewall Company, and Oceanswide. Professor and RiSE Director Susan McKay is part of “Revolutionizing Computing Across the University of Maine System”, led by Professor Harlan Onsrud and co-led by Professor Constance Holden (UMA), a project that involves faculty teaching computing skills at all UMS campuses. Associate Professor Janet Fairman leads a planning grant “Building a Collaborative Partnership to Support K-12 Professional Development in Maine”, with collaborators from USM and UMF. In a separate collaboration, Assistant Professor Anita Stewart McCafferty and Professor Jeff Beaudry (USM) have worked with RiSE faculty and staff to develop and implement a professional development series on formative assessment in science.

***Collaborations with Other Outside Institutes/Organizations.*** The RiSE Center works closely with Bill Zoellick, Director of Education Research at the Schoodic Institute at Acadia National Park on research related to challenges faced by new teachers, development of teacher leadership, and evaluation of impacts of RiSE professional development. Teachers from the Maine STEM Partnership, RiSE faculty and staff, and Leigh Peake, Chief Education Officer at the Gulf of Maine Research Institute, are working on the development of a Maine student research journal, to be launched this fall. This initiative is led by Castine middle-school science teacher Bill McWeeny, part of the Maine STEM Partnership teacher leadership coalition.

### **III. Financial Sustainability**

***E&G Support; Salary and Operating Support.*** The MST Program is supported in part through E&G funding (\$168,000). This funding is allocated for expenses associated with running a 30-student program, including faculty compensation to teach some of the MST courses. Some of this funding is also allocated to the Department of Physics and Astronomy to support their teaching needs, as partial compensation for Professor Susan McKay’s time as center director and teacher for SMT590 and SMT591. Currently all other RiSE faculty members receive full salary

through their home departments. The RiSE Center also receives, through successful competition in the Maine Academic Prominence Initiative (MAPI), \$34,000 annually, which is used to provide bridge support for staff, postdoctoral research associates and graduate students doing research. MAPI funds also provide small writing grants for MST graduates and their advisors who submit papers to refereed journals based upon MST thesis research.

**MEIF Support.** The RiSE Center receives \$61,125 in MEIF funding to support its research mission. Most of this revenue goes toward the salary of the financial and personnel manager, the only base-budgeted staff member in the RiSE Center. Remaining funds are used for research and evaluation coordination, bridging students and postdoctoral research associates between grants, and running the RiSE Center colloquium series.

**Research Funding; Submitted and Awarded.** In the past year, the RiSE Center submitted 22 new proposals for a total of \$14,580,000. Six new awards were funded for a total of \$620,643, and 24 awards were continued (typically after annual report review), with total award values of \$24,456,000. Details are provided in Appendix D.

**Brief Overview of Major New Award.** With eight new awards contributing to the RiSE Center's success this year, it is not possible to even briefly summarize each major award within the space provided. Here we summarize one new award to Associate Professor Mitchell Bruce. Additional information about other new awards will be provided upon request. This NSF award, "Fostering Connections between Macroscopic, Submicroscopic, and Representational Levels Using Analogical Reasoning in the Chemistry Laboratory" builds upon the **CORE** (Chemical Observations, Representations, Experimentation) learning cycle that has been developed and used at the University of Maine. It supports, in part, MST students Devin Howard and Joe Walter, who have both also been selected for the NSF Teaching Fellowship Program. According to Bruce, "the approach is based upon a theory called structure mapping theory, which has had wide acceptance, but has never been used as a strategy in chemical laboratory courses until the development by Bruce and collaborators of **CORE**. One key feature of this approach is to have students explicitly consider both the similarities and limitations of models that are introduced during the laboratory experiment. Research has shown that while instructors often explain the similarities of a model to students, rarely do they discuss where the model breaks down. However, there is wide agreement that the limitations of the model are critical to understanding how to apply it."

**Return on Investment.** For FY17, the RiSE Center's new awards totaled \$620,643, considering the return on MEIF investment in the center provides a return on investment of 10.15 times. (One could argue that the costs of supporting a graduate program, including teaching and director buyout, should not be included in this calculation, since these costs are generally born by the academic departments rather than the research centers. The RiSE Center is somewhat unusual in that it runs such a large graduate program.) If one combines the MEIF and RiSE E&G budgets, which also support teaching costs, students, and other expenses associated with the MST Program, the return on investment is still 2.4 times. This return on investment does not count the continuing grant revenue or the value of improving Maine STEM education and STEM workforce through professional development to educators PK-16+.

**Revenue Centers.** Most RiSE external funding comes from the National Science Foundation, with significant amounts also coming from the Maine Department of Education, U.S. Department of the Interior, U.S. Department of Energy, U.S. Department of Commerce, and private foundations, such as the Perloff Family Foundation, which has donated five 3D printers to the RiSE Materials Warehouse.

**Private Giving/Alumni Cultivation.** The RiSE Center has received approximately \$12,290 in private donations during the past year to support its work. The center continues to (re)connect with alumni from the MST Program, with many alumni involved in RiSE professional development, assisting in MST courses, and mentoring new graduates. Since the program is only fourteen years old, we do not yet have an extensive alumni base for donations.

**Initiatives to Increase Efficiency.** During the past year, we have continued using work study students to staff the RiSE Center office and assist with preparations for professional development, colloquia, and other center events. We were fortunate to be able to hire talented students who quickly learned the job and did excellent work, saving the RiSE Center over \$15,000 while providing these students with valuable work experience. We plan to continue this staffing model through the coming year, provided that qualified students can be found.

#### IV. Culture of Excellence

**Faculty Achievements.** RiSE faculty members hold leadership positions in professional organizations and are invited participants at many conferences. For example: **Francois Amar** was an invited participant in a workshop on professional development organized by the National Collegiate Honors Council. **Mitchell Bruce**, who was promoted to full professor this year, received funding from NSF for research into fostering connections between macroscopic and submicroscopic phenomena in chemistry (\$275,284). Making these connections was one of the persistent problems for science students that teachers in the MainePSP identified. More information about this grant is given above. **Chris Gerbi** is the recipient of an NSF Career Award, “Identifying Dominant Controls on Strain Localization on the Lower Crust”. **Janet Fairman** was promoted to associate professor with tenure. **Susan McKay** has been invited to participate in the NSF 2017 Noyce Summit on Stimulating Research in Preservice Education of STEM Teachers in High-Need Schools. She also serves as an appointed member of the Maine Governor’s STEM Council. **Sarah Nelson** has been selected to serve on the Steering Committee for the Northeastern Ecosystem Research Cooperative. **Eric Pandiscio** has been invited to serve on the Maine Selection Committee for the finalists for the Presidential Awards for Excellence in Mathematics and Science Teaching. **Molly Schaffler** gave an invited presentation at the international Data Science Education Technology Conference held in Berkeley, CA. **Jon Shemwell** was promoted to associate professor with tenure. **Michelle Smith** organized 25 co-authors at 6 different institutions to publish a paper “A clicker-based study that untangles student thinking about the processes in the central dogma”. (See Pelletreau et al. in Appendix B.) **MacKenzie Stetzer**, who was promoted to associate professor with tenure, serves as the co-chair of the Development Committee for the AP Physics C exam. **Natasha Speer** served as chair/co-chair of a conference/workshop on preparing mathematics graduate students, an NSF-sponsored event. **John Thompson** was elected vice-chair of the American Physical Society Topical Group on Physics Education Research Executive Committee and is now the Chair Elect and Chair of the Programs Committee for this group. **Michael Wittmann** serves as a member of the Board of Trustees of the Knowles Science Teaching Foundation.

**Research and Scholarship Summary.** RiSE Center faculty have published 29 refereed journal articles or conference proceedings and five technical reports as listed in Appendix B. They gave 35 invited presentations and 55 contributed presentations at conferences and departmental colloquia.



***Curricular Innovations/Integration with UMaine Education Mission.*** RiSE Center faculty and staff run the Faculty Course Modification Incentive Grant – Maine Learning Assistant (FIG – MLA) Program, which brings research-supported practices into STEM classrooms and laboratories and evaluates their impacts on students. The evaluation component brings together FIG faculty, RiSE faculty, and MST students to measure the outcomes of the course modifications and use this information to guide further improvements. During the past year, 24 FIG faculty participated in this community, impacting 22 courses in 10 STEM departments across three colleges. The total enrollment of FIG-MLA courses was 4,275 students and 103 undergraduates were part of the Maine Learning Assistant Program.

## **V. Student Engagement, Student Success**

***Undergraduate Student Research, Scholarship or Creative Activities.*** In the summer of 2016, RiSE provided undergraduate research opportunities in STEM teaching and learning for ten undergraduates, funded by NSF. Beginning in May of 2017, we have offered summer undergraduate research opportunities to four undergraduates. These undergraduates, who are interested in teaching careers, complete an undergraduate research project, capstone, or honor's thesis as an outgrowth of their summer work. Through these opportunities, provided as part of the Undergraduate STEM Education Professionals (USEP) Program, the undergraduates also work with teachers on evidence-guided improvements of curriculum, instruction, and assessments and have the opportunity to observe STEM classes at the PK-12 and University level.

***Undergraduate Student Awards.*** N/A

***Graduate Student Research, Scholarship or Creative Achievement.*** The MST Program requires a research thesis in teaching and learning related to STEM for all graduates. With 23 full-time and 8 part-time MST students, graduate student research is a large part of the RiSE Center's work. Student names are bolded in the publications and presentations listings in Appendices B and C, showing the involvement of these students, many of whom are future teachers, in research.

***Graduate Student Awards.*** MST student Elizabeth (Betsy) Trenckmann received the President's Research Impact Award at the University of Maine Student Symposium for her presentation "Collaborating Across the University of Maine System to Improve Student Understanding of the Role of Energy and Matter in Photosynthesis," advised by Michelle Smith. She was also named the Outstanding Graduate in 2017 from the MST Program this year. Additional information about Betsy is provided in the Highlighted Student Profile below.

***Retention and Graduation Numbers, Initiatives.*** Data from the FIG-MLA Program suggests that first-year undergraduate students who take two or more FIG-MLA courses are more likely to be retained than those who do not. This trend persists for both STEM and non-STEM majors. We are continuing to monitor this data as additional faculty join the program and more students are impacted. (See Appendix G.)

***Degrees Granted.*** Six MST students graduated during the past year: William Ferm (Advisor: MacKenzie Stetzer), Rachel Martin (Advisor: Susan McKay), William Schlager (Advisor: Molly Schaffler), Elizabeth Trenckmann (Advisor: Michelle Smith), Jen Tyne (Advisor: Natasha Speer), Marina Van der Eb (Advisor: Susan McKay). Two of these graduates have accepted teaching positions in Maine and are NSF Teaching Fellows (Ferm and Trenckmann), one was selected as the Coordinator for the Maine STEM Partnership at the RiSE Center (Van der Eb),

one is pursuing a Ph.D. at Texas A&M (Martin), one teaches at the University of Maine (Tyne), and one plans to teach out of state (Schlager).

**Highlighted Student Profile.** We choose to highlight Elizabeth (Betsy) Trenckmann, this year's student selected by the RiSE faculty as the Outstanding Graduate from the MST Program. Betsy, originally from Colorado, came to the MST Program from Maine Maritime Academy, where she majored in marine biology. Her thesis research, advised by Associate Professor Michelle Smith in the School of Biology and Ecology, focused on student understanding of the role of energy and matter in photosynthesis, and involved students and faculty across the University of Maine System. She presented this research at the University of Maine Student Symposium and received the President's Research Impact Award. She is first author on a paper accepted for publication in CourseSource, "An active-learning lesson that targets student understanding of population growth in ecology." She has worked to complete all requirements for certification in secondary life sciences through the MST Program. She did her student teaching with Leslie Boyd at Orono High School and has accepted a position teaching biology and Earth sciences at Hermon High School for the fall. She has been selected as an NSF Teaching Fellow, an appointment that she will hold for the next five years, as she further develops her science teaching and leadership skills. More information about Betsy can be found at <https://umaine.edu/news/blog/2017/05/10/elizabeth-trenckmann-seeking-inspire-high-schoolers/>.

## **VI. Preserving – Restoring Infrastructure N/A**

### **VII. Summary of Anticipated Challenges**

(1) The RiSE Center has built, with grant support, an excellent reputation for high quality research and research-guided professional development. It has also expanded its MST Program and has launched, with the College of Education and Human Development, a STEM Education Ph.D. Program. While these expansions have occurred, the base budget for the MST Program has been reduced and MEIF support remains flat. An organization of this size needs appropriate fulltime, base-budgeted staff support to do its work. It puts stress on the organization to be so understaffed in these crucial, ongoing areas of need. The center needs a full-time assistant director to support all aspects of the center's daily operations, including documentation for accreditation of the MST Program, grant proposal preparation, conferences and events, and reporting on grants and contracts. A research and evaluation coordinator is also required in order to ensure compliance with research involving human subjects and FERPA regulations, as well as data management, including security and access. Currently the only base-budgeted RiSE staff member is the financial and personnel manager, also essential for a center of this size with so many grants, graduate student appointments, materials purchases, and teacher stipend payments.

(2) During the last seven years, the RiSE Center has benefited from substantial graduate student and staff support from the Maine Physical Sciences Partnership (MainePSP), an NSF Math Science Partnership (MSP) Program award and the Maine Elementary Sciences Partnership (MaineESP), which the MainePSP seeded. The federal MSP program has been discontinued, and the \$14 million MainePSP award, along with supplements and extensions, will end in August, 2017. Federal agencies have not announced another initiative in STEM education of this magnitude, and it is difficult to obtain the multiple smaller grants that would be required to replace this stable, longer term funding. Yet, there is a strong desire to sustain the work and

community formed through this grant and the projects that it has seeded. The University of Maine administration has institutionalized and supported the FIG – MLA Program, initially established through this grant. It is more challenging to piece together sustainable funding for the PK-12 work, in spite of data showing how beneficial it has been to Maine students and the willingness of the school partners to pay the costs of materials rentals for hands-on science and part of the costs of ongoing teacher professional development.

(3) From our school partners and the Maine Department of Education, there is increased demand for comprehensive mathematics teacher professional development, similar in scope to that provided through the MaineESP and MainePSP. The model developed and the lessons learned from these partnerships could be applied in mathematics, but the University of Maine (and the UMS) do not have enough faculty in mathematics education to undertake this type of large scale project. Additional mathematics education faculty with expertise in PK-12 are needed in order to support teachers to provide high quality mathematics education to all Maine students.

### **VIII. Summary of New Initiatives**

As an outgrowth of the RiSE Center retreats and strategic planning this year, there is a firm commitment by faculty to increase the center’s research productivity and visibility and, among many faculty, to develop more collaborative research projects across disciplines, taking advantage of the interdisciplinarity of the RiSE Center. Groups of faculty have begun meeting to develop common research questions and explore possible collaborations. The RiSE Research Group, which meets weekly, has grown to a gathering of typically 10-20 researchers, and provides informal feedback for student and faculty research projects. Further, RiSE faculty are working increasingly with those from other campuses within the UMS, leading to collaborative proposals and shared educational and professional development practices. One possibility under discussion is the expansion of the FIG – MLA Program to other campuses, to improve retention and encourage the use of research-supported practices in STEM teaching throughout the UMS.

During the past year, the Leadership Team of the NSF Teaching Fellowship Program selected the first fifteen fellows (of a total of twenty-two fellows funded). This program is designed to recruit, prepare and retain new science and mathematics teachers from the MST Program for high-need rural Maine school districts. To date, fellows have been placed in Gray-New Gloucester High School, Hermon High School, and Old Town High School. A pool of leading experienced teachers, with disciplinary and grade-band expertise to match those of the fellows, has also been selected and will be expanded as more fellows are selected. This community, a partnership of RiSE faculty and staff and new and experienced teachers, will be able to have a substantial positive impact on STEM education in rural Maine during the six years of this grant. The grant supports work by leading teachers and ongoing targeted professional development for the fellows. It also supports research being led by Bill Zoellick, Director of Education Research at the Schoodic Institute at Acadia National Park, to better understand the challenges faced by these new teachers, the development of teacher leadership in this community, and the supports that are most effective during the induction phase of a teacher’s career, particularly in a rural, high-need school. This knowledge will guide future teacher preparation and professional development for teachers in rural areas, both in Maine and nationally.

Through the MainePSP, the RiSE Center has developed a scalable model for state-wide professional development for teachers that leads to improved outcomes for students. (See, for example, Appendix H.) This model is currently being discussed as a strategy to help every student succeed in science and mathematics. Although this statewide expansion would require considerable investment and collaboration across the state, it has the potential to make Maine a national leader in STEM education. Further, the approach applied to the STEM disciplines could be adapted to other areas of study, strengthening PK-12 education through statewide partnership, including other UMS campuses.

*Appendix A*

**LISTING OF RiSE CENTER FACULTY AND STAFF  
2016 – 2017**

**Erika Allison** (through September, 2016)

RiSE Center Project Director

**Carolina Alvarado**

Postdoctoral Research and Teaching Associate and Visiting Libra Professor (through August, 2016)

**Francois G. Amar**

Professor, Department of Chemistry and Dean, Honors College

**David J. Batuski**

Professor and Chair, Department of Physics and Astronomy

**Mitchell R. Bruce**

Associate Professor of Chemistry

**Elizabeth Byerssmall**

NSF Teaching Fellows Program Coordinator

**Justin Dimmel**

Assistant Professor of Mathematics Education and Instructional Technology

**Robert D. Franzosa**

Professor of Mathematics and Statistics

**Christopher Gerbi**

Associate Professor of Earth and Climate Sciences

**Janet Fairman**

Associate Research Professor of Education

**Ethan Geheb**

RiSE Professional Development and Resource Coordinator

**Travis Hall** (through January, 2017)

Maine STEM Partnership Coordinator

**Erin Hayes-Pontius** (through August, 2016)

RiSE Resource Coordinator

**Elizabeth Hufnagel**

Assistant Professor of Science Education

**Sara Lindsay**

Associate Professor, School of Marine Sciences

**Susan R. McKay**

Director, RiSE Center, and Professor of Physics

**Laura Millay**

RiSE Research and Evaluation Coordinator

**Elizabeth Muncey**

RiSE Professional Development and Resource Coordinator

**Sarah Nelson**

Associate Research Professor, Senator George J. Mitchell Center, and Associate Research Professor in Watershed Biogeochemistry, School of Forest Resources

**Eric A. Pandiscio**

Associate Professor of Mathematics Education

**Franziska Peterson**

Assistant Professor of Mathematics Education

**Maureen Raynes**

RiSE Financial and Personnel Manager

**Molly Schaufler**

Research Assistant Professor (adjunct), School of Earth and Climate Sciences and Climate Change Institute

**Jonathan Shemwell**

Assistant Professor of Science Education  
and Cooperating Assistant Professor of Physics

**Deborah Shulman**

RiSE Professional Development and Resource Coordinator

**Michelle Smith**

Associate Professor of Biological Sciences, C. Ann Merrifield Professor in Life Science Education, and Cooperating Associate Professor of STEM Education

**Natasha Speer**

Associate Professor of Mathematics Education

**MacKenzie Stetzer**

Assistant Professor of Physics and Cooperating Assistant Professor of STEM Education

**Jaymi Thibault**

RiSE Undergraduate Assistant

**John R. Thompson**

Professor of Physics and Cooperating Professor of STEM Education

**Marina Van der Eb**

Maine STEM Partnership Coordinator

**Erin Vinson**

RiSE Campus Initiatives Coordinator

**Michael C. Wittmann**

Professor of Physics and Cooperating Professor of STEM Education

## Appendix B

### PUBLICATIONS

*RiSE Faculty, Postdocs, Graduate Students, and Staff are in bold.*

- Barth-Cohen, L. A., & Wittmann, M. C.** (2017). Aligning Coordination Class Theory with a New Context: Applying a Theory of Individual Learning to Group Learning. *Science Education*.
- Bragdon, D., Pandiscio, E., & Speer, N.** (2017). University Students' Graph Interpretation and Comprehension Abilities. *Investigations in Mathematics Learning*.
- Bruce, M. R. M., Bruce, A. E., Avargil, S., Ois, F., Amar, G., Wemyss, T. M., & Flood, V. J.** (2016). Polymers and Cross-Linking: A CORE Experiment To Help Students Think on the Submicroscopic Level. *Journal of Chemical Education*.  
<https://doi.org/10.1021/acs.jchemed.6b00010>
- Bruce, M. R., Wilson, T. A., Bruce, A. E., Bessev, S. M., & Flood, V. J.** (2016). Infrared Radiation and Greenhouse Gases. *Journal of Chemical Education*, 93(11), 1908–1915.  
<https://doi.org/DOI:10.1021/acs.jchemed.6b00047>
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**Appendix C**

**PRESENTATIONS**

<b>Name</b>	<b>Description</b>
Amar, Francois G	Books in My Life: Reading that Transforms
Amar, Francois G	The Honors Collegiate Way: Excellence, Innovation, and Engagement
Amar, Francois G	Colleges Partnering Across the Globe: The Tembusu College and University of Maine Honors College Experience
Amar, Francois G	Acid/Base Defect Sites on Tungsten Oxide Clusters
Bruce, Mitchell R	Connecting Macroscopic, Submicroscopic, and Representational Levels Using Analogical Reasoning: Working Towards a Generalized Understanding of Using Representations
Bruce, Mitchell R	Examining the Use of Representations in Science: A Hands-On Introduction to Structure Mapping Theory, an Invited Workshop
Bruce, Mitchell R	Workshop: Want to Improve Your Teaching of Chemistry? Try Analogical Reasoning! 2016 Maine STEM Partnership Fall Summit, Point Lookout, Northport, ME, Nov. 18-19, 2016.
Fairman, Janet	Fairman, J., Jorgensen, B. (April 2017). Transforming teachers' instructional practice: The role of formative assessment data from online homework. Paper presented as part of a research team symposium on the ASSISTments online mathematics homework study in Maine, presented at the AERA Annual Meeting, San Antonio, TX, April 30, 2017.
Fairman, Janet	Briefed the Education and Cultural Affairs Committee of the Maine State Legislature on implications of the ESSA federal education policy, and also on implications of proficiency-based high school credentials for college access.

Fairman, Janet	Briefed the Education and Cultural Affairs Committee of the Maine State Legislature on research findings related to strategies that support school leaders.
Fairman, Janet	Briefed the Education and Cultural Affairs Committee of the Maine State Legislature on research findings from a study of district implementation of educator evaluation and professional growth systems in Maine.
Fairman, Janet	Briefed the Education and Cultural Affairs Committee of the Maine State Legislature on implications of federal education policy for Title 1 funding and state and district reporting on student achievement.
Gerbi, Christopher	Gerbi, C., Johnson, S.E., Shulman, D. and Klepeis, K., 2017, Influence of microscale weak zones on bulk viscous strength, Geophysical Research Abstracts, v. 19, EGU17-5770.
Gerbi, Christopher	Gerbi, C., Shulman, D.J., Foley, M.B., Culshaw, N.G., Marsh, J.H., and Yates, M.G., 2017, Anatomy of amphibolite facies strain gradients in granitoids of the Grenville Front Tectonic Zone, Ontario, Canada, Geophysical Research Abstracts, v. 19, EGU2017-5781.
Pandiscio, Eric	Inquiry Learning in Middle Level Geometry. Maine STEM Partnership Symposium. October, 2016. Orono, Maine.
Pandiscio, Eric	Preservice teachers' interactions with geometric manipulatives: An exploratory study. Dimmel, J.K., & Pandiscio, E. Poster presented at the Association of Mathematics Teacher Educators annual meeting, Orlando, FL. February 2017.

Peterson, Franziska	<p>Title: Pre-service elementary teachers' language use when reasoning about mathematical texts; Abstract: Professor Peterson's dissertation research concentrated on preservice elementary teachers (PSET) and their use of language when reasoning about box-and-whisker plots. The study drew from Halliday's systemic functional linguistics and used functional language analysis (FLA). According to Schleppegrell (2007), FLA is used to show how meaning is created in different contexts and different kind of texts and it divides language into three strands of meaning: (1) Experiential, (2) Interpersonal, and (3) Textual and logical meaning. This study took place in a two-step interview in which PSET were asked to interpret as well as construct box-and-whisker plots. Results indicate that the ways PSET approached the interpretation and construction of box-and-whisker plots influenced their understanding and vice versa. This was reflected in their choice of words and phrases concerning linguistic agency and process types. These findings, as well as on-going research on reasoning about other mathematical representations are discussed.</p>
Schauffler, Molly	Professional Development Strand: Interdisciplinary Approaches to STEM (Presentation and Panel discussion)
Schauffler, Molly	Overview of Data Literacy
Smith, Michelle K.	<p>Navigating from vision to change: The development of an ecology and evolution assessment that measures student learning across the major. This talk was given by my postdoc Dr. Mindi Summers</p>
Smith, Michelle K.	<p>Using student constructed responses to guide the development and adoption of instructional activities by a cross-institutional instructional development team. Presentation given by my postdoc Dr. Karen Pelletreau.</p>
Smith, Michelle K.	<p>Examining Persistence in Faculty Learning Communities by Biology Faculty. Presentation given by UGA postdoc Jill McCourt</p>

Smith, Michelle K.	A new set of guidelines for using Bloom's Taxonomy to evaluate the cognitive processes targeted in genetics questions Talk given by CU Boulder postdoc Jennifer Avena
Smith, Michelle K.	GenBio-MAPS: A programmatic assessment to measure student understanding of core biology concepts across a general biology curriculum. Talk given by University of Nebraska-Lincoln faculty member Brian Couch
Smith, Michelle K.	Insight into Student Thinking: Informing Instruction with the Automated Analysis of Constructed Response Assessments. Talk given by MSU faculty member Mark Urban-Lurain
Smith, Michelle K.	Creation of an analytic rubric to evaluate content changes in students' responses about the flow of genetic information. Project led by MSU postdoc Rosa Moscarella
Smith, Michelle K.	Collaborating Across the University of Maine System to Improve Student Understanding of the Role of Energy and Matter in Photosynthesis. Talk given by UMaine MST student Elizabeth Trenckmann
Smith, Michelle K.	Crash Course in Vision & Change. Workshop for the Genetics Society of America TAGC Meeting.
Smith, Michelle K.	You Can Publish That, Too!
Smith, Michelle K.	Supporting Faculty in Making Changes: Opportunities to Promote Instructional Transformations in STEM Education
Smith, Michelle K.	Using Classroom Data to Navigate from Vision to Change
Smith, Michelle K.	Making Student Response Systems Work in the Classroom
Smith, Michelle K.	Transforming the Classroom and Helping Others to Adopt Teaching Innovations
Smith, Michelle K.	What Are My Students Thinking? Using Multiple Modes of Assessment to Identify and Improve Student Conceptual Understanding
Smith, Michelle K.	Using Student Learning and Classroom Observation Data to Transform College Teaching

Smith, Michelle K.	Using Evidence to Transform Undergraduate Teaching
Speer, Natasha	Speer, N. (2016). Thinking about how others think: Research on knowledge used in teaching secondary and undergraduate mathematics
Speer, Natasha	Speer, N. (2016). Why did they think that was the answer? Using and developing mathematical knowledge for teaching by examining students' written work
Speer, Natasha	Speer, N., Pandiscio, E., Dunham, J., & Dorko, A., (2016). Reflecting on the ways students think about transformational geometry
Speer, Natasha	Speer, N. (2017). Using research on student learning and teachers' knowledge to design professional development for novice college mathematics instructors
Speer, Natasha	Design (or improve) Preparation of Your Graduate Students to Teach: Using MAA's CoMInDS Resource Suite
Speer, Natasha	Bookman, J. & Speer, N. (2017). Improving the Preparation of Graduate Students to Teach Undergraduate Mathematics
Speer, Natasha	Speer, N., Ellis, J., & Deshler, J. (2017). Evaluation of Graduate Student Professional Development and Instruction by Mathematics Departments: Results from a National Survey.
Speer, Natasha	Speer, N., Dunham, J., Pandiscio, E., Hauk, S., & Hsu, E. (2017). Students' Ways of Thinking About Transformational Geometry.
Stetzer, MacKenzie	Developing metacognitive knowledge about productive reflection on salient distracting features. T. K. LÃ¡, J. T. Shemwell, and M. R. Stetzer
Stetzer, MacKenzie	Investigating the impact of different prompts on student reasoning,â C. Gette, M. Kryjevskaiia, M. R. Stetzer, and A. Boudreaux
Stetzer, MacKenzie	Using the Cognitive Reflection Test to investigate student reasoning inconsistencies. N. Grosz, C. Gette, M. Kryjevskaiia, A. Boudreaux, and M. R. Stetzer

Stetzer, MacKenzie	Using the Cognitive Reflection Test to investigate student reasoning inconsistencies, contributed poster, N. Grosz, C. Gette, M. Kryjevskaja, A. Boudreaux, and M. R. Stetzer
Stetzer, MacKenzie	Examining student reasoning with multi-variable expressions, M. Kryjevskaja, C. Gette, P. R. L. Heron, A. Boudreaux, and M. R. Stetzer
Stetzer, MacKenzie	Examining students' abilities to follow and evaluate qualitative reasoning chains, W. N. Ferm Jr., J. C. Speirs, and M. R. Stetzer
Stetzer, MacKenzie	Probing student ability to construct reasoning chains: A new methodology, J. C. Speirs, W. N. Ferm Jr., M. R. Stetzer, and B. A. Lindsey
Stetzer, MacKenzie	Investigating the impact of task design on student reasoning, contributed poster, C. Gette, M. Kryjevskaja, M. R. Stetzer, A. Boudreaux, and S. Julin
Stetzer, MacKenzie	Investigating student ability to reason in different directions, M. R. Stetzer, J. C. Speirs, and W. N. Ferm Jr.
Stetzer, MacKenzie	Investigating students' understanding of ac biasing networks, K. L. Van De Bogart and M. R. Stetzer
Stetzer, MacKenzie	Investigating student ability to follow and evaluate reasoning chains, contributed poster, W. N. Ferm Jr., J. C. Speirs, M. R. Stetzer, and B. A. Lindsey
Stetzer, MacKenzie	Probing student ability to construct reasoning chains: a new methodology, contributed poster, J. C. Speirs, W. N. Ferm Jr., M. R. Stetzer, and B. A. Lindsey
Stetzer, MacKenzie	Utility of the Cognitive Reflection Test in research on student reasoning in physics, contributed poster, N. Grosz, C. R. Gette, M. Kryjevskaja, M. R. Stetzer, and A. Boudreaux
Stetzer, MacKenzie	Using contrasting cases to develop student metacognitive knowledge about salient distracting features in physics problems, contributed poster, T. K. Lã, J. T. Shemwell, and M. R. Stetzer

Stetzer, MacKenzie	Investigating students' understanding of ac biasing networks, contributed poster, K. L. Van De Bogart and M. R. Stetzer
Stetzer, MacKenzie	Collaborative research: Examining the development of student reasoning skills, M. Kryjevskaja (invited presenting author), A. Boudreaux, P. R. L. Heron, B. Lindsey, and M. R. Stetzer
Stetzer, MacKenzie	Effective use of contrasts in learning strategic knowledge for physics problem solving, T. K. Le, J. T. Shemwell, and M. R. Stetzer
Stetzer, MacKenzie	Investigating student learning in upper-division laboratory courses on analog electronics
Thompson, John R	Education research at a disciplinary interface: Investigating student understanding of mathematics in physics.
Thompson, John R	Physics Students' Use Of Symbolic Forms When Constructing Differential Elements In Multivariable Coordinate Systems, B. P. Schermerhorn and J. R. Thompson.
Thompson, John R	Student Understanding of Elements of Multivariable Calculus, J. R. Thompson, B. P. Schermerhorn, and J. C. Speirs.
Thompson, John R	Student construction of differential length elements in multivariable coordinate systems: A symbolic forms analysis, J. R. Thompson and B. P. Schermerhorn.
Thompson, John R	Student use of symbolic forms when constructing differential vector elements, B. P. Schermerhorn and J. R. Thompson.
Thompson, John R	Student construction and use of three-dimensional coordinate system differential elements, B. P. Schermerhorn and J. R. Thompson.
Wittmann, Michael C	Energy Flow K12 Energy Instruction, M.C. Wittmann, C. Alvarado, weeklong teacher workshop

Wittmann, Michael C	Blending mathematical formalism and gestures when separating variables in physics, M.C. Wittmann, invited symposium talk
Wittmann, Michael C	Who Let the Cold Out?, C. Alvarado, M.C. Wittmann, Adam Z. Rogers, L. Millay, contributed presentation
Wittmann, Michael C	Teacher Knowledge of Student Difficulties: Collectively, We're a Genius!, M.C. Wittmann, C. Alvarado, L. Millay, contributed presentation
Wittmann, Michael C	Problematizing cold with K12 Science Teachers, C. Alvarado, M.C. Wittmann, Adam Z. Rogers, L. Millay, contributed poster
Wittmann, Michael C	Collectively, we're a genius!: Teachers discussing student difficulties, M.C. Wittmann, C. Alvarado, L. Millay, contributed poster
Wittmann, Michael C	Understanding waves, M.C. Wittmann, teacher workshop
Wittmann, Michael C	Listening to Teachers: Understanding knowledge of energy from multiple perspectives, M.C. Wittmann, keynote talk.
Wittmann, Michael C	"Diagnosing student difficulties," M.C. Wittmann and L.A. Millay, teacher workshop
Wittmann, Michael C	What do we mean by knowledge when teaching physics? M.C. Wittmann, invited talk
Wittmann, Michael C	Seeking Different Kinds of Understanding: Research with Middle School Teachers, M.C. Wittmann, invited talk
Wittmann, Michael C	Noticing student difficulties in student data, M.C. Wittmann and L.A. Millay, teacher workshop
Wittmann, Michael C	How models of knowledge help us think about teachers' understanding of student knowledge, M.C. Wittmann, invited talk.
Wittmann, Michael C	Self-Efficacy of Secondary Teachers Regarding the Teaching of Energy Concepts, P.H. Wilson and M.C. Wittmann, contributed presentation



*Appendix D*

**External Grants and Contracts: New Grants Awarded to RiSE Faculty, 2017**

<b>PI Name</b>	<b>Role</b>	<b>%Resp</b>	<b>Title</b>	<b>FundingAgency</b>	<b>Award Amt.</b>	<b>Award Date</b>
Nelson, Sarah	PI	100	Design and production of ALSC TIME Lakes compendium	US Environmental Protection Agency through Adirondack Lakes Survey Corporation	\$8,714	7/20/16
Bruce, Mitchell R	PI	60	Fostering Connections between Macroscopic, Submicroscopic,	National Science Foundation	\$275,284	9/7/16
Nelson, Sarah	PI	25	Technical Assistance: GLKN Monitoring Larval Dragonflies for Mercury	US Dept of the Interior	\$30,000	9/8/16
Nelson, Sarah	PI	100	Linking freshwater mercury concentrations in parks to risk factors and bio-senti	US Dept of the Interior	\$39,447	9/19/16
Smith, Michelle K.	PI	90	Collaborative Research: Expanding a National Network for Automated Analysis of C	National Science Foundation	\$38,824	10/17/16
Nelson, Sarah	Co-PI	30	RAPID: Experimental Recovery at the Bear Brook Watershed in Maine	National Science Foundation	\$49,720	12/16/16
Gerbi, Christopher	PI	50	Collaborative research: Computational methods supporting joint seismic	National Science Foundation	\$97,736	1/30/17
Nelson, Sarah	PI	90	EPA IAG for Clean Air Act trends research, 2017-2018	US Environmental Protection Agency through University of New Hampshire	\$80,918	3/8/17

**Continuing Grants for RiSE Faculty**

<b>Funding Agency</b>	<b>Title</b>	<b>PI Name</b>	<b>Co-PI Name</b>	<b>Award Amt.</b>
US Dept of Energy	Thermochemical Conversion of Woody Biomass to Fuels and Chemicals		F. Amar	\$1,889,988
Howard Hughes Medical Institute	HHMI PHAGE GENOMICS FUNDING		F. Amar	\$100,000
US Dept of Health & Human Services through Mount Desert Island Biological Lab	Comparative Functional Genomics INBRE in Maine (Honors College) Yr 3	F. Amar		\$105,035
National Science Foundation	CAREER: Identifying Dominant Controls on Strain Localization	C. Gerbi		\$220,864
National Science Foundation	Origin and vertical extent of damage zones around continental strike-slip faults		C. Gerbi	\$282,951
National Science Foundation	Collaborative Research: Influence of natural ice microstructure on rheology in g	C. Gerbi		\$518,673

National Science Foundation	Maine Physical Sciences Curriculum Partnership: Research and Infrastructure	S. McKay	M. Bruce, M. Wittmann, J. Thompson	\$14,407,853
National Science Foundation	NSF Supplement Award DRL 1550654	S. McKay	M. Bruce, M. Wittmann, J. Thompson	
National Science Foundation	Building Rural STEM Educator Capacity through Partnership: Preparation for the	S. McKay	M. Smith, J. Shemwell, M. Stetzer	\$299,997
National Science Foundation	A Model NSF Teaching Fellowship Program to Improve STEM Teacher Recruitment, Pre	S. McKay	M. Stetzer, M. Smith, E. Pandiscio	\$1,950,034
Maine Department of Education	The Maine Elementary Sciences Partnership: Professional Development for PreK-5	S. McKay	E. Pandiscio	\$1,700,000
US Dept of the Interior	Assessing threats of changing climate to drinking water quality		S. Nelson	\$10,669
US Dept of the Interior	Linking freshwater mercury concentrations in parks to risk factors	S. Nelson		\$125,000
US Dept of Commerce	The Future of Four Seasons in Maine: a Scientist-Teacher-Student Yr 2	S. Nelson		\$100,279

US Environmental Protection Agency through University of New Hampshire	EPA IAG for Clean Air Act trends research, 2015-2016	S. Nelson		\$134,268
National Science Foundation	Collaborative Research: Navigating from Vision to Change with Bio-MAPS	M. Smith		\$219,966
National Science Foundation	Collaborative Research: Expanding a National Network for Automated Analysis	M. Smith		\$106,441
National Science Foundation	Catalyzing Institutional Change Through Synergistic Observation	M. Smith	S. McKay, M. Stetzer	\$249,851
National Science Foundation	Improving the Preparation of Graduate Students to Teach Undergraduate Mathematics		N. Speer	\$1,029,299
National Science Foundation	Research on learning and teaching at the physics-engineering interface:		M. Stetzer	\$599,999

National Science Foundation	Collaborative Research: Examining the development of student reasoning skills	M. Stetzer		\$169,806
National Science Foundation	Collaborative Research: Research on learning and teaching at the physics	J. Thompson		\$197,647
National Science Foundation	Continuing the Conversation in DBER: The Transforming Research in Undergraduate STEM Education (TRUSE) Conference Transforming Research in Undergraduate STEM Education		J. Thompson	\$37,342

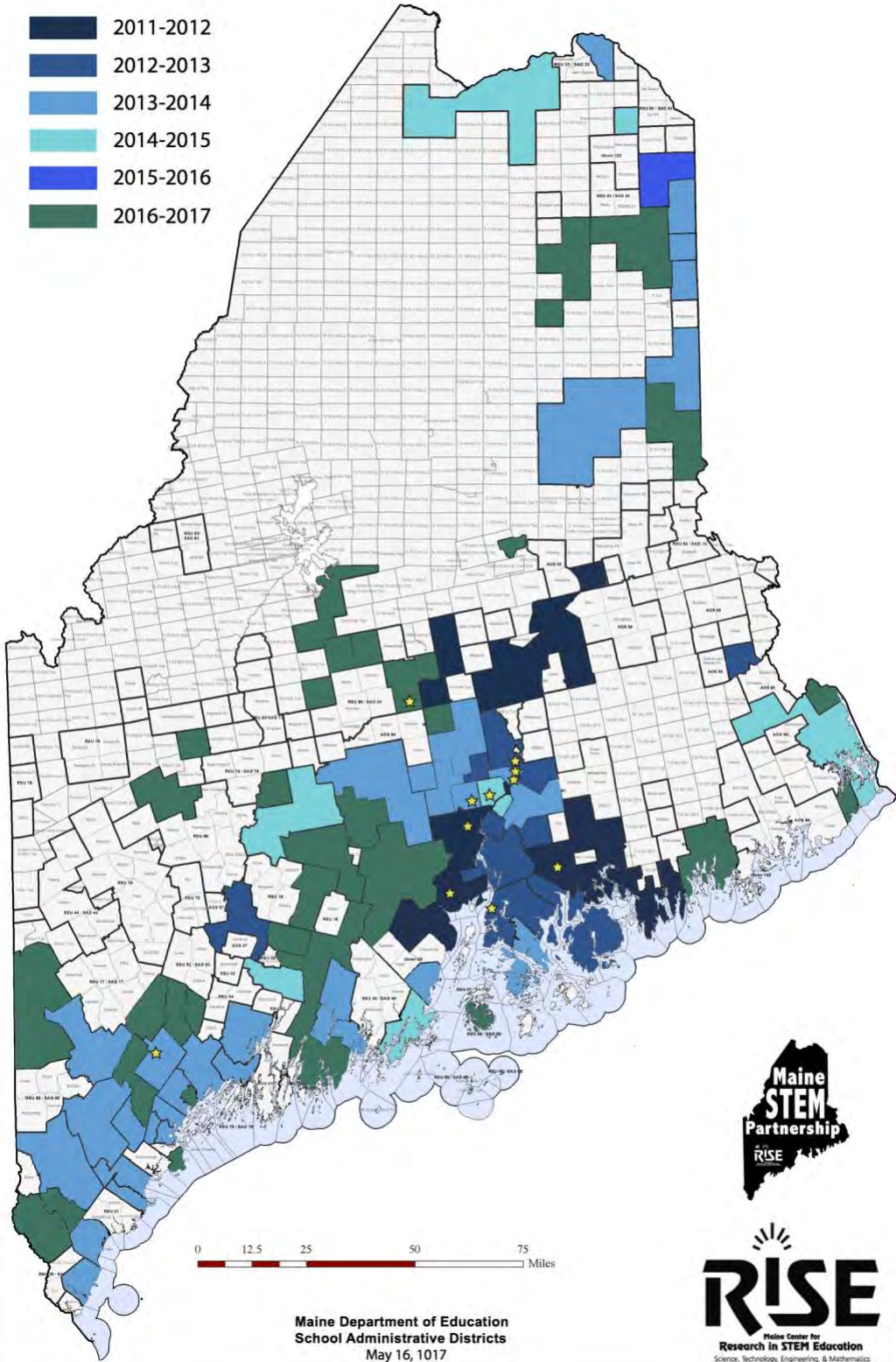
*Appendix E*

**Courses Offered by the RiSE Center 2016 – 2017**

<b>Semester</b>	<b>Title</b>	<b>Professor</b>	<b>Enrollment</b>
Summer 2016	SMT 699 Graduate Thesis/ Research	Susan McKay	18
Fall 2016	SMT 501 Integrated Approaches to Physics I	Michael Wittmann	6
Fall 2016	SMT 503 Integrated Approaches in Earth Sciences I	Christopher Gerbi	15
Fall 2016	SMT 505 Integrated Approaches in Mathematics I	Natasha Speer	5
Fall 2016	SMT 588 Seminar in Science and Mathematics Education Research	Elizabeth Hufnagel	11
Fall 2016	SMT 699 Graduate Thesis/ Research	Susan McKay	18
Fall 2016	INT 492 Maine Learning Assistant Pedagogy Course	MacKenzie Stetzer	42
Spring 2017	SMT 500 Educational Psychology with Applications to Science and Mathematics Teaching and Learning	Michael Wittmann	17
Spring 2017	SMT 506 Integrated Approaches in Mathematics I	Justin Dimmel	5
Spring 2017	SMT 507 Integrated Approaches in Biology	Michelle Smith	8
Spring 2017	SMT 590 Seminar for Teaching Interns	Susan McKay, Molly Schaffler	9
Spring 2017	SMT 591 Secondary Student Teaching	Susan McKay, Molly Schaffler	9
Spring 2017	SMT 699 Graduate Thesis/ Research	Susan McKay	7
Spring 2017	INT 492 Maine Learning Assistant Pedagogy Course	MacKenzie Stetzer	18

Maine Center for Research in STEM Education  
 Maine STEM Partnership (MSP)  
 School Districts

- 2011-2012
- 2012-2013
- 2013-2014
- 2014-2015
- 2015-2016
- 2016-2017



Maine Department of Education  
 School Administrative Districts  
 May 16, 2017



*Appendix G*

**Selected Outcomes of the FIG-MLA Program**

- The FIG-MLA Program grew in 2016-17 to involve 103 Maine Learning Assistants and 24 faculty in modifying 22 STEM courses across 10 departments, with total enrollment of 4,275 students.
- 78% of incoming STEM majors take one or more FIG-MLA courses during their first year of enrollment at the University of Maine
- Students who take 2 or more FIG-MLA courses during their freshman year are significantly more likely to be retained into their second year at University of Maine, than students who take 0 or 1 FIG-MLA courses.

<b>Departments and Courses Added to FIG-MLA Program by Year</b>		
2012-2013	School of Biology & Ecology Physics & Astronomy School of Marine Sciences Earth Sciences	BIO 100, BIO 350, ERS 201, PHY 121/122, SMS 300
2013-2014	Chemistry Electrical & Computer Engineering Mathematics & Statistics	CHY 121/122, ECE 342, MAT 122, MAT 126, PHY 441, SMS 422
2014-2015	Chemical & Biological Engineering Computer Sciences Molecular & Cellular Biology	BMB 155, CHE 386, COS 250, MAT 126*



2015-2016	No new departments added	BIO 465, BIO 480, CHE 350, MAT 103, PHY 121/122*
2016-2017	Food Science Ecology & Environmental Science	AST 109, BIO 100*, BIO 307, CHY 121/122*, CHY 251, CHY 472, EES 100, ERS 151, FSN 330, MAT 122*, PHY 121/122*, SMS 201
2017-2018	Civil & Environmental Engineering Mechanical Engineering	BIO 200, BMB 322, CIE 331, ERS 102, MAT 116, MAT 122*, MAT 127, MET 320

\*some courses are repeated above either because a different instructor was awarded a FIG-MLA grant or same instructor was awarded another FIG-MLA grant

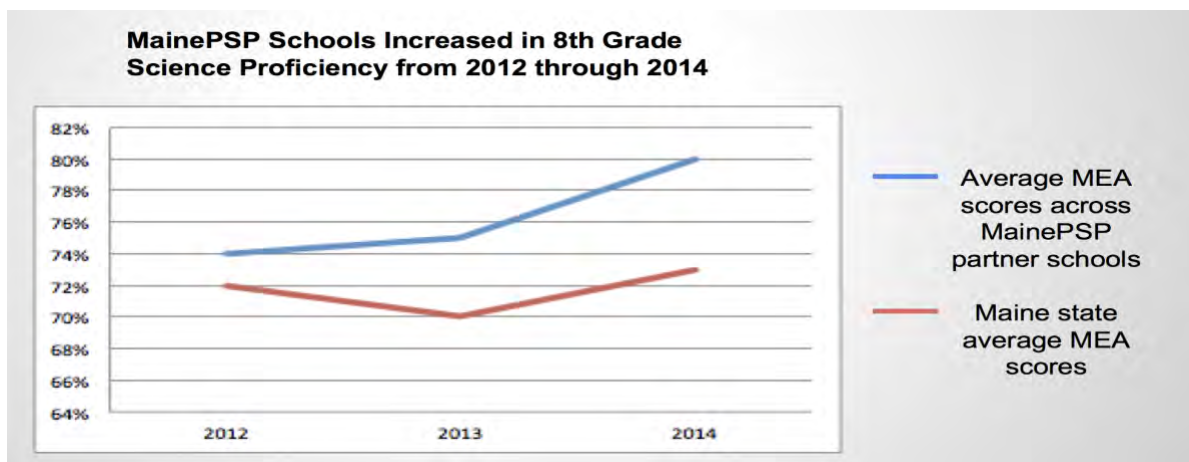
## Appendix H

### Selected Outcomes of Partnership Work at the Elementary and Middle Levels

In 2016-17, the RiSE Center provided over 11,000 hours of professional development and a research and evidence-based professional community to over 700 teachers of Maine students in grades K-12. This programming impacted more than 25,000 Maine students during this instructional year.

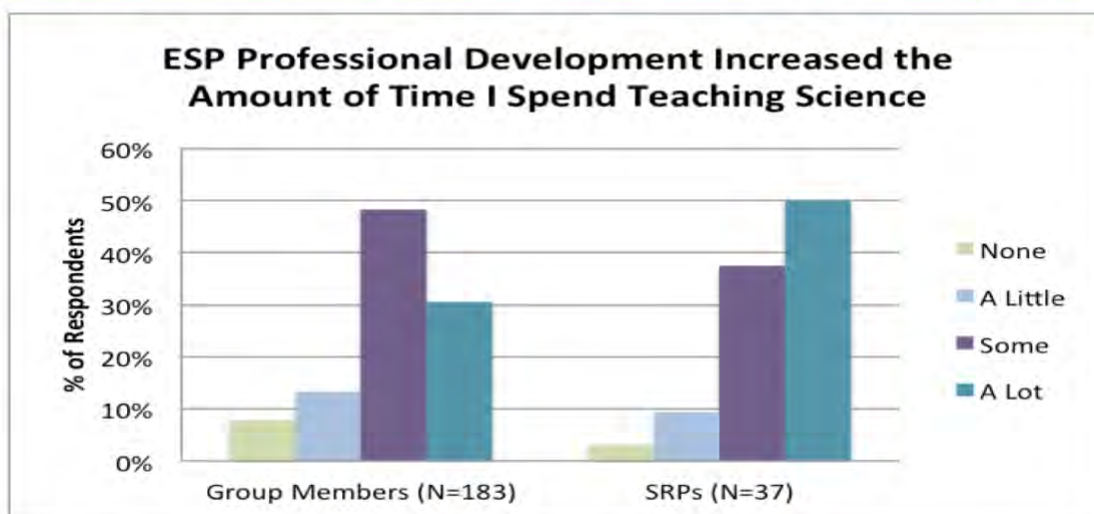
Significant outcomes for Maine students include:

- Improved proficiency on MEA achievement testing for middle school students in the Maine Physical Sciences Partnership



- Increased science instruction for K-5 students in the Maine Elementary Sciences Partnership, *Note: This outcome was reported by Science Resource Partners (SRPs) and their Group Members, and was independently reported by the impacted students.*

**92% of Group Members and 97% of SRPs Reported Increases in Time Spent Teaching Science**



- Improved attitudes toward STEM and STEM careers for students in participating classrooms

*Grade 5 students in Maine Elementary Sciences Partnership Classrooms (Group Member Students and Science Resource Partner or SRP Students) were more likely to agree that “science is interesting and fun” than students in classrooms that did not participate.*

