



## Maine Center for Research in STEM Education (RiSE Center) Self-Study

July 1, 2017 – June 30, 2022

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*Photos (from top to bottom, left to right):*



RiSE Summer Academy at Point Lookout; RiSE affiliated faculty Justin Dimmel and Eric Pandiscio work on early proof of concept for the Sunrule. (photo by Casey Kelly, COEHD UMaine); RiSE affiliated faculty member Franziska Peterson runs a mathematics workshop for teachers; USDA-HEC project team members gather for 3-day workshop in Orono (photo by Marina Van der Eb, RiSE Center)






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## I. Maine Center for Research in STEM Education (RiSE Center) Mission, Vision, Values and Goals

The **RiSE Center mission** is to advance the research and practice of teaching and learning in science, technology, engineering, and mathematics, the STEM disciplines. The **RiSE Center vision** is a vibrant research community that promotes knowledge of and excellence in STEM education. **Shared values** within the RiSE Center are: equity, access, broad engagement, inclusivity, interdisciplinarity, a collaborative environment, a responsive, creative culture of evidence, respect and mutual support. From its core emphasis on STEM Education Research, the RiSE Center **goals** include reaching out to foster Community Partnerships & Innovative Collaborations, providing Graduate Education for STEM educators & researchers, and sustaining a Statewide Professional Community using research to improve STEM education.

### Overview of RiSE Center Key Performance Areas and Highlights

 <p>STEM+C Researcher and Teacher build a soil moisture sensor using Arduinos</p>	<p><b>STEM Education Research Within and Across Disciplines</b></p> <p><i>RiSE Research Portfolio:</i> In FY22, RiSE Faculty and Staff served as PI, Co-PI or Senior Personnel on 12 new awards (\$10,150,451) and 37 continuing awards (\$20,728,728) and supported submission of/submitted an additional 11 grant proposals (\$12,218,283).</p> <p><i>RiSE Presentations &amp; Publications:</i> In FY22, 32 works published or accepted, with 8 additional submissions awaiting decision. No change in publications from FY 2021 and a greater number than five-year average of 28 published/accepted works annually.</p> <p><i>Research Practice Partnerships:</i> With new NSF funding, RiSE faculty and staff added a fourth project building partnerships among researchers and educators, this one funded by NSF ITEST to enhance K-12 instruction with authentic research related to ocean sciences. Existing RPPs that integrate computing with science curricula; recruit, prepare, support and retain science and mathematics teachers in high-need districts; and emphasize quantitative reasoning related to forestry are thriving.</p>
 <p>RiSE Materials support science learning</p>	<p><b>Community Partnerships &amp; Innovative Collaborations at All Educational Levels</b></p> <p><i>RiSE Materials Warehouse:</i> provided science materials and related professional learning for 117 K-12 teachers in 34 schools and 28 school districts across the state, helping to provide &gt;5,400 students with opportunities to learn science through engaging, research-supported learning experiences. 14 new teachers were added to the program in FY22.</p> <p><i>FIG-MLA program:</i> 125 undergraduate peer learning assistants assisted 28 faculty to implement research-based course modifications in 25 separate STEM courses at UMaine, enhancing the learning experiences of 5,427 undergraduate students. Participating in MLA courses increases retention.</p>
 <p>Teachers learning at RiSE Conference</p>	<p><b>Graduate Education for STEM Educators and Researchers</b></p> <p><i>Student Mentoring:</i> RiSE faculty provided 144 graduate student credit hours in the MST program and mentored 5 Master's theses (MST) and 2 PhD dissertations in STEM Education or Physics Education Research. Seventeen students were enrolled in the CAEP-accredited MST program. In FY22, the MST Program awarded its 100<sup>th</sup> degree!</p> <p><i>Professional Learning:</i> RiSE staff and faculty led 40 professional learning opportunities for K-12 teachers, representing 141 individual events or meetings that were attended by 290 unique participants resulting in 5,618 participant hours. Some examples of these professional learning experiences include: mathematics content immersions; the NSF Teaching Fellowship community working groups; the INSPIRES teacher teams working with researchers to develop learning experiences that involve quantitative reasoning and working with data in the context of forestry; content and pedagogy for elementary, middle, and 9<sup>th</sup> grade teachers new to using RiSE Center instructional resources; the Maine STEM Partnership Summit; and the annual RiSE Center Conference.</p>



### Statewide Professional Community Using Research to Improve STEM Education

*Maine STEM Partnership:* STEM educators at all educational levels gathered virtually at the RiSE Summit meeting (November) and in person at the RiSE Conference (Integrating Research and Practice: Working Together to Support Robust Student Learning in STEM) to learn and share best practices.

*NSF Teaching Fellowship Program:* 16 fellows and three program graduates taught in high-need districts during the 2021-22 school year, with one fellow entering the profession during this year. Four teacher mentors participated in leadership team planning to sustain the program beyond grant funding.

*RiSE Center Faculty & Staff:* Dr. Heather Falconer, Dept. of English, joined the RiSE Faculty who now number 22; 9 staff members (6.4 FTE) support all Center activities.

## II. Faculty and Staff Affiliated with the RiSE Center, their Accomplishments and Contributions

A list of RiSE Center affiliated faculty and staff and their titles is provided in Appendix A. Each member of the RiSE Center contributes to its success. Below we briefly highlight some of these contributions for each faculty and staff member.

### RiSE Affiliated Faculty:

**Francois Amar**, Professor of Chemistry, was a founding member of the RiSE Center. He serves on the RiSE Center's Governance Committee, which is currently developing bylaws for the RiSE Center. He also has co-taught one of the core MST courses, Integrated Approaches in Chemical Education Research (SMT598), and serves as advisor and committee member for MST students on their thesis research.

**David Batuski**, Professor of Physics and Astronomy, brings expertise in astronomy to K-12 teachers through sessions focused on their questions and topics unfamiliar to them from the Next Generation Science Standards. He has also served as a member of the thesis committees for MST students.

**Timothy Boester**, Lecturer in Mathematics, has worked to bring research-supported active learning to pre-calculus instruction, bridging high school and college instruction for students. In the summer of 2022, Tim was selected to teach in Thrive Scholars at Amherst College, a program focused on providing greater college access opportunities to underrepresented populations of students from low-income communities. The multi-year program assists students in preparation for college, throughout college, and then in the early stages of their career post-college. He had two MST students there assisting him. This teaching position provided the MST students with the opportunity to teach mathematics as part of a team in racially diverse classes, an experience that is difficult to find in the Orono area. He has taught one of the core MST courses, Educational Psychology with Applications in the Teaching and Learning of the STEM disciplines (SMT500) and advises and serves on the thesis committees of MST students.

**Mitchell Bruce**, Professor of Chemistry, was a founding member of the RiSE Center. He is a co-PI on the RiSE Center's STEM+C grant to integrate computer science and computational thinking into middle school science. He is a Co-PI on an NSF grant "Fostering Connections between Macroscopic, Submicroscopic, and Representational Levels Using Analogical Reasoning in the Chemistry Laboratory" and has a consistent history of grant funding and publication in chemical education research and within RiSE Center research-practice partnerships. He has taught one of the core MST courses, Integrated Approaches in Chemical Education Research (SMT598), and serves as advisor to MST students on their thesis research. He is also a member of the RiSE Executive Committee, the MST Interdisciplinary Program Committee, and the Faculty Course Modification Incentive Grant – Maine Learning Assistant (FIG-MLA) Leadership Team.

**Justin Dimmel**, Assistant Professor of Mathematics Education and Instructional Technology in the School of Learning and Teaching, serves as thesis advisor to MST and STEM Education Ph.D. students. He has been awarded a prestigious NSF Career Grant as well as other external funding to support his research and students. He teaches one of the core MST courses, Integrated Approaches in Mathematics Education (SMT506) and serves on the RiSE Executive Committee.

**Nuri Emanetoglu**, Associate Professor of Electrical and Computer Engineering, recently joined the RiSE Center. He runs an NSF Research Experience for Undergraduates program, and works with the RiSE Center on the program's evaluation. He also brings expertise in research-supported small group problem solving and other strategies to more fully engage students, which he has shared, through RiSE workshops with other faculty, including those on the RiSE USDA-HEC grant.

**Janet Fairman**, Associate Professor in the School of Learning and Teaching, has served as a member of the search committee for a (second) RiSE Center Program Evaluation specialist. She serves on MST and Ph.D. student thesis committees and brings expertise in program evaluation from her position as co-director of the Maine Educational Policy Research Institute.

**Heather Falconer**, Assistant Professor of Professional and Technical Writing, brings expertise in the intersections of culture, discipline, and pedagogy, with a special emphasis on creating inclusive educational spaces. She has also studied the experiences of mentees in the STEM disciplines, especially those from underrepresented groups. She is currently developing a RiSE Center grant for submission to NSF IUSE with RiSE Center Assistant Director Sara Lindsay. Her book, Masking Inequality with Good Intentions: Systemic Bias, Counterspaces, and Discourse Acquisition in STEM Education is in press with University of Colorado Press/The WAC Clearinghouse.

**Saima Farooq**, Lecturer in Physics and Astronomy, has worked with RiSE affiliated faculty MacKenzie Stetzer to bring active engagement strategies into introductory physics lectures and study its impacts. As part of the Introductory Course Environment Faculty Learning Community (ICE-FLC), she has studied the expectations and difficulties of incoming students, especially first generation and under-represented minority students, gaining insight to assist the students for their overall academic success in their first year at UMaine.

**Robert Franzosa**, Professor of Mathematics, was one of the founding members of the RiSE Center. He co-led the development of the active learning, group problem solving materials for the course Algebraic Models in our World and has been responsible for coordinating placements of MST students as teaching assistants in the Department of Mathematics and Statistics. He has advised and served on MST thesis committees. He is currently in partial phased retirement.

**Christopher Gerbi**, Professor in the School of Earth and Climate Sciences and Associate Dean for Research in the College of Natural Sciences, Forestry, and Agriculture, teaches the MST core course Integrated Approaches in Earth Science Education I (SMT503) and has provided field experiences for teachers as part of his research work. He brings expertise in geology to the RiSE Center and has advised and served on MST thesis committees.

**Elizabeth Hufnagel**, Associate Professor of Science Education in the School of Learning and Teaching. She teaches the MST core course Integrated Approaches in Earth Science Education II (SMT###) and has advised and served on MST and STEM Education Ph.D. thesis committees. She brings expertise in the intersectional between emotional expressions and teaching and learning about science topics in classrooms and other science settings.

**Sara Lindsay**, Professor of Marine Sciences and Assistant Director of the RiSE Center, is a Co-PI on the RiSE Center's STEM+C grant and its ITEST grant, and co-leads the education research part of the EPSCoR Track-2 INSPIRES grant, studying quantitative reasoning in the context of forests. She teaches the MST core course Integrated Approaches in Biology Education (SMT507), advises and serves on MST thesis committees, and chairs the Leadership Team for the FIG-MLA Program. She takes the lead in internal and external communication for the RiSE Center.

**Susan McKay**, Professor of Physics and Founding Director of the RiSE Center, is PI of the RiSE Center's NSF Noyce Teaching Fellowship Program, NSF STEM+C, NSF ITEST, and USDA-HEC. She also provides leadership for the RiSE Center's involvement in Maine-eDNA and co-leads the education research strand of the EPSCoR Track-2 INSPIRES grant. She supervises student teachers in the MST Program and teaches the required co-requisite seminar for them (SMT590, SMT591). She chairs the RiSE Center Executive Committee and serves on the MST Interdisciplinary Program Committee. She supervises most of the RiSE professional staff, as indicated in Appendix B. She was the recipient of the UMaine Presidential Public Service Achievement Award in 2019 for her work to advance STEM education and develop STEM education research in Maine.

**Eric Pandiscio**, Associate Professor of Mathematics Education in the School of Learning and Teaching, serves on the RiSE Center Executive Committee and the MST Interdisciplinary Program Committee. He also teaches the core course in the MST Program Integrated Approaches in Mathematics Education II (SMT###). He fosters involvement with elementary and middle level mathematics teachers and the RiSE Center, providing workshops to support their

teaching and learning and is a Co-PI on the RiSE Center's NSF Noyce Teaching Fellowship Program grant. He advises and serves on committees for MST thesis research.

**Franziska Peterson**, Assistant Professor of Mathematics Education, holds a joint appointment between the RiSE Center and the Department of Mathematics and Statistics. She led the recent CAEP accreditation process for the MST Program and she serves as the program's Graduate Coordinator. She is a member of the RiSE Center's Executive Committee, chairs the RiSE Teaching Faculty meetings, and the MST Interdisciplinary Program Committee. She teaches the RiSE Center's required introductory seminars in STEM education research and secondary STEM teaching and learning, which most MST students take in their first semester. She also works with Susan McKay to coordinate assistantship support for all full-time MST students. She is part of the NSF Noyce Teaching Fellowship Leadership Team, is a Co-PI on the RiSE Center ITEST grant, and co-leads the education research strand of the EPSCoR Track-2 INSPIRES grant. She advises and serves on committees for MST thesis research.

**Molly Schaffler**, Assistant Research Professor in the School of Earth and Climate Science and the Climate Change Institute, brings expertise and conducts workshops in data literacy and climate change. She advises and serves on committees for MST thesis research.

**Asli Sezen-Barrie**, Associate Professor of Curriculum, Assessment, and Instruction in the School of Learning and Teaching, is currently a rotator at NSF for two years. She continues to advise and serve on committees for MST and STEM Education Ph.D. thesis research.

**Natasha Speer**, Associate Professor of Mathematics Education, holds a joint appointment between the RiSE Center and the Department of Mathematics and Statistics. She teaches the MST core course Integrated Approaches in Mathematics Education I (SMT505) and advises and serves on committees for MST and STEM Education Ph.D. thesis research. She is a member of the RiSE Center Executive Committee, co-leads RiSE Center strategic planning, and chairs the RiSE Center's Governance Committee. She also organizes the RiSE Center's colloquium series. Her research studies the preparation of graduate students and faculty for teaching mathematics at the college level, and she provides orientation sessions and workshops to support early career professionals in teaching. She co-ran (with MacKenzie Stetzer) the seed grant program for Maine-eDNA, which brings this research and underlying science to postsecondary courses, particularly those at primarily undergraduate institutions. She serves on the FIG-MLA Leadership Team.

**MacKenzie Stetzer**, Associate Professor and Chair of the Department of Physics and Astronomy, advises and serves on committees for MST and Physics Ph.D. students conducting physics education research. His recent research, supported by multiple NSF grants, focuses on student understanding of analog electronics, primarily in the context of upper-division laboratory courses, where he is leading the collaborative development of research-based instructional materials for use in these courses. He is a member of the RiSE Center Executive Committee, a Co-PI on the NSF Noyce Teaching Fellowship grant, and co-ran (with Natasha Speer) the seed grant program for Maine-eDNA, which brings this research and underlying science to postsecondary courses, particularly those at primarily undergraduate institutions. He serves on the FIG-MLA Leadership Team.

**John Thompson**, Professor of Physics and Recent Past Chair of the Department of Physics and Astronomy, advises and serves on committees for MST and Physics Ph.D. students conducting physics education research. His recent research, supported by multiple NSF collaborative research grants, focuses on teaching mathematical methods in physics and learning and teaching at the physics-mathematics interface. Prior to becoming chair, he taught *Physics By Inquiry*, a popular preparatory course for science teachers and a training setting in guided inquiry instruction for MST students. He has also co-taught Integrated Approaches in Physics Education (SMT501), a core course in the MST Program.

**Michael Wittmann**, Professor of Physics, was one of the founding members of the RiSE Center. He advises and serves on committees for MST and Physics Ph.D. students conducting physics education research. He has been instrumental in deepening understanding of learning and teaching of challenging physics concepts at the middle level and has investigated teacher and student knowledge. He is currently on leave at the American Physical Society. He is a member of the RiSE Center Executive Committee.

#### RiSE Affiliated Staff:

**Elizabeth ByersSmall**, NSF Teaching Fellowship Program Coordinator, manages the day-to-day operations of the RiSE Center's NSF Teaching Fellowship Program (\$1.95 million; McKay; PI; Pandiscio and Stetzer, Co-PIs), developing a strong community of new and experienced teachers for high-need Maine districts. The program has a

95% four-year retention rate for its fellows who are teaching in high-need districts, and it has developed STEM leading teachers to advance evidence-guided improvements in STEM education locally, regionally, and statewide. She also took a lead role in organizing events to celebrate the RiSE Center's 20<sup>th</sup> anniversary. (Reports to Susan McKay)

**Yadina Clark**, Administrative Specialist CL3, provides administrative support for all RiSE work, including conferences, summits, colloquium series, and special events, teacher professional learning experiences, web site development and updates, and communications, both internal and external. (Reports to Maureen Raynes)

**Elizabeth Muncey**, Resource and Professional Learning Coordinator, manages the RiSE Center's Materials Warehouse, which supplies a coordinated, hands-on, task-force recommended set of science instructional resources, including books, materials and supplies, to over 5400 Maine PK-9 students. Teachers using these resources also receive professional learning experiences to prepare them to use them effectively and confidently. (Reports to Marina Van der Eb)

**Maureen Raynes**, Financial and Personnel Manager, manages RiSE E&G and MEIF budgets, grant budgets for the RiSE Director and other affiliated faculty who choose to have their grants managed in RiSE. She also handles appointments for RiSE faculty, staff, and students and serves as manager for the RiSE space in Estabrooke. (Reports to Susan McKay)

**Christina Siddons**, Program Evaluation Specialist, conducts evaluations of internal RiSE programs and serves as external evaluator for several contracted projects. She also oversees IRB applications and extensions and data management for the RiSE Center. (Reports to Susan McKay)

**Marina Van der Eb**, Maine STEM Partnership Coordinator, handles all day-to-day operations of this statewide STEM education improvement community. She also coordinates several projects within the Maine STEM Partnership, including STEM+C, EPSCoR Track-2 INSPIRES, and ITEST, on which she is a Co-PI. Marina serves on the RiSE Center Executive Committee and co-leads strategic planning for the RiSE Center. (Reports to Susan McKay)

Collectively this group of faculty and professional staff has developed an impressive and diverse collection of research projects. Below we summarize some of the highlights of the RiSE Center's research portfolio. Full listings of grants and publications for FY22 are provided in Appendices F-H. Information from prior years is available at

**RiSE Research Proposals:** In FY22, RiSE Faculty and Staff (see Appendix A for list) served as PI, Co-PI or Senior Personnel on 12 new awards (\$10,150,451) and 37 continuing awards (\$20,728,728) and supported submission of or submitted an additional 11 grant proposals (\$12,218,283). This research effort includes multiple faculty and staff playing a significant role as senior personnel in two ongoing EPSCoR grants, RII Track-1 eDNA and RII Track-2 INSPIRES. RiSE research grants span the spectrum from basic to applied research in teaching and learning and many involve multi-institutional and multi-state partnerships. Over the last 5 years, the RiSE research portfolio included an annual average of 10 new and 28 continuing awards (average total value of >\$24 million per year). New and continuing awards are listed in Appendices F and G respectively.

**Research-Practice Partnerships:** With NSF funding through the ITEST-DTI program, RiSE faculty and staff added a new project building partnerships among researchers and educators to enhance K-12 instruction with authentic research related to ocean sciences. Existing NSF-funded partnerships that integrate computing with science curricula (STEM+C), and emphasize quantitative reasoning related to forestry (INSPIRES) are thriving.

**RiSE Presentations & Publications:** Although the challenges of Covid-19 continued to impact the research activity of RiSE faculty, students and staff in a variety of ways, RiSE Center members published or have had accepted a total of 32 works including 20 refereed journal articles or conference proceedings, 3 non-refereed journal articles or conference proceedings, 4 book chapters, 1 book, 3 policy reports, 1 image database and 1 video production. An additional 8 manuscripts were submitted and are awaiting decision. This number of publications remains unchanged from FY21 and is greater than the five-year average of 28 published/accepted works annually. A list of published and accepted works by RiSE faculty, staff and students is provided in Appendix H. RiSE faculty and staff shared their research in 34 different presentations at international, national, regional, state and other venues, many virtual.

### III. Internal and External Collaborations

RiSE affiliated faculty and professional staff have listed over 50 external and internal collaborations, from basic research to applications and transfer of research findings into STEM education in formal and informal settings. Below we present several examples of current RiSE internal and external collaborations. Additional information about these collaborations and others can be found in the RiSE Center annual reports archived at

<https://umaine.edu/risecenter/about-us/>.

***Maine STEM Partnership at the RiSE Center*** – The mission of the Maine STEM Partnership is to build and sustain a diverse, statewide community that strengthens PK - 16+ STEM education by promoting rich, research-supported classroom experiences that deepen learning and engage all students. This community seeks to build STEM literacy and career competency, and to encourage students to become STEM educators and education researchers. This research-practice partnership brings together PK-12 teachers and administrators, STEM and STEM education faculty, and other stakeholders interested in tackling persistent problems of practice using research and evidence-guided strategies. For example, it supports research-based modifications to STEM instruction through the FIG-MLA Program, which employed 125 undergraduate peer learning assistants, working with 28 faculty and enhancing learning experiences for 5,427 undergraduate students in 2021-2022. For PK-9 Maine students, this partnership provides hands-on high quality science learning experiences, including the materials needed, while supporting their teachers with professional learning to guide their use of these instructional resources. In 2021-2022, 117 teachers in 34 schools from 28 school districts participated, reaching over 5,400 students. This partnership is governed by a Leadership Team with broad stakeholder representation.

***Collaboration among RiSE faculty, UMaine Dept. of Art (Sculpture), and the Town of Orono*** – Justin Dimmel and Eric Pandiscio, both RiSE Center affiliated faculty and members of the School of Learning and Teaching in the College of Education and Human Development, have partnered with Greg Ondo and Sam Hoey of the UMaine Department of Art (Sculpture), biology student Emma Reedman (pre-med with minors in psychology and interdisciplinary studies), and Mitch Stone from the Town of Orono (Director of Economic Development) to design, create, and install a prototype of their SunRule. The SunRule allows K-12 students, as well as interested adults, to use sunlight to explore fundamental mathematical concepts, as a physical representation for the multiplication.

***Partnership among Six Land-Grant Universities to Bring Active Learning Strategies to Food Processing and Food Engineering Courses, Meet Workforce Needs*** - The University of Maine is working with University of Idaho, Iowa State University, University of Kentucky, Washington State University, and Virginia Tech to bring research-based, evidence-guided strategies to the teaching and learning in food processing, science, and engineering courses and build awareness in these fields, where additional workers are crucially needed. This work is funded by a grant from the U.S. Dept. of Agriculture Higher Education Challenge Program (McKay, PI; Skonberg, UMaine Co-PI) and was an outgrowth of the FIG-MLA Program.

***Three-state collaboration to study teaching and learning quantitative reasoning in the context of forestry*** – RiSE affiliated faculty and staff Lindsay, McKay, Peterson, Siddons, and Van der Eb are part of the Leadership Team for the educational strand of the EPSCoR Track-2 INSPIRES project (Weiskittel, PI), which has involved a team of thirteen teachers from Maine and Vermont in the design, implementation, and assessment of learning experiences for middle and high school students. Teachers have been learning about research, field work, and data collection strategies to study forest ecosystems and they are working to connect their knowledge across the three states. Regina Toolin, from the University of Vermont, and Laura Nickerson, from the University of New Hampshire, are also part of the Leadership Team for this work. This project gives these teachers the opportunity to work closely with and ask questions of researchers. With support from a CLAS Pre-Tenure Faculty Research and Creative Activity Fellowship, **Franziska Peterson** will complete key research to support the EPSCoR Track-2 INSPIRES grant, investigating teachers' knowledge about quantitative reasoning related to forestry.

***NSF Collaborative Research Grants in Physics Education Research*** – RiSE affiliated faculty members MacKenzie Stetzer and John Thompson have built strong research collaborations with colleagues from California State University Fullerton, Cornell University, University of Nebraska Lincoln, North Dakota State University, University of North Florida, Penn State Greater Allegheny, University of Virginia, University of Washington, West Virginia University, and Western Washington University. Much of their work has focused on understanding important



aspects of teaching and learning in undergraduate physics and the interfaces between physics-mathematics and physics-engineering learning. Their research projects are listed, along with the rest of the RiSE portfolio, in Appendices F and G.

***Evaluating the Community Resilience Informed by Science and Experience (CRISE) project at the Gulf of Maine Research Institute*** – **Chrissy Siddons**, Program Evaluation Specialist at the RiSE Center, is working as the external evaluator on a NOAA-funded project led by Gayle Bowness (PI; GMRI), Susie Arnold (Island Institute), Abby Roche (Island Institute), and Upswell, a learning design company. The RiSE Center brings education research expertise to the evaluation process, specifically to understand the knowledge, skills, and leadership characteristics that program activities develop and advance amongst participants. This work adds to the growing body of research centered on community resilience in the face of climate change, with a particular focus on developing ways of measuring social aspects of community knowledge and resilience.

#### IV. RiSE Center Customers and How They Are Served

**Maine school districts and their PK-12 science and mathematics teachers** – The RiSE Center provides a year-long set of instructional resources that schools may rent for the year to do high-quality, hands-on science aligned with the Next Generation Science Standards. Each of these sets of instructional resources was recommended by a task force of teachers, STEM and STEM education faculty, graduate students, and other stakeholders after careful review of possible sets on the market. Teachers who are new to the resources receive introductory training, paid for by their district, from RiSE professional staff and leading teachers. RiSE also offers week-long summer content immersions in mathematics and various other STEM topics, and has several grant-funded initiatives to provide authentic, community-based learning experiences for teachers and opportunities for them to collaboratively build lessons for their students from these experiences. During the school year, RiSE professional staff and leading teachers run virtual discussion sessions for teachers across the state teaching the same middle level or high school courses (e.g. high school chemistry teachers). Also running during the school year are professional learning sequences for a variety of topics including formative assessment, productive classroom discourse, and social and emotional learning in the STEM classroom. These offerings provide a series of specific teaching and learning strategies, which teachers try in their classroom and then reflect upon together afterward. They are designed by RiSE Center faculty, professional staff, and leading teachers, with the leading teachers and professional staff often facilitating these offerings. Through its NSF Noyce Teaching Fellowship Program, the RiSE Center has worked closely with high-need districts to support and retain new science and mathematics teachers and provide leadership development and opportunities for selected experienced teachers and these new teachers as they develop. For all professional learning offered by the RiSE Center, exit surveys are used to collect feedback and the leadership is responsive to this feedback to ensure that professional learning meets teacher needs. In addition to professional learning above, the RiSE Center fosters important connections among STEM educators at all educational levels by hosting the RiSE Summit (held virtually in November) and the RiSE Conference (held in-person in June). This year, 106 STEM educators and researchers participated in an exciting educational June conference program focused on *Integrating Research and Practice: Working Together to Support Robust Student Learning in STEM*. Financial support from numerous grants and units at UMaine, including co-sponsorship by Maine eDNA, made the program accessible to K-12 teachers as well as faculty. Participation in the RiSE Conference increased significantly from FY21 (70 participants), rebounding to pre-pandemic attendance levels. The RiSE Materials Warehouse, professional learning programs, and Summit are coordinated through the Maine STEM Partnership at the RiSE Center. <https://mainestempartnership.org/> In FY22, the RiSE Center provided 141 distinct events or meetings, reaching 290 teachers, with a total 5,618 participant hours of professional learning. This is significantly greater than the annual average of 4839 participant hours of professional learning provided by RiSE in the last three years.

**STEM faculty bringing active engagement and research-supported, evidence-guided practices into their STEM courses** – The RiSE Center runs the Faculty Course Modification Incentive Grant – Maine Learning Assistant (FIG-MLA) Program on campus, which supports faculty as they design, implement, assess, and refine course modifications. These modifications typically rely upon the presence of well-prepared peer leaders, the MLAs, in order to make strategies such as small group problem solving and discussion possible, even in large classes. RiSE affiliated faculty and professional staff run a weekly workshop for the MLAs, building their familiarity with underlying

research in STEM teaching and learning, the advantages of active engagement strategies, and how to make them work well. These weekly sessions also give MLAs a chance to reflect upon their experiences and problem-solve together. In addition to meeting as an MLA group, the course faculty member also meets with the MLAs every week to discuss previous classes and plans for the upcoming ones. Faculty report that MLAs provide them with useful feedback and help them stay more connected with the preferences and challenges being faced by undergraduates in their classes. Students and MLAs are surveyed each semester to see how the program is working from their perspective. Most recent program evaluation data suggest an average 6% retention benefit to first year students who take at one FIG-MLA STEM course compared to those who take non-FIG-MLA STEM courses. Being an MLA deepens content understanding and gives this group of students a community and a chance to reflect on their own learning. It also provides a campus job that is valued by these students. The MLA experience persuades some students to pursue careers in STEM education or STEM education research. This program was begun with an NSF grant and is now continued with support from the Provost's Office, deans, chairs and directors. In FY22, 125 MLAs and 28 FIG faculty reached 5,427 undergraduates. Experienced faculty within the FIG-MLA program and RiSE Center faculty run workshops and discussion sessions, sharing their expertise with colleagues and expanding the program's influence. In addition to this work with UMaine faculty, **Natasha Speer** and **MacKenzie Stetzer** have run a seed grant program through Maine-eDNA to make available opportunities for faculty from Maine post-secondary institutions to provide engaging learning experiences related to the science of eDNA either in existing courses or by creating new courses. These faculty have attended and presented their work at the RiSE Conference and continue to be supported as they refine their offerings. RiSE expertise in this area has also extended to collaborations with faculty at other campuses, such as the USDA Higher Education Challenge grant discussed above.

**UMaine undergraduates** – The FIG-MLA Program, and the professional learning that it offers for faculty both inside and outside of the program, is one way that the RiSE Center serves UMaine undergraduates. Another is by RiSE faculty involvement in innovative teaching and learning experiences and research mentoring in their academic homes. **Francois Amar** co-developed and taught RLE 150, Managing Change: The Science of Sustainability in collaboration with the Mitchell Center. He also spearheaded the Sustainability Hub for Undergraduates (SHU) effort and co-chaired the SHU committee for the Mitchell Center in Spring 2022. **Christopher Gerbi** developed and taught RLE course, RLE 150, Sharing Geoscience on Maine's Public Lands in Fall 2021. **John Thompson** served on the Gateways to Success working group. **Mitchell Bruce** and colleagues published a paper documenting their success in developing and delivering hands-on chemistry labs to remote students during the pandemic. **Nuri Emanetoglu** leads an NSF-funded summer Research Experience for Undergraduates program, engaging students in research related to sensor science and engineering; RiSE staff support evaluation of this project. RiSE faculty continued making research experiences available to undergraduates by mentoring 9 Honors theses or senior capstone research projects last year, on par with the average of 11 such projects mentored annually over the last three years.

**UMaine graduate students** – The RiSE Center offers the CAEP-accredited Master of Science in Teaching (MST) program. Last year RiSE faculty provided 144 graduate student credit hours in the MST program in 13 courses (see Appendix I) and mentored 5 Master's theses (MST) and 2 PhD dissertations in STEM Education or Physics Education Research. Seventeen students were enrolled in the CAEP-accredited MST program. On average, 5 MST degrees have been awarded annually for the last five years. In spring of 2022, the RiSE Center awarded its 100<sup>th</sup> MST degree, 20 years after the program was launched. **Natasha Speer** co-organized summer orientation sessions for new mathematics and science graduate student teaching assistants as well as sessions for all new teaching assistants as part of the Graduate School orientation sessions. This work entails developing curricula and instructional materials, and the sessions provide important support that helps new graduate students succeed in their teaching roles and likely contributes to their retention. She also teaches a one-credit seminar preparing TAs in the Department of Mathematics and Statistics during their first semester teaching in the department.

**Support in grant design for UMaine faculty and program evaluation** – RiSE faculty and professional staff work with early-career UMaine STEM faculty on the design of their career grants and research proposals, building strong education and broader impacts plans and linking them with interested teachers through the Maine STEM Partnership network. Projects that are part of the Maine STEM Partnership are reviewed by its Leadership Team to ensure that they are coordinated with other work and seen as valuable within the schools. RiSE professional staff support these professional learning experiences for teachers, working with the faculty PIs. The RiSE Center also offers program evaluation for funded UMaine and external projects, such as the REU run by **Nuri Emanetoglu** and the CRISE project at the Gulf of Maine Research Institute described above.

## V. Plans for Future Growth

The RiSE Center has a four-pronged plan for future growth:

1. **Addition of faculty members who are discipline-based education researchers**, preferably joint appointed, in areas of urgent need: biology, ecology and environmental (possibly forestry) education, chemistry education, engineering education, and physics education, as well as in other STEM departments. Recently the School of Computing and Information Science hired a computer science (CS) faculty member who does research in CS education, Greg Nelson. Nelson is planning to apply to become an affiliated faculty member of the RiSE Center this fall. It would be great to have a second colleague in this area, since there is so much need for CS education for teachers and students. It is an essential piece of workforce development, and one that RiSE has been able to compete successfully for NSF grants from STEM+C and ITEST. The RiSE Center has proposed additional new faculty as part of cluster hires and the next EPSCoR Track-1 initiative. When the RiSE Center was founded over 20 years ago, there were 8 existing STEM faculty who formed the core development group for the Center. Of these eight original members, four have retired and one more is nearing the end of phased retirement. As part of the launch of the Center, four additional faculty positions were created to support its research and the MST Program, two in physics and two in mathematics. Michael Wittmann is now vacating one of the physics positions, and it is essential that he be replaced. Approximately 10 years ago, three additional tenure-stream faculty positions were created as part of the NSF-funded Maine Physical Sciences Curriculum Partnership (MainePSP), one each in Physics (MacKenzie Stetzer), School of Teaching and Learning (now Beth Hufnagel), and the School of Biology and Ecology (Michelle Smith; faculty line not continued in discipline-based education research after Smith left UMaine). The salaries for these positions were paid by the grant for the first five years of each position, with the commitment that each college would continue the position after the grant ended. Another influx of faculty is needed over the next 1-3 years in order to maintain the research productivity and continuity of the RiSE Center.

Faculty members in discipline-based education research are an excellent investment for UMaine and the State of Maine. They bring positive, research-based, evidence-guided course modifications to their home departments. They strengthen the PK-12 education system, preparing stronger students for our undergraduate programs, and provide the expertise to support positive course modifications at UMaine through FIG-MLA and other faculty development programs. They support graduate teaching assistant, pre-service, and in-service teacher education, again strengthening teaching and learning and Maine's workforce development. A look at the research productivity of those who have been hired as part of the RiSE Center shows the significance of these faculty members in terms of research productivity, including student research mentoring. Continuing STEM education, including STEM education research, as a signature area for UMaine is a strategic priority. We want to continue to have the capacity to be known for excellence in STEM education research, teaching and learning, and the RiSE Center contributes to that reputation.

2. **Increase in philanthropic giving** to support all aspects of RiSE Center work, especially the Maine STEM Partnership, which has broad appeal to potential donors. There are many donors connected with Maine and/or UMaine who are passionate about education and could be tapped to support the RiSE Materials Warehouse, professional learning opportunities for new and experienced teachers, and other supports to provide access for all students to high quality STEM teaching and learning. The RiSE Center has begun to cultivate relationships with some potential donors through the University of Maine Foundation, but this is an area that requires a committed staff member to handle internal and external communication and to continue to build these relationships (see below).

3. **Increase professional staff positions to provide a communications specialist and a research and evaluation coordinator**. These positions could be partially grant funded, but would need continuity and some funding provided in base-budget lines to ensure continuity and time to build the essential relationships that contribute to doing these jobs effectively. The communications specialist would be able to draft materials for potential donors as well as handle other internal and external communications needs at the Center. It is important that these positions have some base funding, since development of proposals using grant funds is not generally permitted. These positions are a necessary part of the infrastructure for an interdisciplinary research center as active and productive as the RiSE Center.

4. **Development of additional grant proposals and collaborations to increase research funding** is an essential part of our plan, with using the positions in #3 to take advantage of additional funding sources and bring together additional partnerships for shared work. The portfolio of funded grants at the RiSE Center (Appendices F and G) is impressive, but there are opportunities that are missed due to limited faculty and professional staff capacity.

## VI. Diversity, Equity and Inclusion Efforts

RiSE Center faculty and staff contribute to local and national efforts to improve diversity, equity and inclusion. Here are some recent examples: **Asli Sezen-Barrie** served on the Maine College of Engineering, Computing, and Information Science (MCECIS) Transitions and DEI Committee. As part of the Introductory Course Environment Faculty Learning Community (ICE-FLC), **Saima Farooq** studied the expectations and difficulties of incoming students, especially first generation and under-represented minority students, gaining insight to assist the students for their overall academic success in their first year at UMaine. RiSE Center staff members have developed on-boarding plans for new staff members and, as part of these plans, **Maureen Raynes** and **Yadina Clark** have begun to create a Wiki to support onboarding and inclusion of new faculty, staff and students. A goal of this project is to help employees feel welcome, supported, included and valued in an environment that invites them to contribute their best work. RiSE Center Director **Susan McKay** co-chaired the President's Council on Diversity, Equity and Inclusion from 2020-2022. At the 2022 RiSE Conference, **Sara Lindsay** shared strategies for helping students build science identity with K-16 teachers from across the state. **Heather Falconer's** book, *Masking inequality with good intentions: Systemic bias, counterspaces, and discourse acquisition in STEM education*, which is under contract with the University Press of Colorado, is one example of how RiSE faculty are shining a light on issues of equity and inclusion in STEM disciplines through their research. With support from a USDA-HEC grant, RiSE faculty, staff and graduate students facilitated work across 6 institutions to better align food processing courses to workforce needs, deepen students' active engagement in learning, and address gender inequity in the workforce. Through the Maine STEM Partnership, the RiSE Materials Warehouse supports schools with high quality, low-cost instructional materials that increase equity and access to quality science education. Additionally, the Rise Center's NSF Teaching Fellowship Program, designed to help meet Maine's workforce need for science and mathematics teachers in high-need districts, had 16 fellows and 3 program graduates teaching in high-need districts during the 2021-22 school year.

## VII. Efforts to Preserve R1 Classification

Through its robust education research activities and grant funding, the RiSE Center contributes to the research capacity of the University of Maine, while at the same time supporting Maine educators at all educational levels to provide strong STEM instruction that includes authentic research and inquiry related to local, state, national and even global priorities (e.g., changing forests and oceans). Grants awarded to RiSE faculty are currently supporting two postdoctoral research associates in physics education and several PhD students as graduate research assistants. RiSE Center faculty and staff are building partnerships and connections to increase student awareness and preparation for productive STEM careers. In addition to its MST graduate program, which recently met the 100 graduates mark, the RiSE Center faculty support the STEM Education PhD program. Three of the four students in the STEM Education PhD program are graduates of the MST Program who have chosen to continue research in STEM Education at the doctoral level. RiSE faculty and staff collaborate with researchers across the nation and around the world, enhancing the visibility and reputation of the University.

## VIII. Challenges

Below are some of the major challenges that have emerged through surveys and discussions during the process of preparing this self-study. Appendix J provides a more complete list.

- (1) Obtaining support for more RiSE faculty, especially ones with joint appointments or other arrangements, so that RiSE governance and other work is not just a voluntary, added on responsibility. The STEM Departments are also in need of added positions and are reluctant to give up pieces of positions to research centers.
- (2) Changing the way that long-term partnerships with schools and professional learning offerings are viewed in faculty activity reports and by peer committees. This work is usually called service, whereas it is certainly a part of scholarship (assuming that it is appropriately scholarly).
- (3) The challenges that some faculty face in being able to devote time to RiSE-related work because of the needs of their home departments. Many STEM departments are also very short-handed. This makes it difficult to have the

Center and the work it does be representative of all members because not all members have the same opportunities to contribute to governance and to be involved in projects.

(4) As RiSE grant-funded activities increase, the RiSE Center needs to hire more personnel, particularly a communications specialist and research coordinator. Recent hires of a half-time assistant director and a 70% administrative specialist have certainly helped with the RiSE Center workload, but the RiSE Center still has needs for these positions.

(5) With increasing need for flexible meeting and teaching modalities, the RiSE Center needs a video technology upgrade to its primary meeting & teaching space, the Fireside Conference room (113 Estabrooke).

(6) As the RiSE Center returns to offering in-person professional learning and community building, securing affordable, climate-controlled and comfortable lodging for participants who are traveling more than 60 miles is becoming a significant challenge. Many local hotels are not available at the rates allowed by federal funding agencies, and have limited availability during summer months, when most of our programs run. Although it is affordable, housing on campus is not air conditioned, and recent participants staying on campus found the amenities unacceptable (i.e., disposable sheets).

(7) There is a critical shortage of STEM majors interested in pursuing teaching as a career while, at the same time, there have been increased retirements and the pandemic has exacerbated retention issues in the profession. Recruiting for the MST Program and support for in-service teachers need to be more extensive and strategic to address this teacher workforce challenge. The MST Program is better with more students, and more diversity among students. Expansion, or even sustaining current enrollments, at this time is a challenge.

(8) The RiSE Center needs to have the capacity and expertise to effectively and efficiently fund raise, working with the University of Maine Foundation and other resources on campus. We know that there are donors out there interested in supporting our work, but it is hard to find and follow up with them.

(9) The RiSE Center has developed effective programs, through NSF grants, for STEM teacher support and retention in high-need districts during the induction period and for integrating computer science and computational thinking into middle level science. It is difficult to find ongoing funding sources to continue and expand these programs post-grant, yet they are just what Maine needs right now.

## Appendix A. Listing of RiSE Center Faculty and Staff

### RiSE Affiliated Faculty:

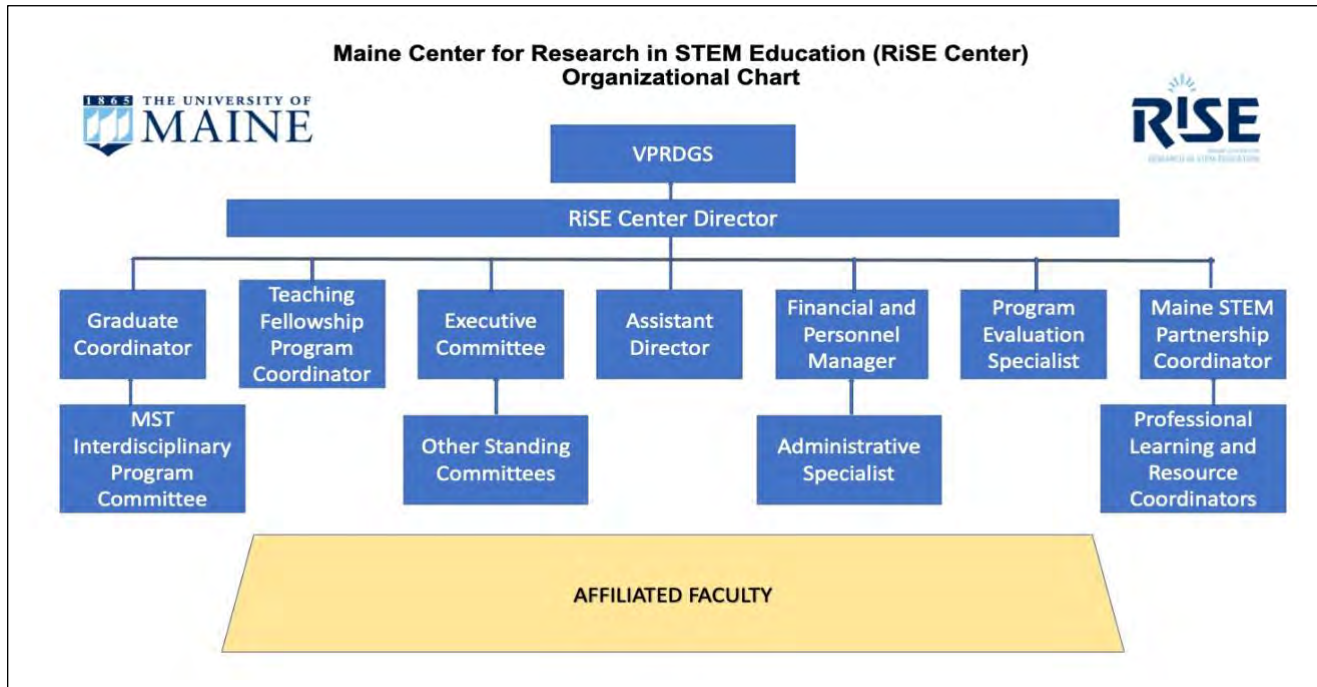
Name	Title	Email
Amar, François	Professor of Chemistry	amar@maine.edu
Batuski, David	Professor of Physics	batuski@maine.edu
Boester, Timothy	Lecturer, Mathematics	timothy.boester@maine.edu
Bruce, Mitchell R.	Professor of Chemistry	mbruce@maine.edu
Dimmel, Justin	Associate Professor of Mathematics Education and Instructional Technology	justin.dimmel@maine.edu
Emanetoglu, Nuri	Associate Professor of Electrical & Computer Engineering	nuri.emanetoglu@maine.edu
Fairman, Janet	Associate Professor, School of Learning and Teaching	janet.fairman@maine.edu
Falconer, Heather	Assistant Professor of Professional and Technical Writing	heather.falconer@maine.edu
Farooq, Saima	Lecturer, Physics and Astronomy	saima.farooq@maine.edu
Franzosa, Robert D.	Professor of Mathematics	franzosa@math.umaine.edu
Gerbi, Christopher	Professor, School of Earth & Climate Sciences and Associate Dean, NSFA	christopher.gerbi@maine.edu
Hufnagel, Elizabeth	Associate Professor, School of Learning and Teaching	elizabeth.hufnagel@maine.edu
Lindsay, Sara	Assistant Director of the RiSE Center and Professor, School of Marine Sciences	slindsay@maine.edu
McKay, Susan	Director of the RiSE Center and Professor of Physics	susan.mckay@maine.edu
Pandiscio, Eric	Associate Professor, School of Learning and Teaching	eric.pandiscio@umit.maine.edu
Peterson, Franziska	Assistant Professor of Mathematics and RiSE Center Graduate Coordinator	franziska.peterson@maine.edu
Schauffler, Molly	Assistant Research Professor, School of Earth and Climate Sciences, Climate Change Institute	mschauff@maine.edu

Sezen-Barrie, Asli	Associate Professor, School of Learning and Teaching	asli.sezenbarrie@maine.edu
Speer, Natasha	Associate Professor, Mathematics	speer@math.umaine.edu
Stetzer, MacKenzie	Associate Professor and Chair, Physics and Astronomy	mackenzie.stetzer@maine.edu
Thompson, John R.	Professor of Physics	thompsonj@maine.edu
Wittman, Michael	Professor of Physics	mwittmann@maine.edu

**RiSE Affiliated Staff:**

Name	Title	Email
ByersSmall, Beth	Teaching Fellowship Program Coordinator	elizabeth.byerssmall@maine.edu
Clark, Yadina	Administrative Specialist CL3	yadina.clark@maine.edu
Muncey, Beth	Resource and Professional Development Coordinator	elizabeth.muncey@maine.edu
Raynes, Maureen	Financial & Personnel Manager	maureen.raynes@maine.edu
Siddons, Christina	Program Evaluation Specialist	christina.siddons@maine.edu
Van der Eb, Marina	Maine STEM Partnership Coordinator	marina.van@maine.edu
Two hired to start Fall 2022	Professional Learning Specialists	
To be filled, Fall 2022	Research Practice Partnership Professional Learning Coordinator (funded by grants and contracts)	
To be filled, Fall 2022	FIG-MLA and Student Success Initiative Coordinator (replacement position)	
To be filled, Fall 2022	Research and Evaluation Coordinator (funded by grants and contracts)	

Appendix B. RiSE Center Organizational Chart



RiSE affiliated faculty and staff are listed in Appendix A. Their contributions and responsibilities in the RiSE Center are detailed in Section II. Affiliated faculty who hold joint appointments have joint peer committees and both the RiSE Center Director and the Chair or Director of the faculty member’s academic home provide input for their reviews, either as one letter or in two separate letters.

Members of the RiSE Executive Committee are Susan McKay (chair), Mitchell Bruce, Justin Dimmel, Sara Lindsay, Eric Pandiscio, Franziska Peterson, Natasha Speer, MacKenzie Stetzer, and Marina Van der Eb. A standing committee structure for RiSE, currently under discussion, is provided in Appendix J.

Members of the MST Interdisciplinary Program Committee are Franziska Peterson (graduate coordinator and chair), Mitchell Bruce, Eric Pandiscio, and Susan McKay.

Most RiSE professional staff support comes from grants and contracts. Normally a small amount of each salary (5-10%) is from base-budgeted accounts to support their work on RiSE Center special projects, events, and grant proposal preparation. The RiSE Center financial and personnel manager is a full-time position and the administrative specialist position is a 70%-time position, both supported by the Office of the VPRDGS..



Appendix C. Undergraduate and Graduate Students in the RiSE Center

**Students Supported by the Center and Its Affiliated Faculty**

<b>Type of Position</b>	<b>FY18 # of students</b>	<b>FY19 # of students</b>	<b>FY20 # of students</b>	<b>FY21 # of students</b>	<b>FY22 # of students</b>
Maine Learning Assistants (Semester-long positions)	77	82	82	91	97
MST Teaching Assistants (internal)	4	4	4	4	4
MST Research Assistants (Grants and contracts)	12	13	10	9	7
<b>Expenditures</b>					
<b>Type of Position</b>	<b>FY18 Expenditures</b>	<b>FY19 Expenditures</b>	<b>FY20 Expenditures</b>	<b>FY21 Expenditures</b>	<b>FY22 Expenditures</b>
Maine Learning Assistants (Semester-long positions)	74,422.50	123,540.21	92,753.90	74,611.34	70,257.74
MST Teaching Assistants (internal)	35,460.00	35,744.18	21,318.00	8,138.13	18,715.44
MST Research Assistants (Grants and contracts)	94,628.99	60,358.29	130,050.97	64,801.32	60,270.30

**Sources of funds:**

**Maine Learning Assistants:** the Provost’s Office, with additional support from the Deans, and Departments where the Maine Learning Assistants are placed.

***MST Teaching Assistants, Internal:*** one graduate teaching assistantship is allocated in the Graduate School budget as a training opportunity for an MST student in a course that uses research-supported, evidence-guided pedagogical strategies; several partial teaching assistantships in mathematics are in the MST budget, with the remainder of the stipend coming from the College of Liberal Arts and Sciences, and tuition and health insurance paid by the Graduate School. Each MST student is required to teach two semester-long classes or laboratories as a teaching assistant.

***MST Research Assistants:*** Supported by grants and contracts to RiSE affiliated faculty.

**Additional notes:**

MST students are also supported by shared TAs or unfilled TAs in STEM departments. Typically these positions support ~5 students each year.

The numbers of students are distinct students receiving support, not FTEs.

## Appendix D. Financial Summary of the RiSE Center Budgets and Expenditures

<b>Source of Funds</b>	<b>FY18</b>	<b>FY19</b>	<b>FY20</b>	<b>FY21</b>	<b>FY22</b>
MST/RiSE budget (E&G)	<b>189,884.00</b>	<b>178,924.13</b>	<b>190,986.80</b>	<b>205,906.00</b>	<b>206,797.00</b>
MAPI budget (E&G)	<b>34,723.00</b>	<b>34,813.11</b>	<b>35,328.49</b>	<b>36,977.00</b>	<b>38,823.40</b>
MEIF budget	<b>55,289.00</b>	<b>54,101.00</b>	<b>54,780.00</b>	<b>80,589.00</b>	<b>144,512.77</b>
FIG-MLA budget	<b>200,000.00</b>	<b>200,000.00</b>	<b>200,000.00</b>	<b>206,000.00</b>	<b>212,180.00</b>
External grants and contracts (expenditures)	<b>693,271.44</b>	<b>933,061.62</b>	<b>1,366,408.51</b>	<b>1,294,847.73</b>	<b>654,494.82</b>
Donations	<b>216,000.00</b>	<b>93,550.00</b>	<b>314,846.00</b>	<b>6,156.00</b>	<b>50,455.11</b>
<b>TOTAL</b>	<b>\$1,389,167.44</b>	<b>\$1,494,449.86</b>	<b>\$2,162,349.80</b>	<b>\$1,830,475.73</b>	<b>\$1,307,263.10</b>

### Notes:

1. All of the MST/RiSE funds are spent each year. These funds cover the salaries of the director, some joint appointments, those who teach MST courses as overload, and part of the financial and personnel manager, to handle budget management and appointments for the Center and its students.
2. All of the MAPI funds are spent each year. These funds were awarded as part of an ongoing Maine Academic Prominence Initiative Grant (McKay, PI; Amar, Co-PI) and support activities and professional staff positions to enhance research productivity and visibility of the RiSE Center. They are used to bridge postdoctoral research associate positions, give writing grants to graduates of the MST Program to spend a summer after graduation preparing their thesis for publication, provide graduate student summer support for web work and other communications, and support part of the financial and personnel manager and other staff members to involve them in grant preparation and general research administrative work.
3. All of the MEIF funds are spent each year. These funds support some of the faculty joint appointments and the assistant director buyout, administrative specialist support for the RiSE Center, part of the cost of grant financial and personnel management, and other research-related expenditures.
4. The RiSE Center Director, the Maine STEM Partnership Coordinator, and the RiSE Center Financial and Personnel Manager have worked with the University of Maine Foundation and other networks to raise funds for various aspects of the RiSE Center's work, particularly the partnerships with Maine school districts. The large fluctuations in donation revenue are due to major one-time gifts in FY18 and FY20.
5. External grants and contracts (expenditures) include those grants and contracts managed by the RiSE Center and some others managed in the PI's department. We were not able to get full reports on all of these externally managed grants during the July-August data collection window for this report, so these numbers under-report actual expenditures. A more complete accounting will be provided once faculty return to campus for the fall semester.

## Appendix E. List of State, National, and International Organizational Memberships

Advanced Laboratory Physics Association (ALPhA)  
American Association for the Advancement of Science  
American Association of Physics Teachers (AAPT)

- AAPT New England Section
- AAPT Physics Education Research Topical Group

American Association of University Women  
American Astronomical Society  
American Chemical Society  
American Educational Research Association (AERA)  
American Geophysical Union  
American Mathematics Society (AMS)  
American Microscopical Society  
American Physical Society (APS)

- APS Forum on Education
- APS Forum on History of Physics
- APS New England Section
- APS Topical Group on Physics Education Research

American Society for Engineering Education (ASEE)  
Association for the Teachers of Technical Writing  
Association for Writing Across the Curriculum  
Association of Teachers of Mathematics in Maine (ATOMIM)  
Conference on College Composition and Communication  
Council for Undergraduate Research  
Institute for Broadening Participation  
Institute of Electrical and Electronics Engineers (IEEE)  
International Glaciological Society  
International Polychaetology Association  
Mathematical Association of America (MAA)

- MAA Special Interest Group for Research on Undergraduate Mathematics Education (SIGMAA on RUME)

National Association for Research in Science Teaching (NARST)  
National Collegiate Honors Council  
National Council of Teachers of Mathematics (NCTM)  
National Science Teaching Association (NSTA)  
Partnership for Undergraduate Life Sciences Education (PULSE)  
Sigma Xi, The Scientific Research Honor Society  
Society for Integrative & Comparative Biology  
The Honor Society of Phi Kappa Phi

## Appendix F. New Funding Awarded to RiSE Center Faculty and Staff, FY22

Only RiSE Personnel are listed; see UMaine Research Reporting Dashboard for complete listing

Award Date	Title	Funding Agency	RiSE Personnel Involved	Sponsor Total
7/22/2021	Maine Education Policy Research Institute (MEPRI)	ME Dept of Education through Maine State Legislature	Fairman, Janet (PI)	\$125,000
7/30/2021	Math4ME	US Dept of Education through ME Dept of Education	Fairman, Janet (PI)	\$60,062
9/1/2021	Collaborative research: From community to practice: Evaluating how open educational resources facilitate implementation of Vision and Change principles across diverse institutional contexts	National Science Foundation	Stetzer, MacKenzie (PI) (transferred from Erin Vinson)	\$362,761
9/10/2021	IPA DRK-12 Program	National Science Foundation	Sezen-Barrie, Asli (PI)	\$130,708
9/18/2021	RII Track-1: Molecule to Ecosystem: Environmental DNA as a Nexus of Coastal Ecosystem Sustainability for Maine (e-DNA) Yr3	National Science Foundation	McKay, Susan (Sr. Pers) Speer, Natasha (Sr. Pers) Stetzer, MacKenzie (Sr. Pers)	\$4,372,317
9/23/2021	Recruitment, Reproduction and Larval Supply in Alaskan Deep-Water Corals	US Dept of Commerce through Cooperative Institute for the North Atlantic Regi	Gerbi, Christopher (PI)	\$44,998
10/8/2021 & 10/27/2021	RII Track 2 FEC: Leveraging informatics to resolve uncertainties in the Northern Forest's carbon budget <i>RiSE contributes education research and a research-practice partnership with teachers to this project, with RiSE personnel listed all contributing.</i>	National Science Foundation	Lindsay, Sara (Sr. Pers.) McKay, Susan (Sr. Pers.) Peterson, Franziska (Sr. Pers.) Van der Eb, Marina (staff)	\$2,099,999
10/12/2021	Collaborative Research: Beyond procedures: a research-based approach to teaching mathematical methods in physics Yr3	National Science Foundation	Thompson, John R (PI)	\$85,994
10/13/2021	Next Generation Harsh-Environment Materials and Wireless Sensor Techniques for Energy Sector Applicatio	US Dept of Energy	Emanetoglu, Nuri (Co-PI)	\$1,072,930
1/31/2022 & 6/14/2022	NSF CAREER: A Transformative Approach for Teaching and Learning Geometry by Representing and Interacting with Three-dimensional Figures	National Science Foundation	Dimmel, Justin (PI)	\$345,574

3/7/2022	Bangor Savings Bank Faculty Development Award	Bangor Savings Bank (through UMaine Office of Academic Affairs)	Falconer, Heather (PI)	\$2,500
5/1/2022	National Examination Test Tool Version 2.2.1MS, Servant Heart Research Collaborative, UMaine Honors College.	New Covenant Foundation via Office of Innovation	Amar, François (Co-PI)	\$30,064
6/10/2022	DTI: A Model Program to Engage Students in Authentic, Technology-Infused Coastal Research and Monitoring: Building Student Data Literacy and Career Competency through Partnership	National Science Foundation	McKay, Susan (PI) Lindsay, Sara Peterson, Franziska Van der Eb, Marina	\$1,350,000
6/28/2022	Math4ME Program Evaluation	US Dept of Education through ME Dept of Education	Fairman, Janet (PI)	\$67,544

**\$10,150,451**

## Appendix G. Continuing Grants to RiSE Center Faculty and Staff, FY22

Only RiSE Personnel are listed; see UMaine Research Reporting Dashboard for complete listing

Award Date	Title	Funding Agency	RiSE Personnel Involved	Sponsor Total
10/14/2014	Collaborative Research: Research on learning and teaching at the physics-mathematics interface	National Science Foundation	Thompson, John R (PI)	\$197,647
3/4/2016	CAREER: Identifying the Dominate Controls Year 5	National Science Foundation	Gerbi, Christopher (PI)	\$65,582
3/24/2016	A Model NSF Teaching Fellowship Program to Improve STEM Teacher Recruitment, Preparation, Professional Development, and Retention in Rural High-Need Schools	National Science Foundation	McKay, Susan (PI) Pandiscio, Eric (Co-PI) Stetzer, MacKenzie (Co-PI)	\$1,950,034
8/25/2016	Fostering Connections between Macroscopic, Submicroscopic, and Representational Levels Using Analogical Reasoning in the Chemistry Laboratory	National Science Foundation	Bruce, Mitchell (Co-PI)	\$275,284
8/21/2017	Collaborative Research: Promoting instructional change in introductory STEM courses through Faculty Learning Communities focused on the transition from high school to college	National Science Foundation	Stetzer, MacKenzie (PI)	\$154,910
9/19/2017	Collaborative research: Computational methods supporting joint seismic and radar inversion for ice fabric and temperature in streaming flow Year 2	National Science Foundation	Gerbi, Christopher (PI)	\$97,274
9/26/2017	REU Site: Sensor Science and Engineering Yr. 3	National Science Foundation	Emanetoglu, Nuri (PI)	\$136,268
11/1/2017	Improving the Preparation of Graduate Students to Teach Undergraduate Mathematics	National Science Foundation through Mathematical Association of America	Speer, Natasha (PI)	\$25,510
5/22/2018	NSF-REU supplement to PFI: AIR-TT Lateral Field Excited Acoustic Wave Sensor for Monitoring Thin Film Properties in Solid State Devices	National Science Foundation	Emanetoglu, Nuri (Co-PI)	\$8,000
6/22/2018	Collaborative Research: Establishing a new model for research-based curriculum development in physics aligned with dual-process theories of reasoning	National Science Foundation	Stetzer, MacKenzie (PI)	\$863,239
8/23/2018	Improving the Preparation of Graduate Students to Teach Undergraduate Mathematics	National Science Foundation through Mathematical Association of America	Speer, Natasha (PI)	\$37,265
8/28/2018	MRI Acquisition of a 500 MHz NMR Spectrometer with Improved Sensitivity and Accessibility to	National Science Foundation	Bruce, Mitchell (PI)	\$535,900

	Benefit Research and Education at UMaine			
9/11/2018	A remote multimodal learning environment to increase graphical information access for blind and visually impaired students	National Science Foundation	Dimmel, Justin (Co-PI)	\$747,894
9/20/2018	Integrating Computation into Science Teaching and Learning in Grades 6-8: A Diverse Partnership to Develop an Evidence-Guided Model to Serve Rural Communities	National Science Foundation	McKay, Susan (PI) Bruce, Mitchell (Co-PI) Fratini, James (Co-PI) Lindsay, Sara (Co-PI)	\$1,250,000
10/19/2018	The Geometer's Planetarium II: Exploring the connections between geometry and astronomy in an immersive virtual environment	National Aeronautics & Space Administration through Maine Space Grant Consortium	Dimmel, Justin (PI)	\$24,960
1/4/2019	Enhancing Learning Outcomes In Food Engineering And Processing Courses For Non-Engineers Using Student-Centered Approaches	US Dept of Agriculture	McKay, Susan (PI)	\$747,328
2/22/2019	REU Site: Sensor Science and Engineering	National Science Foundation	Emanetoglu, Nuri (PI)	\$430,897
4/12/2019	How do scale and dimension affect students' perceptions of geometric diagrams?	Spencer Foundation	Dimmel, Justin (PI)	\$49,217
6/24/2019	Transdisciplinary Predoctoral Training in Biomedical Science and Engineering	US Dept of Health & Human Services	Fairman, Janet (Co-PI)	\$217,444
6/27/2019	A remote multimodal learning environment to increase graphical information access for blind and visually impaired students	National Science Foundation	Dimmel, Justin (Co-PI)	\$15,360
8/16/2019	Collaborative Research: Research on learning and teaching at the physics-mathematics interface +\$	National Science Foundation	Thompson, John R (PI)	\$282,066
8/9/2019	RII Track 2 FEC: Leveraging informatics to resolve uncertainties in the Northern Forest's carbon budget <i>RiSE contributes education research and a research-practice partnership with teachers to this project, with RiSE personnel listed all contributing.</i>	National Science Foundation	Lindsay, Sara (Sr. Pers.) McKay, Susan (Sr. Pers.) Peterson, Franziska (Sr. Pers.) Christina Siddons (staff) Van der Eb, Marina (staff) (Aaron Weiskittel, PI)	\$3,000,000
8/20/2019	Novel Harsh Environment Materials and Fabrication Techniques for Wireless Sensor Applications yr1	US Dept of Energy	Emanetoglu, Nuri (Co-PI)	\$370,082
8/22/2019	RII Track-1: Molecule to Ecosystem: Environmental DNA as a Nexus of Coastal Ecosystem Sustainability for Maine (e-DNA)	National Science Foundation	McKay, Susan (Sr. Pers.) Speer, Natasha (Sr. Pers.) Stetzer, MacKenzie (Sr. Pers.)	\$2,877,854
9/5/2019	Collaborative Research: Beyond procedures: a research-based approach to teaching mathematical methods in physics	National Science Foundation	Thompson, John R (PI)	\$282,066
6/29/2020	A remote multimodal learning environment to increase graphical	National Science Foundation	Dimmel, Justin (Co-PI)	\$16,000



	information access for blind and visually impaired students			
6/29/2020	Transdisciplinary Predoctoral Training in Biomedical Science and Engineering Yr2	US Dept of Health & Human Services	Fairman, Janet (Co-PI)	\$86,400
7/20/2020	Novel Harsh Environment Materials and Fabrication Techniques for Wireless Sensor Applications yr2	US Dept of Energy	Emanetoglu, Nuri (Co-PI)	\$379,918
8/11/2020	Maine Education Policy Research Institute (MEPRI)	Maine Legislative Council	Fairman, Janet (PI)	\$125,000
8/12/2020	Understanding Extreme Weather with Big Data Yr2	National Science Foundation through Education Development Center	Sezen-Barrie, Asli (PI)	\$38,991
9/9/2020	Collaborative Research: Beyond procedures: a research-based approach to teaching mathematical methods in physics	National Science Foundation	Thompson, John R (PI)	\$85,995
10/1/2020	Examining the impact of the Partnership for Undergraduate Life Sciences Education Recognition Program as a Mechanism to Foster Departmental Transformation	National Science Foundation	Lindsay, Sara (Sr. Pers.) (Award to Dartmouth College, Thomas P. Jack, PI)	\$600,322
10/1/2020	RII Track-1: Molecule to Ecosystem: Environmental DNA as a Nexus of Coastal Ecosystem Sustainability for Maine (e-DNA) Yr2	National Science Foundation	McKay, Susan (Sr. Pers.) Speer, Natasha (Sr. Pers.) Stetzer, MacKenzie (Sr. Pers.)	\$4,471,539
3/12/2021	Examining Academic Self-Efficacy and Writing Development in Students with Specific Learning Disabilities	NCTE/Conference on College Composition and Communication	Falconer, Heather (Co-PI) (through Curry College)	\$4,000
3/18/2021	Collaborative Research: Building Adaptability for Teaching Online through Peer-Reviewed, Active-Learning Resources and Professional Development	National Science Foundation	Vinson, Erin (PI) Stetzer, MacKenzie (new PI)	\$144,771
3/30/2021	Community Resilience Informed by Science and Experience: Developing Knowledge, Skill and Relationships to Build the Capacity of Rural Coastal Communities to Plan for a Resilient Future	Gulf of Maine Research Institute / US Dept of Commerce	McKay, Susan (Sr. Pers.) Siddons, Christina (staff)	\$74,702
5/10/2021	Improving the Preparation of Graduate Students to Teach Undergraduate Mathematics	National Science Foundation through Mathematical Association of America	Speer, Natasha (PI)	\$19,000
6/7/2021	National Examination Test Tool Version 2.2.1MS, Servant Heart Research Collaborative, UMaine Honors College.	New Covenant Foundation via Office of Innovation	Amar, François (Co-PI)	\$40,009

**\$20,728,728**

Appendix H. Published and Accepted Works by RiSE Center Faculty, Staff and Students, FY22  
(RiSE faculty, staff, and students indicated in bold)

Ahmad, A.L.A., Parambath, J.B.M., Postnikov, P.S., Guselnikova, O., Chehimi, M.M., **Bruce, M.R.M.**, Bruce, A.E., & Mohammed, A.A. (2021). Conceptual developments of aryldiazonium salts as modifiers for gold colloids and surfaces. *Langmuir*, 37(30), 8897–8907. <https://doi.org/10.1021/acs.langmuir.1c00884>

**Amar, F.G.** (2021). Honors in the postpandemic world: Situation perilous. *Journal of the National Collegiate Honors Council*, 22(2):3–9. <https://digitalcommons.unl.edu/nhcjournal/690/>

Bajracharya, R.R., Sealey, V.L., & **Thompson, J.R.** (Accepted). Student understanding of the sign of negative definite integrals in mathematics and physics,” accepted for publication in *International Journal of Research in Undergraduate Mathematics Education*, Special Issue on The Teaching and Learning of Definite Integrals, Eds. R. Ely and S. R. Jones.

**Bock, C.G.**, & **Dimmel, J.K.** (2021). Digital representations without physical analogues: A study of body-based interactions with an apparently unbounded spatial diagram. *Digital Experiences in Mathematics Education* 7, 193–221. <https://doi.org/10.1007/s40751-020-00082-4>

**Bruce, M.R.M.**, Bruce, A.E., & **Walter, J.** (2022). Creating representation in support of chemical reasoning to connect macroscopic and submicroscopic domains of knowledge. *Journal of Chemical Education*, 99(4), 1734-1746. <https://doi.org/10.1021/acs.jchemed.1c00292>

**Bruce, M.R.M.**, Bruce, A.E., Bernard, S.E., Bergeron, A.N., Ahmad, A.A.L., Bruce, T.A., Perera, D.C., Pokhrel, S., Saleh, S., Tyrina, A., & Yaparathne, S. (2021). Designing a remote, synchronous, hands-on general chemistry lab course. *Journal of Chemical Education*, 98(10): 3131-3142. <https://doi.org/10.1021/acs.jchemed.1c00559>

**Cleveland, A.**, **Sezen-Barrie, A.**, & Marbach-Ad, G. (2021). The conceptualization of quantitative reasoning among introductory biology faculty. *Journal of Microbiology and Biology Education*. 22(3), e00203-21. <https://doi.org/10.1128/jmbe.00203-21>

**Dimmel, J.K.**, **Pandiscio, E.A.**, & **Bock, C.G.** (in press). Multiplication by Sunlight: How can a geometric definition be realized in a physical tool? Manuscript to be published in the *Journal of Mathematics Education*, Teachers College.

**Dimmel, J.K.**, **Pandiscio, E.A.**, & **Bock, C.G.** (2021). The geometry of movement: Encounters with spatial inscriptions for making and exploring mathematical figures. *Digital Experiences in Mathematics Education*, 7(1), 122 - 148. <https://doi.org/10.1007/s40751-020-00078-0>

Erickson, A.W., Herbst, P.G., Ko, I., & **Dimmel, J.K.** (2021). When what routinely happens conflicts with what ought to be done: A scenario-based assessment of secondary mathematics teaching. *Research in Mathematics Education*, 23(2), 188-207. <https://doi.org/10.1080/14794802.2020.1855600>

**Fairman, J.C.**, Lech, P.L., McCormick, M.R., & Buxton, M.P. (March 2022). *Strategies for Supporting Teachers' Instructional and Mental Health Needs during the COVID Pandemic in Maine and Other States*. Maine Education Policy Research Institute. <https://mepri.maine.edu/files/2022/04/MEPRI-Rpt-on-Strategies-Supporting-Tchrs-033022.pdf>

**Falconer, H.M.** (2022). Preparing disciplinary writing instructors: The Curry College faculty writing fellows program. *Composition Forum*, 48(Spring 2022). <https://compositionforum.com/issue/48/curry.php>

**Falconer, H.M.** (Spring 2023). *Masking inequality with good intentions: Systemic bias, counterspaces, and discourse acquisition in STEM education*. University Press of Colorado/Practices and Possibilities, Fort Collins, CO. [Book under contract]

**Gerbi, C.**, Mills, S., Clavette, R., Campbell, S., Bernsen, S., Clemens-Sewall, D., Lee, I., Hawley, R., Kreutz, K., & Hruby, K. (2021). Microstructures in a shear margin: Jarvis Glacier, Alaska. *Journal of Glaciology* 67(266),1163–1176. <https://doi.org/10.1017/jog.2021.62>

Hauk, S., & **Speer, N.** (accepted, August 2021). Developing the Next Generation of Change Agents in College Mathematics Instruction. To appear in *Justice through the lens of calculus: Framing new possibilities for diversity, equity, and inclusion*. Voigt, M., Hagman, J. E., Gehrtz, J., Ratliff, B., Alexander, N. & Levy, R.(Eds.). Mathematical Association of America Notes series.

**Hufnagel, E.** (2022). Emotional Sense-Making and Critical Thinking in the Era of Post-truth: The Case of Climate Change. In: Puig, B., Jiménez-Aleixandre, M.P. (eds) *Critical Thinking in Biology and Environmental Education*. Contributions from Biology Education Research. Springer, Cham. [https://doi.org/10.1007/978-3-030-92006-7\\_3](https://doi.org/10.1007/978-3-030-92006-7_3)

Johnson, S. E., Song, W. J., Vel, S. S., Song, B. R., & **Gerbi, C. C.** (2021). Energy partitioning, dynamic fragmentation, and off-fault damage in the earthquake source volume. *Journal of Geophysical Research: Solid Earth*, 126, e2021JB022616. <https://doi.org/10.1029/2021JB022616>

Lech, P.L., **Fairman, J.C.**, McCormick, M.R., & Buxton, M.P. (April, 2022). *Strategies for Supporting Student Learning Needs during the COVID Pandemic in Maine and Other States*. Maine Education Policy Research Institute. <https://mepri.maine.edu/files/2022/04/MEPRI-Rpt-on-Strategies-Supporting-Students-042522.pdf>

Louie, J., Buffington, P., Fagan, E., Fitzgerald, B., Roche, B., **Sezen-Barrie, A.**, & Waterman, K. (2022, May). Weather X: Building Data Literacy among Rural Youth. 2022 *STEM for All Video Showcase: Access, Inclusion and Equity*. <https://stemforall2022.videohall.com/presentations/2359>

Mays, M., **Stetzer, M.R.**, & Lindsey, B. A. (2021). “Supporting student construction of alternative lines of reasoning,” 2021 Physics Education Research Conference Proceedings (Virtual Conference August 4-5, 2021), edited by M. B. Bennett, B. W. Frank, and R. E. Vieyra, 277-282 (2021). <https://doi.org/10.1119/perc.2021.pr.Mays>

Meaders, C.L., Senn, L.G., Couch, B.A., Lane, A. K., Stains, M., **Stetzer, M. R.**, **Vinson, E.L.**, & Smith, M.K. (2021). Am I getting through? Surveying students on what messages they recall from the first day of class. *International Journal of STEM Education*. 8:49(1). <https://doi.org/10.1186/s40594-021-00306-y>

Mette, I. & **Fairman, J.** (2022). *MEPRI Survey Study of Maine School Administrators*. A report of the Maine Education Policy Research Institute (MEPRI). Orono, ME: University of Maine.

**Miller-Rushing, A.**, & **Hufnagel, E.** (2022) Trends in K-12 Teacher Agency Research: A Review of Science Education Research, *Journal of Science Teacher Education*, 1–24. <https://doi.org/10.1080/1046560x.2022.2037875>

Riihiluoma, W., Topdemir, Z., & **Thompson, J.R.** (2022). Using Network Analysis Techniques to Probe Student Understanding of Expressions Across Notations in Quantum Mechanics pp. 1124-1130 in Karunakaran, S. S., & Higgins, A. (Eds.). *Proceedings of the 24th Annual Conference on Research in Undergraduate Mathematics Education*. Boston, MA. <http://sigmaa.maa.org/rume/RUME24.pdf>

Riihiluoma, W., Topdemir, Z., & **Thompson, J.R.** (Accepted). Applying a symbolic forms lens to probability expressions in upper-division quantum mechanics, accepted for publication in 2022 *PERC Proceedings* [Grand Rapids, MI, July 13-14, 2022], edited by B. W. Frank, D. Jones, and Q. Ryan (2022).

**Sezen-Barrie, A.**, & Avraamidou, L. (2022). “A Different Kind of Middleman”: Preservice Science Teachers' Agency for Climate Change Education. In *Justice and Equity in Climate Change Education* (pp. 174-197). Routledge.

**Sezen-Barrie, A.**, Henderson, J.A., & Drewes, A.L. (2022). Spatial and temporal dynamics in climate change education discourse: An ecolinguistic perspective. In: Puig, B., Jiménez-Aleixandre, M.P. (eds) *Critical Thinking in Biology and Environmental Education. Contributions from Biology Education Research*. Springer, Cham. [https://doi.org/10.1007/978-3-030-92006-7\\_11](https://doi.org/10.1007/978-3-030-92006-7_11)

Silverbrand, S.J., **Lindsay, S.M.**, & Rawson, P.D. (2021). Detection of a novel species complex of shell-boring polychaetes in the northeastern United States. *Invertebrate Biology*, 140(3): e12343. <https://doi.org/10.1111/ivb.12343>

Silverbrand, S.J., **Lindsay, S.M.**, & Rawson, P.D.(2021). Project 3813: Detection of a novel species complex of shell-boring polychaetes in the northeastern United States. *Invertebrate Biology*. 140 (3). Morphobank, [https://morphobank.org/index.php/Projects/ProjectOverview/project\\_id/3813](https://morphobank.org/index.php/Projects/ProjectOverview/project_id/3813)

Speirs, J.C., **Stetzer, M.R.**, Lindsay, B.A., & Kryjevskaja, M. (2021), Exploring and supporting student reasoning in physics by leveraging dual-process theories of reasoning and decision making. *Physical Review Physics Education Research*, 17(2), 020137. <https://doi.org/10.1103/PhysRevPhysEducRes.17.020137>

Appendix I. Courses offered by the RiSE Center, FY22

Semester	Title	Professor	Enrollment	Credit Hours
Summer 2021	SMT 699 Graduate Thesis/ Research	Susan McKay	7	8
Fall 2021	SMT 504 Integrated Approaches in Earth Sciences Education II	Elizabeth Hufnagel	5	15
Fall 2021	SMT 506 Integrated Approaches in Mathematics Education II	Justin Dimmel	5	15
Fall 2021	SMT 588 Science and Mathematics Education Research (Seminar)	Franziska Peterson	7	7
Fall 2021	SMT 589 Graduate Seminar	Franziska Peterson	7	7
Fall 2021	SMT 699 Graduate Thesis/ Research	Susan McKay	7	19
Fall 2021	MLA Professional Learning Sessions (1 hour weekly for first time MLAs)	Sara Lindsay Erin Vinson	40	0
Spring 2022	SMT 500 Educational Psychology with Applications to Science and Mathematics Teaching and Learning	Timothy Boester	7	21
Spring 2022	SMT 505 Integrated Approaches in Mathematics Education I	Natasha Speer	4	12
Spring 2022	SMT 590 Seminar for Teaching Interns	Susan McKay	3	3
Spring 2022	SMT 591 Secondary Student Teaching	Susan McKay	3	15
Spring 2022	SMT 598 Special Topics in Science and Mathematics Education	Jonathan Doty	5	5
Spring 2022	SMT 699 Graduate Thesis/ Research	Susan McKay	8	17
Spring 2022	MLA Professional Learning Sessions (1 hour weekly for first time MLAs)	Natasha Speer Erin Vinson	27	0

## Appendix J. Self-Study and Strategic Planning Process and Outcomes

### Input from Faculty, Staff, and MST Students for the Self-Study:

In order to better understand the strengths, weaknesses, opportunities and challenges that RiSE faculty, staff, and students notice, the RiSE Center Director scheduled two discussion sessions (July 28<sup>th</sup> and August 4<sup>th</sup>) and provided an anonymous survey that members could also use to provide input about these aspects of the RiSE Center. Below we list recurring themes from these meetings and surveys. An \* indicates that, although this viewpoint was expressed most often, the opposite was also expressed.

#### ***Strengths:***

The people (faculty, staff, and students) are the RiSE Center's strongest feature. [This point was made over and over again in discussions and surveys.]

The MST students are a close-knit group.\*

The RiSE Center has developed strong partnerships with high-need districts to retain STEM teachers.

The Maine STEM Partnership is a strength, and teachers have a very strong commitment to its communities.

The RiSE Center's statewide reach and impact are strengths.

The MST Program offers incredible opportunities for students, all fully paid for.\*

The Maine STEM Partnership makes effective use of virtual professional learning to connect people across the vast distances of Maine. The RiSE Center also provides wonderful in-person events.

RiSE is known as a place of expertise and quality.

The RiSE Center is nationally known for STEM education research.

Diversity of disciplines represented by the faculty, who really do collaborate with each other., is a strength \*

Preparation of MST graduates by requiring University TA experience, with ongoing mentoring to improve instructional knowledge is unusual in teacher preparation and is a strength.

The FIG-MLA Program has a huge impact on STEM teaching and learning at the University of Maine.

MST graduates and student teachers have built a very strong reputation for the program in Maine school districts.

The faculty and staff are very supportive of MST students.\*

Opportunities for graduate students to be part of grant-funded work in relevant ways are fantastic.

The RiSE Center provides a valuable, safe, supportive community for Maine in-service STEM teachers.

This Center offers such exciting interdisciplinary research opportunities for graduate students.

There are great graduate courses and teaching, done by faculty who are passionate about their field.

Full funding for students in the program, very unusual for those preparing to teach, provides access for those who otherwise could not afford graduate study.

RiSE has a statewide reputation for quality professional learning for teachers.

The RiSE Center has non-hierarchical, participatory governance.

This Center is a leader in changing teaching and learning in the STEM disciplines to more inquiry, hands-on learning.

Real strengths are the comradery, quality, and commitment of its staff.

RiSE is strong because of its egalitarian decision making.

***Weaknesses:***

The MST Program misses the balance between research and teacher preparation, by emphasizing research over preparing STEM majors to be teachers.

There is no orientation for new MST students.

The MST Program needs more pedagogical courses and classroom observation opportunities.

More math professional learning experiences are needed for in-service teachers.

Some students feel as if their voices are not heard and that faculty are too into meetings and research to check in with them.

The organization is too lean. If someone is sick or has to miss some work time, there is no one to cover for them, which is very stressful.

RiSE facilities are generally good, but there needs to be good technology in the conference room for projecting and active learning.

The Materials Warehouse in the basement of Estabrooke is an amazing space, but it is not part of the UMaine facilities cleaning responsibilities. This area does need to be cleaned regularly, since it is often part of RiSE Center tours and materials stored in this space need to go out to schools clean.

Some people wear too many hats in the RiSE Center and are overloaded.

There are fewer people around and less important spontaneous interactions due to covid. We need our vibrant, in-person culture back! (e.g. faculty attending RiSE Research Group)

***Opportunities:***

With the growth of engineering education on campus and in the state, there are opportunities for engineering education research faculty, more involvement with engineering and learning about engineering careers in PK-12 grades, and more innovations in teaching engineering. Additional faculty and staff could have a big impact here.

RiSE is at the leading edge of understanding teaching and learning and transferring this knowledge into classrooms through its research practice partnerships. More people could enhance the research and the transfer, both very important for workforce development.

More faculty and staff interaction with students.

Creation of student orientation and on-boarding; also on-boarding for faculty and staff.

Creation of a useful handbook for faculty, staff, and MST students.

Greater racial and ethnic diversity of students, staff and faculty; also greater diversity of research interests.

Additional elective courses offered by RiSE faculty.

Additional hands-on inquiry in STEM across state.

Support for teachers and districts building community connections, environmental monitoring partnerships, and other community-based relevant science and engineering.

More need than ever to support STEM teachers. The current and future predictions of shortages are scary!  
Expansion of RiSE professional staff due to new grants and contracts.

More use of social media.

More connections with graduates from the MST Program.

Expanded involvement of RiSE as part of big initiatives / need more capacity to do this.

Make sure that all students are supported in adjusting to being a graduate student and (if applicable) moving to the Orono area, especially international students.

***Challenges:***

Recruiting STEM majors to be teachers. [Suggestions: use student organizations in the STEM departments. Many students and faculty are unaware of the MST Program]

Hiring professional staff quickly (and still getting quality people) when new grants and contracts are awarded.

Changing the way that long-term partnerships with schools and professional learning offerings are viewed in faculty activity reports and by peer committees. This work is usually called service, where it is certainly a part of scholarship, assuming that it appropriately scholarly.

Having more RiSE faculty with joint appointments or other arrangements so that RiSE governance and other work is not just a voluntary, added on responsibility.

Sustaining important, high-impact grant-funded programs.

Effectively and efficiently fund raising – We know that there are interested donors out there, but it is hard to find and follow up with them.

Internal and external communication

Increased competitiveness for grant dollars.

Publicizing and increasing attendance at RiSE Center colloquia and other events.



Real need for a Communications Specialist! This needs to be someone's full-time job.

The challenges that some faculty face in being able to devote time to RiSE-related work because of the needs of their home departments. Many STEM departments are also very short-handed. This makes it difficult to have the Center and the work it does be representative of all members because not all members have the same opportunities to contribute to governance and to be involved in projects.

### Strategic Planning at the RiSE Center:

During this review period, the RiSE Center has followed a process of dynamic strategic planning, meeting 2-4 times per year, although the gatherings has been reduced and become virtual during the pandemic. An outgrowth of these discussions has been the identification of key strategies for the RiSE Center and committees to support them. The document below captures the flavor of this plan, although the details will be discussed and then gradually implemented during the 2022-2023 academic year. Paralleling this process are the development of RiSE Center Bylaws and completion of a (virtual) Handbook of RiSE Center Policies and Procedures. In addition to full faculty and staff strategic planning meetings, run by a Strategic Planning Committee, the RiSE Center staff has continued to hold a couple of retreats each year, to get to know colleagues better, understand the work that others are doing, review progress toward meeting shared goals, and set new shared goals for the coming year.



## Key Strategies and Committees

RiSE faculty and staff worked as a group in Spring 2019 to identify four key strategies for the RiSE Center. These strategies were selected from the larger set of strategies in our strategic plan, based on our discussion about strategic priorities. Selection of these four was unanimous. We also identified RiSE committees and tasked them with moving each key strategy forward.

**Key Strategy 1:*****Support RiSE faculty in their diverse education research priorities/pursuits***

Committee overseeing this strategy: Research Committee

Some specific things to do as part of this strategy:

- Clarify RiSE faculty requirements and benefits
- Support faculty in navigating grant functions (for instance, using the GL, MaineStreet, PeopleSoft)
- Support faculty in navigating IRB, FERPA, Data Management, etc.
- Clarify for RiSE faculty what resources are available through the RiSE Center and how to get access to those resources (e.g., staff time, for what, how)
- Build capacity for sustainable staff time to support and collaborate with faculty

**Key Strategy 2:*****Improve internal and external communications about our work, impacts, capacity, and successes***

Committee overseeing this strategy: Communications Committee

Some specific things to do as part of this strategy:

- Improve communications within RiSE, on campus, and beyond campus
- Increase awareness among RiSE faculty about who does what for research
- Add staff capacity for marketing and communications
- Support more synthesis/summary of research (for the lay-person)
- Showcase our work for the local campus for other STEM colleagues (perhaps through the June conference)
- Connect to campus efforts to increase awareness/communication between STEM faculty/staff across campus
- Develop a research portfolio of the work we do and a set of materials (web posts, fact sheets, etc.) to disseminate information about our research
- Communicate with legislators and hold an event to inform them about our work
- Leverage the marketing resources of the university
- Continue/expand mailing list for our newsletter

**Key Strategy 3:*****Provide research-based and evidence-based professional learning opportunities and access to professional communities for STEM educators at all levels of instruction***

Committees overseeing this goal: Professional Learning Committee and MST Curriculum Committee

Some specific groups to consider and things to do as part of this strategy:

- For MST students
- For Maine Learning Assistants
- For STEM faculty
- For STEM teachers
- Provide high quality coursework experiences for STEM educators (both pre-service and current)
- Support research collaborations (internal and with external partners)

**Key Strategy 4:**

*Increase organizational efficiency and sustainability by creating a governance/operations manual for RiSE that describes the role of the exec committee, standing committees, decision-making and leadership, etc.*

Committee overseeing this strategy: RiSE Governance Committee

In addition to the Governance Committee, ad hoc committees of RiSE faculty and staff will help complete portions of this Manual. For example, a current ad hoc committee with members Michael Wittmann (chair), Sara Lindsay and Justin Dimmel is drafting ideas for RiSE promotion and tenure guidelines.

Additional ad hoc committees to be formed as needed to address key governance topics – for example, one ad hoc committee will need to address how to access RiSE staff for grants and how grants are pursued within the Center.

**RiSE Executive Committee (This committee is already established and functioning.):**

*The RiSE Executive Committee meets as needed to discuss/make decisions on behalf of the Center, with input from other RiSE personnel as needed.*

Members of the executive committee are to include (a) representatives from both faculty and staff and (b) at least one representative from each RiSE committee, so that the Executive Committee can be updated on committee progress at each meeting. It would be great to spell out the role of the executive committee in more detail in the governance manual (see Key Strategy 4 ☺)

Current members of the executive committee: Susan McKay (chair), Mitchell Bruce, Justin Dimmel, Sara Lindsay, Eric Pandiscio, Franziska Peterson, Natasha Speer, MacKenzie Stetzer, and Marina Van der Eb

Appendix K. Map of School Districts Partnering with RiSE through the Maine STEM Partnership

