

Annual Project Report 5, 2013 [NSF Award 0831974]

Cover

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Accomplishments

* What are the major goals of the project?

Our *broad goals*, as stated in the RITES proposal, remain unchanged. They are:

- 1 Increase the number and diversity of students who are proficient on state science assessments and who pursue STEM careers;;
- 2 Develop and provide high quality teacher professional development and teacher preparation inclusive of inquiry, technology use and research based strategies;;
- 3 Implement rigorous, inquiry- based, technology enhanced secondary science curriculum materials statewide;;
- 4 Provide evidence- based outcomes through integrated research and evaluation that support ongoing program improvement and development;; and,
- 5 Sustain program impact through a partnered model that includes secondary school through higher education and private sectors, committed to science education. Moreover, as stated in previous year's annual reports these efforts are carried out in the service of three overarching goals.

Goal 1 Partnership. Develop a partnership centered around the K- 12 and HE communities, but inclusive of other stakeholders that has a shared vision for the improvement of STEM education throughout the state (*broad goals 1 & 5*);;

Goal 2 Professional Development. Deepen science content knowledge and enhance the use of science practices for middle and high school students through a rich offering of professional development (PD) and technology enhanced materials for middle and high school science teachers (*broad goals 2 & 3*);; and,

Goal 3 Documentation. Document our successes and challenges in these efforts, in a manner that informs other STEM initiatives (*broad goal 4*).

The following sections chronicle our progress in Year 5, in terms of these three goals. For each of the four NSF Accomplishment categories (Major Activities, Specific Objectives, Significant Results and Key Outcomes), we have listed what if any contributions occurred from each of our three overarching goals. The following sections chronicle our progress in Year 5, in terms of these three goals. Attached are two appendices. Appendix 1 contains figures and tables that support assertions made in "Accomplishments";; Appendix 2 contains photographs that provide context for statements about the RITES investigations made in "Accomplishments". Finally, following the appendices, the external evaluation report for year 5 is attached.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

In order to achieve the objectives of this goal, we focused on the following activities. The rationale for these efforts are described under “Specific Objectives”, and the outcomes are listed under “Significant Results...” and “Key Outcomes...”

1. Professional Development (PD). The PD program serves a dual purpose, as not only the vehicle for not only improving teacher competency, but also as the foundation of the RITES partnership, for it has played a major role in bringing together the Core Partner Districts’ administrators, who share strategies and resources through the Partnership Committee.

This very tangible aspect of the program serves as a catalyst for our multi-layer model of partnership. It brings together faculty from HE and 6-12, who develop a very personal, and yet powerful level of partnership, which proved to be effective in changing practices in both environments. It is a point of connection for the RITES School Council, which in turn expands discussions and sharing well beyond the existing PDs, so teachers collaborate in seeking practical approaches to benefit all districts, and sharing tools that range from teacher evaluation tools to inquiry rubrics.

2. Round tables. This year RITES initiated a series of quarterly conferences, called Roundtables, in which HE and K-12 stakeholders met to freely share their needs, and the ways in which they could collaboratively attain them. Other stakeholders involved in informal science education (e.g., the Roger Williams Zoo) were encouraged to, and did, participate. As discussed below, this activity has provided a platform for some of the efforts of the State Leadership Team for the NGSS implementation (this group offered feedback to NGSS writers during the development phase of the new standards). RITES is heavily represented on that state committee.

3. Other activities included the following: In Year 5, extended efforts for collaboration were implemented through outreach to other initiatives in the state. RITES joined forces with GEMS-Net (a project started with an NSF grant and now funded by districts) to bring Betsy Rupp Fulwiler, an expert in the field of science literacy, to RI for a day-long workshop and also partnered to develop a short course on the topic of writing in the science classroom. We introduced Providence to GEMS-Net in order to offer inquiry opportunities at the elementary level. At URI, we reached out to the state EPSCoR initiative to connect with their existing networks of partners;; we contributed heavily to a new collaborative effort among several of the schools within the university, called the Collaborative Explorations in Mathematics and Science. At Rhode Island College, we participated in planning meetings for a new laboratory district initiative, which strongly links the college to the Central Falls district, transforming the educational model in the district and the College – Central Falls is a RITES district. We also established collaboration with New England Science and Sailing (NESS) to link Core Partners to community resources and worked collaboratively to create opportunities for students to do authentic research and deepen content knowledge.

Goal 2 Professional Development

As in previous years our PD program for middle and high school STEM teachers was the primary mechanism for enhancing teacher content knowledge and pedagogical proficiency, ultimately improving STEM literacy in RI. It consists of summer workshops and other activities that strengthen the science content of teachers, promote best teaching practices, and introduce teachers to cutting edge technology.

PD activities of note during Year 5 include:

- 1 Summer Institute - Three week long summer institute with 16 course offerings addressing life, earth and space, and physical science, including special courses on writing in the science classroom and engineering in the science classroom. In total, 139 teachers representing 18 RI school districts attended this institute in Year 5.
- 2 Fall and spring conferences - two all day Saturday workshops, pulling RITES teachers together as a professional learning community to improve science teaching and learning. Breakout sessions and workshops were lead by teachers and higher education partners.
- 3 The *Artifact* - Teachers develop as professionals by reflecting on the impact of RITES resources, primarily RITES investigations in their classrooms. The artifact is an opportunity for teachers to collect classroom data, share it with other educators and use it to guide and inform instruction. Teachers present their artifacts to one another at the Spring Conference.

Significant Objectives:

- 1 Writing in Science Workshop - Full day writing in science workshop with nationally recognized leader in the field, Betsy Rupp Fulwiler, engaging 123 RI science teachers.
- 2 Short courses offered during the academic year – RITES provides a selection of its summer session workshops during the school year for RITES teachers who cannot attend during the summer.
- 3 Core District PD - RITES provides specialized professional development to core partner districts. These opportunities vary depending on the requests of the teachers and building/district leaders. The following is a list of the different types of PD we have contributed to in collaboration with our districts this year: (1) Collaboratively developed field-based units that allow students to act as scientists by collecting, displaying and analyzing data - Westerly and Cranston;; (2) Forming essential questions for unit planning and providing model lessons - Johnston;; and Coaching workshops for teacher leaders – Providence;; and (4) Thinking Like a Scientist Workshop for HS science teachers – South Kingstown.

4 Resource Team Meetings – Training for master teachers and HE partners through the development of short courses and RITES Investigations/Activities.

5 The creation of Investigations - computer- based activities that make appropriate use of technology in the service of creating inquiry- based learning activities. These activities exist online, and are freely available to the STEM community;; links to the investigation portal are provided in the next section “Products: websites.”

Goal 3 Documentation

As a mature project in Year 5, RITES has developed several methods to document its success, in ways accessible to various STEM communities. Please see "How have the results been disseminated to communities of interest?" below for a complete listing of methods. The most significant documentations of this year are:

- 1 Scholarly publications. RITES saw its first publications by faculty this year. See “Products: Publications.”
- 2 Conference presentations. RITES presented the results of research at eleven national and regional science and educational conferences. See “Products: Publications.”
- 3 Science Inquiry Report, March 2013. Published on the RITES website, this report documents that students of RITES teachers scored significantly higher than their non- RITES counterparts on the inquiry section of the state science exam. See “Products: Websites”.
- 4 Pre- post content assessments. RITES used pre- and post- tests from the AAAS and MOSART item banks to track the learning gains of both teachers who participated in RITES PD and students who subsequently took courses from them. The average normalized learning gain for teachers was 0.39 and for students 0.44, both relatively high gains.

Goal 1 Partnership

A major objective of Year 5 was to insure that the diversity of the participants in RITES mimics that of the state’s student population. We had two other objectives this year, the intent of which was to further strengthen the RITES partnership. The first pertains to the professional development model for crafting the PD program, which coupled with the inclusion of K- 12 teachers in all aspects of the PD formed the foundation of the RITES statewide partnership. The second objective was to strengthen this RITES partnership, so that it extended well beyond our core partners, and included not only the K- 12 community, but all HE (public and private) institutions and other non- traditional STEM stakeholders in Rhode Island. These objectives are entirely consistent with the stated goals of the proposal, in which we argued that a successful five- year effort would result in a statewide, shared vision of science literacy in the state. We have met all of these Goal 1 Objectives for Year 5, as evidenced by the “Significant Results” and “Key Outcomes” listed in following sections.

Goal 2 Professional Development

A major objective of Year 5 was to have completed and updated all Investigations and other PD materials mentioned in the original proposal. We have met this goal. Additionally we had two other objectives, both of which dealt with realigning our PD so as to be compliant with Common Core Standards and Next Generation Science Standards. Objective 1: Address NGSS Science and Engineering Practices

In response to Rhode Island’s early adoption of the Next Generation Science Standards, RITES goal this year was to provide models and promote discussion on how participants could rethink their science curriculum based on the NGSS Framework. RITES focused on introducing the Science and Engineering Practices through curricular examples and model teaching.

The goal was to communicate the difference between the *traditional* use of lab experiences to demonstrate scientific content from the *NGSS process* of engaging in science and engineering practices around a specific topic to construct and deepen scientific knowledge. RITES resource teams used both the investigations and the short courses as platforms for modeling this difference and discussing the shifts in teaching and impacts on learning that would result.

Objective 2: Connecting to the Common Core Standards for Writing in the Science Classroom

RITES also identified the need for professional development connected the Common Core standards for reading and writing in the science classroom. RITES asked all resource teams to find opportunities in the short courses and in their investigations/activities to have teachers and students engaging in scientific writing. A short course was designed, in partnership with GEMS- Net, to provide teachers with strategies for strengthening and using scientific writing to deepen scientific thinking.

Both objectives were met.

Goal 3 Documentation

1. For teachers participating in RITES PD, the following data were collected and analyzed:
 - 1 Learning gains
 - 2 Satisfaction Surveys

2. For students, the following data were collected and partly analyzed:
 - 2 Learning gains for students whose teachers used RITES investigations in their classes (heretofore referred to as “RITES students”).
 - 2 Comparison, in a few instances, with students who cover the same content material, but with it presented in a traditional manner
 - 2 Correlation of learning gains for various socioeconomic groups (in progress)
- 2 4. NECAP results We are identifying those aspects of RITES that have the desired impact.

Goal 1 Partnership

The most significant lessons learned by RITES, all of which will benefit both the MSP and larger STEM communities, are summarized below. The results substantiate two aspects of the growth of the partnership. The first — the **professional development model (PD)** — documents the success of our model for PD that includes K- 12 and HE teachers working together, as equals, to develop our summer program. This collaborative effort formed the foundation for the growth of a statewide partnership involving all STEM stakeholders;; its successful growth is summarized immediately below. The second aspect is described under the following section, titled **Partnership**. Lastly, The progress RITES has made in terms of its commitment to diversity concerns is addressed.

Professional development (PD) model, as it pertains to partnership building – The “interconnected model of partnership for change and sustainability” proved the key strategy to achieving scale [state- wide implementation] within a four- year time span. The phrasing is taken from the evaluator’s year four report, and refers to the interconnecting of inquiry practices, PD, and materials & resources through the multi- layered partnership in the project. Most reform efforts do not achieve full scale in a few years – several years are usually necessary. RITES reached essentially “statewide implementation” (more than 70% of schools, of districts, and of science teachers participating in the project) in four short years.

Statewide partnership – In our effort to develop RITES to its present level as a statewide project, we designed a multi- tiered partnership model, where hundreds of teachers participate in sharing and networking at one level, while smaller groups of faculty members and administrators make deeper connections through leadership committees. Resource Teams, for example, provide a medium for collaboration between HE and K- 12 faculty. Our data indicate that collaboration between HE and K- 12 faculty is not only effective as a mechanism to develop high quality materials, but also is in itself a PD opportunity for the developers, both in HE and K- 12 (cf. manuscript by Knowlton et al, listed in Publications). Other key structures in RITES are the School Council and the Leadership Committee, both of which are described in an earlier section of this report. Since year 1, we have used the PRISM rubric to assess the growth and health of partnership. Based on that rubric, RITES reached high scores on the PRISM scale in year 4 of the grant, and partners became fully responsible for continuation efforts, taking ownership of the project.

In Year 5, other, extended efforts for collaboration were implemented through outreach to other initiatives in the state;; they are listed under Activities.

Teacher Quantity and Quality – RITES grew from one core district to six by year four, and one more has joined in year 5. With 27 districts and over 500 science teachers, RITES has reached a critical mass and is truly statewide by any measure.

Student Diversity – RITES collects student demographic data through the RI Department of Education’s data warehouse and for the seven core district partners this is supplemented by data- sharing agreements. These data indicate that RITES students largely reflect the state distributions for student populations of minority (non- white), socioeconomic, special needs (measured by IEP), and ELL status. By cross- referencing these data with school- level usage data, we can verify that RITES’ materials use and learning effects (see next section) are equitable and accessible to all student populations.

Goal 2 Professional Development

- 1 Curriculum support materials, targeting a few points in the curriculum for deeper engagement in inquiry/science practices, can result in significant improvements in teacher and student inquiry/science practices across the disciplines. The approach of adding these aligned opportunities, rather than restructuring complete curricula, enabled quick adoption of RITES in many districts, and it will facilitate a successful “transition” to NGSS.
- 2 Significant gains in the inquiry section of the NECAP are observed for RITES students after teachers complete at least one full PD cycle (two years). The NECAP analysis report states the following: “Consistently, students who received science instruction from a RITES- trained teacher had significantly higher scores on the state assessment of science inquiry skills, even after controlling for the effects of poverty, minority group membership, special education and Limited English proficiency status. This pattern was found at Grade 8 and Grade 11 in core districts in which data on the students of RITES trained and untrained teachers were available (Providence, Cranston, and Johnston).” (Brand, 2013). To a large extent, this outcome validates the initial design of the project, which focused on teachers, or used teachers “as a proxy for students.”
- 3 The PD program had impacts on teacher gains in content, inquiry/science practices, technology, and best practices, and led to measurable improvements in the same areas for students in the classroom.
- 4 Our Investigations all contain proprietary software (developed by the Concord Consortium and RITES staff) that allows students and teachers to analyze a variety of scientific data, collected with probes or generated through

models (see Products section). Originally written in Java code, we are converting all investigations to HTML 5.1, so that our programs will be platform independent, and capable of running on mobile devices.

5 The Investigations and other RITES materials can be freely accessed at our portal, which is described in the Website section.

Goal 3 Documentation

Our ability to capture changes in STEM literacy of students and teachers involved in RITES dramatically increased this year, in part because of data sharing agreements with our core partners. Because of their importance, documentation of observed changes are presented under “Key outcomes”.

Other significant results include: Key outcomes or Other achievements:

1 The value-added model and case studies are emerging as effective methods for identifying confounding variables and isolating the specific effects of RITES PD.

2 It is well known that a critical mass of teacher participation is necessary for school reform to be effective. RITES investigations of usage, as it correlates with teacher participation in RITES, may serve to determine at what point other reforms can expect to have a significant impact. RITES is also interested in doing data analysis to assess the optimal amount of inquiry done in the classroom, when balanced with the need to use other approaches for a complete set pedagogical approaches used.

3 These last few points are highly dependent on statistical analysis of complex data. RITES has the opportunity to do deeper analysis than most projects in Rhode Island could do in the past. This is because the project has greatly benefitted from a relationship of mutual trust built among all partners. Because of the nature of this partnership, the project was entrusted with both detailed demographic data and detailed results of state assessments that normally are not readily available. The key analyst and statistician in this work was uniquely positioned to deal with the nuances of the data, but that work has been hindered by his untimely death this summer. Moving forward, some of the previous work will need to be reconstructed by new analysts.

Goal 1 Partnership

In our effort to develop RITES to its present level as a statewide project, we designed a multi-tiered partnership model, where hundreds of teachers participate in sharing and networking at one level, while smaller groups of faculty members and administrators make deeper connections through leadership committees. These smaller settings include Resource Teams, the School Council, and the Leadership Committee. All of them have been described in previous sections. Starting in year 1, we used the PRISM rubric to assess the growth and health of partnership, and based on that instrument, RITES reached high level of partnership in year 4 of the grant, and partners became fully responsible for continuation efforts, taking ownership of the project that same year.

Goal 2 Professional Development

A key achievement is the completion of 41 Investigations that cover all aspects of middle and high school science curricula. They have gone through several cycles of usage and revision, and are ready to be used beyond the RITES community. We originally chose topics on the basis of high priority needs, as expressed by teachers. The partnership and RITES teachers are now engaging in re-developing the investigations within the NGSS framework.

Goal 3 Documentation

Since this goal overarches all aspects of the project, we organize this section to address the key NSF goals to which all MSP programs like RITES must adhere: *Teacher Quantity and Quality, Challenging Courses and Curriculum, Evidence-Based Design, and Institutional Changes and Sustainability.*

Teacher Quantity and Quality – RITES grew from one core district to six by year four, and one more has joined in year 5. With 27 districts and over 500 science teachers, RITES has reached a critical mass and is statewide by any measure. Note, that from the beginning RITES has been careful to engage urban, urban ring, and rural districts, and the diversity in RITES reflects the diversity of the state.

Most importantly, RITES impacts the quality of teachers. This is measured by gains in content knowledge for both teachers and students, by an increased use of best practices for teachers, and by gains in inquiry skills for students as measured on the NECAP statewide assessment. For content gains, we consider a 0.3 normalized learning gain significant. NECAP gains, on the other hand, are analyzed based on a more traditional statistical analysis, where 95% confidence makes a correlation statistically significant.

Challenging Courses and Curriculum – RITES PD includes technology-enhanced investigations developed to align with state standards. The emphasis of these investigations and of the rigorous short courses that teachers take during two summers is a fusion of deeper content knowledge, inquiry skills, and science practices. Teacher surveys reflect very high level of satisfaction (81- 100%) with short courses and both the Fall 2012 and Spring 2013 Conferences. Their short course pre- and post- content

assessments also show significant normalized learning gains (in 90% of classes, n=10, and 70% of students, n=270), and students of RITES teachers demonstrate statistically significant gains in inquiry skills, as well as gains in content knowledge. The evidence for the student gains in content knowledge on pre- post assessments is detailed in the Student Learning section below.

Student Learning – We collect five types of student- level learning data: pre- post investigation content assessments;; NECAP inquiry construct sub- set scores, as shown above;; investigation usage;; embedded investigation assessments;; and Reformed Teaching Observation Protocols – RTOP(Lawson, et al., 2002) for depth of inquiry. The evaluators from the Education Alliance further collect survey data on student motivation toward science and interest in STEM careers. The investigation usage and embedded assessments are used by RITES teachers for formative information to target instruction and by staff to support equitable access of materials across student populations. We developed a modified RTOP to focus on key areas of concern to partners. While initial results suggest RITES classes score above average, RITES is currently standardizing the results to the full RTOP.

NECAP data indicate that RITES students do significantly better than non- RITES students and these results are true even after controlling for the effects of poverty, minority group membership, special education and Limited English proficiency status. These outcomes are evident after teachers complete the full, two- year PD cycle;; for Providence, the pattern is evident after one year. This may be because in Providence the RITES PD was *mandated PD by the district*, rather than encouraged (but voluntary) as in other districts. This may cause the district to reach a critical mass of implementation sooner than other districts. On the other hand, it is also possible that in a stressed urban district, first year gains are more noticeable, but second- year gains will be even more meaningful, as in other districts.

Evidence- Based Design – As previously mentioned, RITES research and data collection relative to the PD and student learning have grown significantly in the second half of the project, and currently include the following instruments: 1) NECAP results;; 2) teacher satisfaction surveys;; 3) pre/post/post student and teacher surveys;; and 4) Modified- RTOP. Since Summer 2012 these data are consistently collected for RITES investigations. Together with data from the Department of Education [RIDE] and data- sharing agreements from core districts, these data were used to continuously modify our PD so as to meet both the common and the individual needs of the districts. We have accomplished this through the development of assessment cycle based on the work of Kubitskey (2006). An example of this cycle, as applied to the *Rock Cycle* Investigation, is shown here. The six research and evaluation activities keyed to the diagram, together with the four data instruments form the basis for our innovation cycle.

Institutional Changes and sustainability – The benefits of RITES to RI education extend well beyond gains in student and teacher STEM literacy;; they are also seen in institutional changes emerging in both higher education and the districts. In addition to enhancing both the rigor and relevance of the PD, the pairing of scientists with K- 12 teachers has become one of the main vehicles for strengthening the bond between HE and K- 12 communities. On a larger scale, the School Council, a professional learning community consisting of 35 K- 12 teachers from 27 districts, has evolved through efforts of the districts. At the beginning, HE was disproportionately represented in RITES, and primarily administrators spoke for K- 12. In response to this disproportionate representation, we increased our outreach efforts and created a partnership in which K- 12 has not only assumed a role of equal in defining and guiding RITES, but also their involvement has shifted RITES toward a teacher- focused partnership. This continual evolution of RITES towards an authentic partnership of learners is apparent when viewed through the lens of the PRISM rubric, as already indicated above. As indicated below, collaborative efforts with other STEM agencies led to changes in the partner institutions. It is also worth mentioning the impact our Roundtables had in fostering interest in the NGSS even among HE partners. The many groups that participated in the Roundtables are now serving as the foundation for the State Leadership Team to organize a coalition of stakeholders who will gather tools and develop plans for the state transition to the NGSS.

*** What opportunities for training and professional development has the project provided?**

We provide several types of professional development [PD] opportunities for project participants, each tailored to the needs of different members of the RITES community. Educators and administrators develop professionally through their involvement in some of the following components of our program: a three week summer institute, a Fall and Spring conference, school council meetings and resource teams. We also provide tailored professional development to core districts (those districts that share in the stewardship of the grant).

The RITES summer institute is the centerpiece of RITES' PD for faculty. It is designed to bring the partnership together around the goal of developing challenging courses and curricula by extending pedagogical content knowledge (PCK), that is, deepening content knowledge and improving science teaching practices, for all facilitators and participants who are at various points of their professional careers. RITES teachers attend two, 2•••- day workshops at the institute which provides the common experiences that serve as a platform for content and activities in both the Fall and Spring Conferences. This year, 139 or 20% of district science faculty from 18 [50%] of RI districts participated.

The summer institute workshops are designed and developed by resource teams. These teams of higher education faculty and lead science teachers develop short courses and online investigations (the model lessons we share with participants). Members of these teams benefit from the collaborative and iterative process of developing both a 2-3 day program and model curriculum focused on using the science and engineering practices and incorporating writing in the content area.

Resource team members positively influence each other's teaching. HE faculty have reported changing their lecture formatted practices to involve more participatory methods, and 6- 12 educators have cited an increase in confidence through the deepening of their content knowledge to quote just a few of the many positive outcomes.

In addition to influencing one another and developing a professional network, resource team members gain professionally from working with the RITES staff. The RITES staff provide training and support for resource teams in using different forms of technology and help provide feedback and guidance on developing lessons and structuring course agendas. The process is collaborative and involves experts with a variety of expertise coming together as equals.

In response to Rhode Island's early adoption of the Next Generation Science Standards, we provided models, curricular examples and discussions on how to rethink science curricula based on the NGSS science and engineering practices within the context of the cross- cutting concepts. Participants engaged with those activities 'as students' and then reflected on the structure and components of the lessons 'as teachers'. Participants were asked to transfer what they learned to their own classrooms.

We also provided PD connected the Common Core standards for reading and writing in the science classroom. RITES partnered with URI's Guiding Education in Math and Science Network [GEMS- Net], and provided a workshop, Writing in the Science Classroom, which is based on the research- based approach outlined in Betsy Rupp Fulwiler Writing in Science. (Both GEMS- Net and Fulwiler research are the results of former NSF funded projects.)

We provide specialized professional development to our core partner districts: Chariho, Cranston, Johnston, Providence, South Kingstown, Westerly and Woonsocket. These opportunities vary depending on the requests of the teachers, building administrators, and district leaders. This year, we did the following:

- Facilitated collaborative development of a district wide lab rubric - Chariho
- Collaboratively developed field- based units - Chariho, Cranston, Westerly
- a Assisted in re- design of science labs to address NGSS practices - Johnston, S Kingstown
- b Facilitated field- trips to informal science opportunities - Providence

Another set of opportunities were available through the School Council, which is composed of representatives from all RITES districts. These teachers self- determine their meeting content and format. These meetings offer a quarterly opportunity for teachers to participate in a focused, inter- district professional learning community. In turn, they take ideas, opportunities, strategies and tools back to their schools and districts. Topics this year included: Using NECAP data to determine next summer's investigations and short course topics;; Using NECAP to make decisions for the classroom;; Analyzing the investigations to better meet the inquiry construct;; Using RITES investigations and artifacts to support Student Learning Objectives, Professional Growth Goals, and district initiatives;; and Using the investigations as a check on reaching one's objectives.

Additionally, we developed the Science Education Roundtable which creates a statewide professional learning community for all stakeholders of the STEM education community. This group of 80+ meets quarterly. This past year, Roundtable members identified three initiatives for common development. We agreed to facilitate these efforts: 1. Build a RI Science Resource Website;; 2. Improve NECAP Inquiry results;; and 3. Prepare all interested students for STEM careers.

*** How have the results been disseminated to communities of interest?**

We use several modes of communication, tailored to the message and the audience. These are:

- Monthly online newsletter for teachers participating in the PD program and their school administrators.
- a Monthly online partner newsletter for members of the partnership, and district and higher education administrative staff.
- b The home website
- c The investigations portal
- d Targeted emails via Constant Contact
- e Participation in University and College committees and organizations - e.g., Guiding Education in Math and Science Network, Collaborative Explorations in Mathematics and Science Program initiative, RI STEM Center and Central Falls District Initiative.
- 1 and virtual meetings of the School Council

- 2 and virtual meetings of the Leadership Team
- a Quarterly meetings of the Science Education Roundtable
- b Publications
- c Conference presentations & posters

Links for the newsletters, website, and portal, as well as publications and conferences are listed in appropriate sections of this report.

*** What do you plan to do during the next reporting period to accomplish the goals?**

As this is the fifth year annual report for a five year MSP grant, there is no “next reporting period” per se. That said, our team is focused on crafting a final report that will be useful to the MSP community and others. Additionally, we are actively seeking new funding to continue this work, and the Leadership Team is meeting throughout the period of the no- cost extension (Oct 1, 2013 - Mar 31, 2014) to implement sustainability measures.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Appendix 1 Supporting Documentation.pdf	This Appendix contains figures and tables that support assertions made in this section, Accomplishments. They are organized according to natural groupings (e.g., Technology), rather than by Goals as above. The information in many of these graphics pertain to more than one RITES goal.	Daniel Murray	09/30/2013
Appendix 2 Images of Investigations.pdf	APPENDIX 2: Examples Of Teachers and Students Using Rites Investigations. This Appendix contains images that capture the RITES investigations as experienced by teachers in workshops and students “in the class”. All except Figure 8, Engineering, address environmental sciences issues.	Daniel Murray	09/30/2013
RITES Evaluation Report, Year 5.pdf	This is the external evaluator’s fifth annual evaluation of the RITES project. The evaluation is performed by The Education Alliance at Brown University.	Daniel Murray	09/30/2013

Products

Journals

Schiffman, L., Cardace, D., Kortz, K., Saul, K., Gilfert, A., Veeger, A.I., and Murray, D.P. (2013). Sleuthing Through the Rock Cycle, and online guided inquiry tool for middle and high school geoscience education.. *Journal of Geoscience Education*..

Status = PUBLISHED;; Acknowledgment of Federal Support = Yes ;; Peer Reviewed = Yes

Knowlton, S., Fogleman, J., Reichsman, F., and deOliveira, G. (). Higher Education Faculty Collaboration with K-12 Teachers to Design and Deliver Teacher PD: A learning experience for all and foundation for sustained partnership.. *Journal of College Science Teaching*..

Status = UNDER_REVIEW;; Acknowledgment of Federal Support = Yes ;; Peer Reviewed = Yes

Books Book Chapters Theses/Dissertations Conference Papers and Presentations

Caulkins, J.L., Murray, D.P., de Oliveira, G., and Veeger, A.I. (2012). *The RITES Model: G6- 12 and Higher Education Partnership Working to Improve Science Education in Rhode Island*. Geological Society of America Annual Conference. Charlotte, North Carolina.

Status = PUBLISHED;; Acknowledgement of Federal Support = Yes Murray, D.P., de Oliveira, G., Caulkins, J.L., Veeger, A.I., and McLaren P.J. (2012). *The RITES Way for NGSS Success*. American Geophysical Union Annual Conference. San Francisco, CA.

Status = PUBLISHED;; Acknowledgement of Federal Support = Yes

Cardace, D., Schiffman, L.A., Kortz, K.M., Saul, K., Veeger, A.I., and Murray, D.P. (2012). *Bringing Geoscientific Practices to Schools Through Guided Inquiry and the NSF- MSP- funded RITES Project*. American Geophysical Union Annual Conference. San Francisco, CA. Status = PUBLISHED;; Acknowledgement of Federal Support = Yes Caulkins, J.L., de Oliveira, G., Dooley, H.L., McLaren, P.J., Murray, D.P., Storey, A., and Veeger, A.I. (2013). *From Implementation to*

Impact – Rhode Island’s Five Year Journey. NSF Learning Network Conference. Washington, DC. Status = PUBLISHED;; Acknowledgement of Federal Support = Yes Murray, D.P., de Oliveira, G., Caulkins, J.L., and Dooley, H.L. (2013). *Life Cycle of RITES Implementation: The past, present, and future*

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Literacy for Middle and High School Students. Geological Society of America Annual Meeting. Denver, CO. Status = ACCEPTED;; Acknowledgement of Federal Support = Yes Murray, D.P., Caulkins, J.L., Veeger, A.I., Brand, S., de Oliveira, G., Dooley, H.L., Burns, A.L. (2013). *Evaluating RITES, a Statewide*

Math and Science Partnership Program. American Geophysical Union Annual Conference. San Francisco, CA. Status = ACCEPTED;; Acknowledgement of Federal Support = Yes de Oliveira, G., Caulkins, J.L., Dooley, H.L., Murray, D.P., Veeger, A.I., Brand, S., Fogleman, J. (2013). *Transfer of Analytical Skills*

From Subject to Subject: Reality or Fiction?. American Geophysical Union Annual Conference. San Francisco, CA. Status = ACCEPTED;; Acknowledgement of Federal Support = Yes

Other Publications

Technologies or Techniques

Data Dashboard for RITES Administration, Staff and Partners Real time analytics about Investigations being used connected to the RITES Filemaker Contacts Database
Summaries of Investigation use over user selectable time periods

- a Descriptive statistics by teacher or district Analytics of Use
- b By cohort
- c By month and program year
- d Class size analysis
- e Course and conference attendance analysis Implementation Survey Calendar Visualization

Artifact Dropbox and Archive Site

■ <http://artifact.ritesproject.net> Provides instruction and lets teachers upload the- artifacts with any size limitations or format restrictions.

Secure dropbox site

■ <https://upload.ritesproject.net>

■ Encrypted upload site to allow district partners to upload student data (statewide standardized science assessments or NECAP, and Teacher- Class- Student connected data)

Databases

RITES developed several database structures that enable the project and its partners to communicate effectively, undertake formative and summative assessments which lead to just- in- time reactions;; i.e., evidence- based practices.

■ Filemaker Contacts Database

○ Participating teachers

■ Events attended

■ Program component completion

a Courses attended by program year

b Fall conference attended by program year

c ■ Spring conference attended by program year

d ○ School administrators and leaders

e ■ District admin

f ■ School principals

g ■ Used for communicating about:

h Program benefits to teachers at their schools

i NECAP and TCS Partner Data

○ *Collected from Core Partner districts*

• NECAP Scores

• Teacher- Course- Student data to facilitate analysis of the NECAP data at

the classroom and student level

Real- time Cloud Synchronized Data Saving

■ *developed in collaboration with the Concord Consortium*

This year saw the advent of an improved and streamlined student data saving process in the Investigations software. Previously, student work was stored on the local machine and then uploaded to the cloud when students closed the Investigation at the end of a class period. While this local- to- cloud solution avoided the need for permanent local storage and was on the whole successful, the timing of student work flooding the network at the end of the class sometimes resulted in an overload of the network connection. This caused inconvenient delays at the end of the class period and occasionally a loss of student data. The new system automatically uploads student work in an Investigation at given intervals, the timing of which can be adjusted by the project administrator. As a result, (1) the upload is distributed over the entire class period, resulting in a faster shutdown at the end of the class;; (2) there is more robust data saving on unreliable wireless networks.

Anonymous Student Reports

■ *developed in collaboration with the Concord Consortium*

Teachers can automatically anonymize student reports (removing all student names) to share or show examples of student work for class discussions and in presentations easily and safely.

Question Rationales

■ *developed in collaboration with the Concord Consortium*

We added a new capability for authors of Investigations to the system this year. Any multiple choice question can now include a follow up question that asks the student to explain why they chose the answer they did. This affordance can help students to explain their thinking, and help teachers and researchers to better understand student thinking and misconceptions, important to both guiding students and researching the effects of the Investigations on student learning.

Redesigned Investigations Portal

■ *developed in collaboration with the Concord Consortium*

The Investigations Portal provides access to the 41 online RITES Investigations both for RITES teachers and students, saves student work on the investigations, and allows all comers to the Investigations website to preview

investigations at will or register for an account. During the previous project year, the Concord Consortium conducted an extensive Investigations Portal redesign project in collaboration with the RITES Technology Liaison and working closely with a professional user experience consultant. The redesign process incorporated substantial teacher input in developing the features of the Portal. This year, the resulting extensive redesign was finalized and deployed for student and teacher use. Teachers were trained in the fall on how to use the new streamlined interface with their classes. The training involved both classroom techniques and charting student progress through the portal.

Teacher features

■ developed in collaboration with the Concord Consortium

- 1 Recent activity page shows teachers a quick overview of student work when they first enter the portal. Drilling down quickly reveals more detailed progress on assignments and links to reports.
- 2 Browse and search page redesigned to let teachers filter materials (Investigations and activities within Investigations) using the title and description of the materials, science domain, grade level, types of sensors required.
- 3 Teachers can reorder content of longer Investigations to fit their classroom schedule.
- 4 Teachers can track student progress in real time via the reporting system using either detailed reports, summary tables on particular assignments or summary tables across all work in a class.
- 5 Teachers can display real-time data collection on a smartboard or other projected screen using the cloud synchronized data available

in the teacher reports. These reports update automatically as data is received from the student workstations. Student features

■ developed in collaboration with the Concord Consortium

- 1 Students can access their own progress reports and detailed saved work quickly and conveniently from devices without Java (e.g. smart phones and tablet computers) using the new web based reports.
- 2 Student home page displays a quick overview of the student's progress through each assigned activity.

Patents

Nothing to report.

Inventions

Nothing to report.

Licenses

Nothing to report.

Websites

Title: RI Technology Enhanced Sciences

URL: <http://www.ritesproject.net>

Description: This is the home site for the project. It has served as a distribution center for information on the project for participants, partners and stakeholders.

Title: RITES Investigations Demonstration Site

URL: <http://demo.ritesproject.net>

Other Products

Nothing to report.

This is a demonstration mode copy of the site that teacher participants use to launch RITES Investigations.

RITES Science Inquiry NECAP Study

<http://www.ritesproject.net/research/RITES%20SCIENCE%20INQUIRY%20REPORT%20MARCH%202013.ppt>
attredirects=0&d=1

This is a link to a PDF of RITE's report on the increased student achievement of its teachers' students on the statewide, standardized assessment. Data is provided for 3 core partner districts at both the 8th and 11th grades, which are the only grades assessed by the state at this time.

The primary finding is: consistently, students who received science instruction from a RITES- trained teacher have significantly higher scores on the state assessment of Science Inquiry skills after

controlling for the effects of student's household poverty.

RITES Newsletters

<http://www.ritesproject.net/news>

A way to keep in touch with what's new at RITES is through one of our newsletters. RITES has two newsletters, tailored for different audiences.

Our Partnership Newsletter is for district and higher ed personnel connected to or interested in the project. It provides information on upcoming events, RITES research and accomplishments, and articles of district and statewide scope.

Our Participants' Newsletter is for teachers. It provides up- to- date information about the professional development program, the online community, developments in the RITES technology and resources, and the implementation of the investigations

RITES Dashboards

<http://dashboard.ritesproject.net>

The RITES dashboards display real- time and longitudinal data relevant to investigation usage and participant engagement. The data provides formative information to partners and staff, enabling them to make evidence- based decisions that will deepen participation by teachers and students. These decisions affect student achievement and teacher expertise on both formative and summative assessments and evaluations.

Participants

What individuals have worked on the project? Name Most Senior Project Role		Nearest Person Month Worked
Anne I Veeger	Co PD/PI	1
Alicia j Storey	Co PD/PI	1
Daniel P Murray	PD/PI	6
Peter McLaren	Co PD/PI	1
Glenisson deOliveira	Co PD/PI	5
Jay Fogleman	Faculty	6
Dawn Cardace	Faculty	5

Eric Roberts Faculty 1

Erin Escher K- 12 Teacher 1

Lucy Spelman Faculty 1

Jessica Donohoe Other Professional 5

Ian Jaffe Postdoctoral (scholar, fellow or other postdoctoral position) 1

Buddy Comet K- 12 Teacher 3

David Upegui K- 12 Teacher 1

Cindy Brittain Faculty 1

Robyn Pothier K- 12 Teacher 1

Joshua Beagan K- 12 Teacher 2

Alicia Sullivan K- 12 Teacher 2

Elizabeth Laliberte Other 1

Hilary Downes- Fortune K- 12 Teacher 1

Caroline Stabile Faculty 1

Adria Alfano K- 12 Teacher 1

Kerri Krawczyk K- 12 Teacher 1

Ian Dell Antonio Faculty 2

Mary Kutcher K- 12 Teacher 1

Leanne Elder Postdoctoral (scholar, fellow or other postdoctoral position) 1

John Labriola K- 12 Teacher 2

Rudolph Moseley Other Professional 1

Arthur Petrosinelli Other Professional 1

Kristen Danusis K- 12 Teacher 1

Heather Taylor Other Professional 1

Judith Lundsten Other Professional 2

Frieda Reichsman Other Professional 2

Have other collaborators or contacts been involved? Y

Date	Name	Role	Count
9/30/13		RPPR -Preview Report	
	Howard Dooley	Other Professional	12
	Amy O'Donnell	Other Professional	12
	William Day	Other Professional	12
	Joshua Caulkins	Other Professional	12
	Henry Wladkowski	Other Professional	8
	Lori Jaccoluci	Other Professional	5
	Sean Dacey	Other Professional	2
	Nathaniel Coolidge	Graduate Student (research assistant)	4
	Michele Martel	Graduate Student (research assistant)	6

What other organizations have been involved as partners? Name Location

Name	Location
Brown University	Providence, RI
CHARIHO	Richmond, RI
Community College of RI	Warwick, RI
Cranston Public Schools	Cranston, RI
Johnston Public Schools	Johnston, RI
Providence Public Schools	Providence, RI
RI College	Providence, RI
RI Department of Education	Providence, RI
South Kingstown Public Schools	South Kingstown, RI
University of RI	Kingston, RI
Westerly Public Schools	Westerly, RI

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The principal disciplines are middle and high school science content and education. As documented elsewhere in this report, in this arena RITES' presence in K- 12 classrooms correlates with learning gains. RITES districts are modifying their STEM curricula so as to incorporate insights into best teaching practices, inquiry- based activities, and depth of content gained from participation of their teachers in RITES PD.

We are also seeing the beginnings of changes in STEM teaching in higher education, as well, towards a culture more attuned to societal needs with respect to science literacy. RITES core higher education partners see participating faculty also gaining insights into new and best teaching practices, which are changing science instruction in their classrooms. At URI a committee of STEM faculty meets on a regular basis, so as to ways in which high school students can not only be attracted to STEM courses, but also be retained (as the drop- off rate for incoming students who choose STEM majors is high). Part of the strategy for reaching this goal is to work in close communication with K- 12 STEM teachers, so as to smoothen the transition from high school to college. Again not surprisingly, many of the HE faculty involved in these efforts is deeply involved in RITES.

The NGSS initiative is poised to become the accepted model for science standards nationwide, and Rhode Island was the first state to adopt the NGSS. RITES played a critical role in this adoption. Peter McLaren, a Co- Pi for RITES, is also a national leader in the implementation of NGSS. Rhode Island has a Leadership group of thirty- six K- 20 STEM faculty and other STEM advocates, and over half of them are affiliated with RITES. Many of the teachers and faculty members attracted to RITES PD are among the best in the state, and their involvement has strengthened and informed RITES about how to best work with the K- 12 and higher education communities. At the same time, RITES is informing the process for effective NGSS implementation in the classrooms of faculty in K- 12 and, as

appropriate, in higher education

What is the impact on other disciplines?

The implementation of Common Core State Standards in mathematics, science literacy and language arts proceeds in Rhode Island, propelled by a Race to the Top grant. RITES investigations, through their emphasis on the incorporation of science literacy and both the science and mathematical practices are influencing the implementation of CCSS in RI.

Because NGSS has a renewed priority for engineering, RITES PD and materials are being enhanced to include engineering challenges.

RITES is having a considerable impact on most RI districts, as they do not have the resources for separate engineering curricula. In these districts, meeting the engineering strands and practices in NGSS means "engineering in the science classroom." Through workshops, equipment incentives and engineering- enhanced investigations, RITES is providing both the resources and the expertise to science teachers to integrate engineering in their classrooms coherently and appropriately, with the least (RITES hopes) disruption and stress to both teachers and students.

What is the impact on the development of human resources?

Roughly two thirds of the middle and high school STEM faculty have participated in RITES PD. As documented elsewhere in this report, they have become better STEM teachers, both in their content knowledge, pedagogy, and their pedagogical- content knowledge. Also, the technology staffs in the districts have received support from RITES, and now understand more clearly how to more effectively support classroom implementation and use of technologies in the schools. This was a significant unintended consequence of implementation of the investigations.

As part of the RITES grant, URI and RIC agreed to create a tenure- track, science faculty position at each campus. These faculty would be paid half- time by RITES for three years, and then transition to fully- funded by the institutions. This has occurred, and one faculty was fast- tracked, and has already attained tenure. The positions have a commitment to science education, and their contracts, tenure decisions, and, eventually, advancement considered education publications and outreach on equal par with their science publications and outreach.

Participation in RITES has also had a positive impact on higher education faculty, who have learned from both RITES and the K- 12 master teachers about best teaching practices. In the beginning, RITES worked with individual faculty members;; however, at URI, RITES now accomplishes this work in collaboration with other initiatives which are creating a culture and expectation of improved teaching tied to student retention and success. RITES is having a positive impact on the discussions and decisions.

What is the impact on physical resources that form infrastructure?

For participating districts RITES supplies both cutting edge science materials (such as probes and software) and face- to- face guidance in the use of technology and maintenance of their often fragile internet connectivity. Each teacher receives a \$700 equipment stipend for each of the two years of their participation in the PD program. RITES has also created a lending library, which provides access to materials that may not be available in certain districts and access to materials that are too expensive to be purchased by districts. The resultant investment has been an investment of ~\$500,000 to date.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Together with the Concord Consortium RITES has developed investigations and activities. They are tightly aligned to RI science standards and transitioning to alignment with NGSS content, cross cutting concepts and practices. They provide teachers and students with a user- friendly platform for engaging in discovery- base science. Assessments are embedded in the software which enables teachers, and RITES researchers, to track changes in student learning gains.

The portal and its infrastructure are located at the University of RI and is on the OSHEAN network, a quasi- public agency which provides schools, libraries, and the state system with a high- speed, secure network. Currently RITES has an agreement with URI to provide space and maintain the network connectivity;; RITES is responsible for hardware and software maintenance and upgrades. Eventually, RITES expects that URI will also maintain the equipment, and either RITES or the Concord Consortium will maintain and upgrade the software. This information technology is open source, and can be accessed through the RITES portal. A link to the portal is provided in "Products: Websites."

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Nothing to report.

Changes

Changes in approach and reason for change

The goals of RITES remain unchanged. However, changes in the work plan occurred, and they are described below.

Actual or Anticipated problems or delays and actions or plans to resolve them

The original five year RITES grant was for ~\$12,500,000. However, for a variety of reasons that were largely external to RITES we were underspent at the end of Year 2, triggering a withdrawal of our Year 3 funding. We have made great progress in Years 4 & 5, and this year NSF granted a \$900,000+ supplement to cover expenses incurred in the successful completion of the project. With that supplement we were able to reach all of our stated goals, as evidenced in other sections of this report. The details of this problem and its resolution have been chronicled and discussed with NSF at length, and all necessary approvals were obtained.

A significant delay in the final analyses of our data has been caused by the recent, untimely and completely unexpected death of our statistician. While the University is committed to working with RITES to fill the position as quickly as possible, it will be early- winter before that happens. Consequently, most of the final analyses will be completed and put out for publication during the no- cost extension (Oct 1, 2013 - Mar 31, 2014).

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.

RPPR -Report Submitted Successfully

Award 0831974 - Annual Project Report

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