



Maine Center for Research in STEM Education (RISE Center) University of Maine Annual Report July 1, 2021 – June 30, 2022

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I. Maine Center for Research in STEM Education (RiSE Center) Mission & 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. **Goals:** From its core emphasis on STEM Education Research, the RiSE Center reaches out to foster Community Partnerships & Innovative Collaborations, provide Graduate Education for STEM educators & researchers, and sustain a Statewide Professional Community using research to improve STEM education.

Overview of RiSE Center Key Performance Areas and FY 2022 Highlights

 <p>STEM+C Researcher and Teacher build a soil moisture sensor using arduinos</p>	<p>STEM Education Research Within and Across Disciplines</p> <p><i>RiSE Research Portfolio:</i> 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 & Publications:</i> 32 works published or accepted, with 8 additional submissions awaiting decision. No change from FY 2021 and greater 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 third project building partnerships among researchers and educators to enhance K-12 instruction with authentic research related to ocean sciences. Existing partnerships that integrate computing with science curricula, and emphasize quantitative reasoning related to forestry are thriving.</p>
 <p>RiSE Materials support science learning</p>	<p>Community Partnerships & Innovative Collaborations at All Educational Levels:</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 >5,400 students with opportunities to learn science through engaging, research-supported science activities. 14 new teachers were added to the program.</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>Graduate Education for STEM Educators and Researchers</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.</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.</p>
 <p>NSF Teaching Fellows & Mentors</p>	<p>Statewide Professional Community Using Research to Improve STEM Education</p> <p><i>Maine STEM Partnership:</i> 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.</p> <p><i>NSF Teaching Fellowship Program:</i> 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.</p> <p><i>RiSE Center Faculty & Staff:</i> Dr. Heather Falconer, Dept. of English, joined the RiSE Faculty who now number 22; 9 staff members (6.4 FTE) support all Center activities.</p>

II. Efforts to improve diversity, equity and inclusion

RiSE Center faculty and staff contribute to local and national efforts to improve diversity, equity and inclusion. **Dr. 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), **Dr. 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 **Maureen Raynes** and **Yadina Clark** began creating 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 **Dr. Susan McKay** co-chaired the President's Council on Diversity, Equity and Inclusion. At the RiSE Conference, **Dr. Sara Lindsay** shared strategies for helping students build science identity with K-16 teachers from across the state. **Dr. Heather Falconer's** book, *Masking inequality with good intentions: Systemic bias, countspaces, 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 teaching in high-need districts during the 2021-22 school year, with one entering the profession during this year.

III. RiSE Center Key Performance Areas & Indicators with FY 2022 Highlights & Trends

Goal: Conduct and Sustain STEM Education Research Within and Across Disciplines

RiSE Research Proposals: RiSE Faculty and Staff (see Appendix 1 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 2 and 3 respectively.

Research Practice Partnerships: With new NSF funding through the ITEST-DTI program, RiSE faculty and staff added a third 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 FY 2021 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 4. RiSE faculty and staff shared their research in 34 different presentations at international, national, regional, state and other venues, many virtual.

Goal: Foster Community Partnerships & Innovative Collaborations at All Educational Levels:

The RiSE Center continues to sustain and enhance the **Maine STEM Partnership**, a statewide STEM education Improvement Community for PK-16+ educators.

The **RiSE Materials Warehouse**, a key component of the Maine STEM Partnership, 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 >5,400 students with opportunities to learn science through engaging, research-supported science activities.

Fourteen new teachers were added to the program this year, impacting an additional 600 students. RiSE Resource and Professional Development Coordinator **Beth Muncey** oversaw this effort that included packing over 900 bins of hands-on science materials and coordinating logistics for teachers across the state to exchange materials, to leverage these science materials as a shared statewide resource.

FIG-MLA Program: The Faculty course modification Incentive Grant-Maine Learning Assistants program (FIG-MLA program) employed 125 undergraduate peer learning assistants who 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. In the last five years, an average of 128 students served as MLAs annually, directly impacting on average 5,407 students per year.

Goal: Provide Graduate Education for STEM Educators and Researchers

Student Mentoring: Graduate and undergraduate students are integral to the center's research and last year RiSE faculty provided 144 graduate student credit hours in the MST program in 13 courses (see Appendix 5) 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. RiSE Faculty mentored an additional 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.

Professional Learning: 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. This is significantly greater than the annual average of 4839 participant hours of professional learning provided by RiSE in the last three years.

Goal: Sustain a Statewide Professional Community Using Research to Improve STEM Education

Maine STEM Partnership: 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 a rich 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. Participation in the RiSE Conference increased significantly from FY2021 (70 participants), rebounding to pre-pandemic attendance levels.

NSF Teaching Fellowship Program: Launched in 2017, the prestigious NSF Teaching Fellowship Program, designed to help meet Maine's workforce need for science and mathematics teachers in high-need districts, had 16 fellows teaching in high-need districts during the 2021-22 school year, with one entering the profession during this year. Sixteen fellows and three graduates of the program taught in high-need districts during the 2021-22 school year, with one entering the profession during this year. Optional leadership professional learning was available to Fellows with two or more years of teaching experience. Nine Fellows took advantage of these five unique opportunities and attended a combined total of 179 hours of meetings. Looking to the future, 4 teacher mentors participated in leadership team planning to sustain the program beyond grant funding.

RiSE Center Faculty & Staff: The impressive basic and applied research, teaching and outreach conducted by the Maine Center for Research in STEM Education relies on the activities of its talented faculty and staff (Appendix 1). This year, **Dr. Heather Falconer**, Department of English, joined the RiSE Faculty who now number 22. Dr. Falconer brings important cross-disciplinary research expertise related to student success in STEM disciplinary writing. In addition, nine staff members (6.4 FTE) support all Center activities. Although the number of RiSE faculty and staff has been growing or stable for the last three years, several key staff positions are currently in transition, and **Dr. Robert Franzosa** entered a phased retirement while **Dr. Michael Wittmann** and **Dr. Asli Sezen-Barrie** have been on leave with the American Physical Society and National Science Foundation, respectively.

IV. RiSE Center activities support University of Maine Strategic Vision and Values

Fostering Learner Success

Undergraduate Student Experiential Learning Initiatives: Since 2012, the RiSE Center's **FIG-MLA program** has supported 71 different instructors in 16 departments as they modified 52 different courses to implement evidence-based teaching methods with the help of 564 undergraduate Maine Learning Assistants (MLAs), enhancing the learning and success of 40,597 students enrolled in those classes. This year, out of 125 total MLAs, 66 were first-time

MLAs who participated in weekly professional learning sessions offered by **Erin Vinson, Dr. Sara Lindsay and Dr. Natasha Speer** to support their professional growth in providing peer instruction. 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. **Dr. 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. **Dr. Christopher Gerbi** developed and taught RLE course, RLE 150, Sharing Geoscience on Maine's Public Lands in Fall 2021. **Dr. John Thompson** served on the Gateways to Success working group. **Dr. Mitchell Bruce** and colleagues published a paper documenting their success in developing and delivering hands-on chemistry labs to remote students during the pandemic. **Dr. 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. **Dr. Elizabeth Hufnagel** collaborated with Asa Adams and Old Town Elementary School principals and teachers to set up a teaching clinic for ESC 316 students to have practice teaching science to elementary students in a school setting.

Graduate Studies Impact: Five MST students completed their theses and graduated this year, with **Hazel Cashman**, who completed her student teaching at Orono High School, selected by RiSE faculty as the outstanding graduate student in May 2022. MST students participated in a variety of opportunities for professional and career-development through grant-funded projects, teaching assistantships in STEM courses, and teaching placements in middle and high-schools including Portland High School and the Rose M. Gaffney School in Machias. **Dr. 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.

Discovering and Innovating

RiSE members have had another outstanding year of research and scholarship (see section III and Appendices 2, 3, 4). From immersive mathematics in virtual environments to immersion in authentic marine research on the coast of Maine recent grants to RiSE Center faculty will support teaching and learning in STEM disciplines throughout the state. **Dr. Justin Dimmel** was awarded an NSF CAREER award to investigate how three-dimensional figures are represented in high school geometry textbooks, how teachers communicate about three-dimensional geometries in their classes, and how manipulating spatial and physical models in a real-time immersive environment contributes to student learning about geometry. Funded by the NSF ITEST program, **Dr. Susan McKay (PI), Dr. Sara Lindsay, Dr. Franziska Peterson, and Marina Van der Eb (Co-PIs)** will work with teachers & administrators from RSU71 in Belfast, Maine over the next four years to engage coastal Maine teachers and students in coastal monitoring and research using technology to help students build data literacy and communication skills, as well as awareness and readiness for marine-related careers. **Dr. MacKenzie Stetzer and Dr. Natasha Speer** continued to support faculty awarded seed grants to modify undergraduate courses through the Maine eDNA RII-Track 1 EPSCoR grant; several recipients shared their work at the RiSE Conference. With support from a CLAS Pre-Tenure Faculty Research and Creative Activity Fellowship, **Dr. Franziska Peterson** will complete key research to support the RII-Track 2 INSPIRES grant that investigates teachers' knowledge about quantitative reasoning related to forestry. RiSE Program Evaluation Specialists **Laura Honders and Christina Siddons** led efforts to publish findings from the NSF-funded STEM+C program that integrated computing and computer science in middle level science curricula. **Dr. Elizabeth Hufnagel** developed and taught a new course, ESC 556 Climate Change Education, for the M.Ed. CA&I program for practicing teachers. Working with Gregory Ondo and Sam Hoey of UMaine Sculpture and Mitch Stone of the Town of Orono, **Dr. Justin Dimmel and Dr. Eric Pandiscio** designed a public art installation for Webster Park in Orono, ME, the Sun Rule, that will explore connections between math and art.

Growing and Expanding Partnerships

RiSE Center activities focus on building partnerships. Through the Maine STEM Partnership, RiSE Materials Warehouse, NSF Fellowship program, the RiSE Summit and RiSE Conference, as well as several grant-funded initiatives, the RiSE center supported professional learning for more than 290 unique K-12 educators this year, representing more than 5600 participant hours. The RiSE Materials program added one school district, 14 new teachers and impacted an additional 600 students (see Appendix 6). **Dr. Franziska Peterson**, with **Dr. Susan**

McKay and Elizabeth Byers Small, initiated a 2-year partnership with RSU 63 (Eddington Elementary, Holden Elementary, and Holbrook Middle School) to review and analyze NWEA student data to inform, plan and implement personalized professional learning that builds K-8 teachers' math education confidence and improves formative assessments of student learning. Educators from RSU34 (Old Town, Alton, Bradley) are interested in creating a similar partnership. **Dr. Timothy Boester** worked with high school teachers as part of the Division of Lifelong Learning Precalculus program, bringing curriculum and assessment updates to the high schools involved in MAT 122, including repackaging tests at the college level for the high school course pacing. Within the state, **Dr. Janet Fairman** serves as Co-Director for the Maine Education Policy Research Institute, providing education research and policy analysis to the Education Committee of the Maine State Legislature; **Dr. Susan McKay** serves on the MEPRI Steering Committee. **Dr. Asli Sezen-Barrie** worked with nonprofit Educational Development Corporation to engage rural students in ME and NH in working with data. The RiSE Center continued to support teachers in ME, NH and VT to integrate quantitative reasoning in forestry contexts and big data in their instruction through the EPSCoR RII-Track 2 INSPIRES grant.

V. Preserving/Restoring Infrastructure

Flooring on the first floor of the RiSE Center in Estabrooke Hall was replaced after it became badly damaged.

VI. Summary of Anticipated Challenges

As RiSE grant-funded activities increase, we need to hire more personnel, particularly a communications specialist and research coordinator. 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. 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).

VII. Summary of New initiatives and Opportunities

In addition to the numerous projects and activities already described, the RiSE Center is contributing to several significant initiatives on campus, including providing evaluation support for the proposed Innovations in Graduate Education project, Transdisciplinary Curricula that Integrate Microbial, Social and Environmental Equity to Promote Transformative Research and the NIH proposal, Aging Disparities - Mentoring, Immersion, Research, and Education (ADMIRE) Program. In addition, the FIG-MLA leadership team has been working with the UMS TRANSFORMS Gateways to Success team to leverage our experience implementing a successful learning assistant program and support the upcoming system-wide pilot initiative to foster student success in gateway STEM courses across the system. Building on the CAEP accreditation of the MST Program and prior strategic planning, the RiSE Center developed a new committee structure to streamline its work and involve more members in governance. This dynamic strategic planning process will continue in 2022-2023.

VIII. Carnegie RI 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). 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. RiSE faculty and staff collaborate with researchers across the nation and around the world, enhancing the visibility and reputation of the University.

Appendix 1. RiSE Center Faculty and Staff, FY 2022

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	Assistant 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	christopher.gerbi@maine.edu
Hufnagel, Elizabeth	Assistant Professor, School of Learning and Teaching	elizabeth.hufnagel@maine.edu
Lindsay, Sara	Assistant Director of the RiSE Center and Associate 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	asli.sezenbarrie@maine.edu

	Teaching	
Speer, Natasha	Associate Professor, Mathematics	speer@math.umaine.edu
Stetzer, MacKenzie	Associate Professor, Physics and Astronomy	mackenzie.stetzer@maine.edu
Thompson, John R.	Professor of Physics / Department Chair, Physics and Astronomy	thompsonj@maine.edu
Wittman, Michael	Professor of Physics	mwittmann@maine.edu

RiSE Affiliated Staff:

Name	Title	Email
ByersSmall, Beth	NSF Teaching Fellowship Program Coordinator	elizabeth.byerssmall@maine.edu
Clark, Yadina	Administrative Specialist CL3	yadina.clark@maine.edu
Honders, Laura (through May 2022)	Research and Evaluation Coordinator	
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
Shulman, Deborah (through January 2022)	Professional Learning Coordinator	
Van der Eb, Marina	Maine STEM Partnership Coordinator	marina.van@maine.edu
Vinson, Erin (through May 2022)	Campus Programs Coordinator	

Appendix 2. Funding Awarded to RiSE Center Faculty and Staff, FY 2022

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	Honders, Laura (Sr. Pers.) 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 3. Continuing Funding Awarded to RiSE Faculty and Staff, FY 2022

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	Honders, Laura (Sr. Pers.) 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 4. Published and Accepted works by RiSE Center Faculty, Staff and Students, FY 2022
(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

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

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

Speirs, J.C., **Stetzer, M.R.**, Lindsay, B.A., & Kryjevskaiia, 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 5. Courses offered by the RiSE Center, FY2022

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 6. Map of School Districts Partnering with RiSE Through the Maine STEM Partnership

