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Documenting The Design And In-classroom Success Of An Online Learning Module Covering The Rock Cycle Created By The NSF-MSP Funded RITES Project

Schifman L.A. Department of Geosciences University of Rhode Island, Kingston, RI 02881; RITES Project, University of Rhode Island, Kingston, RI 02881
Cardace D. Department of Geosciences University of Rhode Island, Kingston, RI 02881; RITES Project, University of Rhode Island, Kingston, RI 02881
Caulkins J.L. RITES Project, University of Rhode Island, Kingston, RI 02881
Kortz K.M. Physics Department, Community College of Rhode Island, Lincoln, RI 02865; RITES Project, University of Rhode Island, Kingston, RI 02881
Saul K. Nicholas A. Ferri Middle School, Johnston, RI 02919; RITES Project, University of Rhode Island, Kingston, RI 02881
*Contact Information: laura.schifman@gmail.com

Abstract. The *Rhode Island Technology Enhanced Science* (RITES) program aims to increase the amount and quality of inquiry based learning in science classrooms statewide. Middle and high school teachers who join RITES enroll in a 2.5-day-long short course where science content and pedagogical materials are covered by a resource team composed of one higher education professional and one in-service teacher. After the short course, the teachers are able to make use of online learning modules provided by RITES in their own classrooms. These online modules, called "Investigations," are a collection of interactive tools that allow graphing and interpretation of images through short answer questions, with ancillary pages of teacher notes and additional concept exploration for students in each content area. In this work, we follow one Investigation in particular, *Sleuthing through the Rock Cycle*. We discuss the design and creation of the investigation as well as its classroom implementation by documenting classroom observations and engagement counts, with data including modified RTOP* [1] results, and notes on teacher choices in planning and presenting the Investigation. By observing the Investigation in the classroom in different Rhode Island middle and high schools we begin to constrain the effectiveness of the Investigation as a teaching tool and guided inquiry resource for RITES teacher-participants and their students.

Designing *Sleuthing Through the Rock Cycle*: choosing guided inquiry as pedagogy

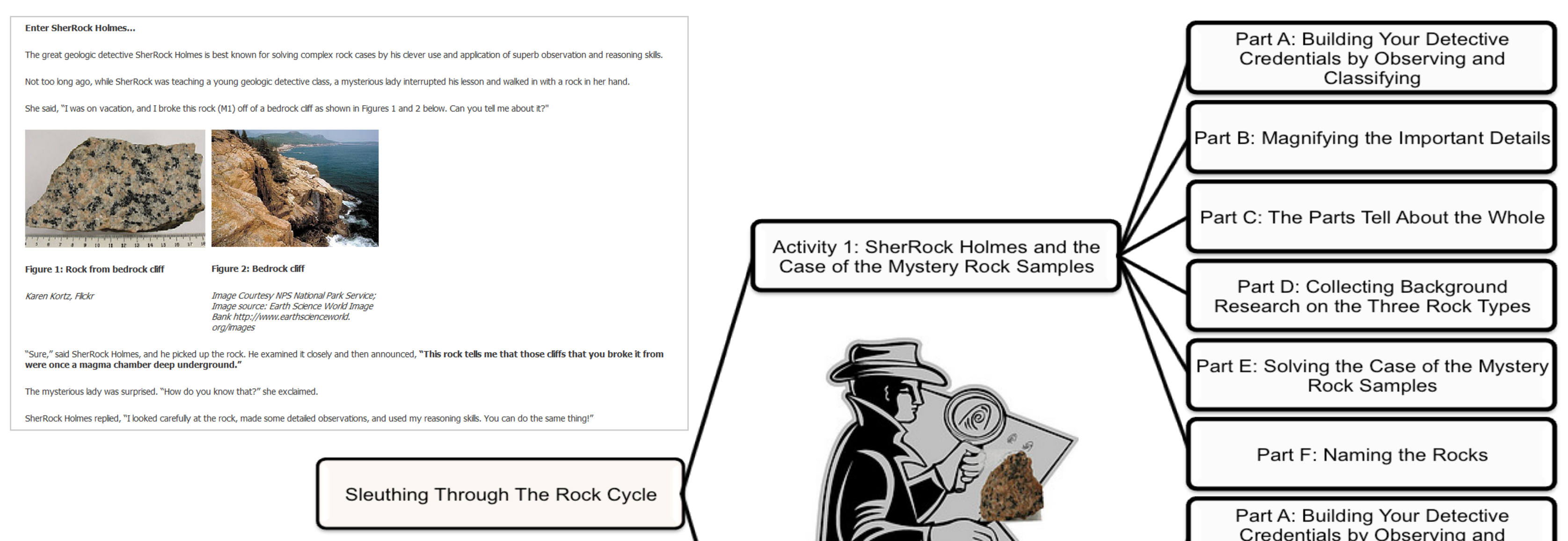
In guided inquiry exercises students work through a process of scientific investigation leading to particular answers or concepts known to the teacher [2,3]. Constructivist inquiry-based learning modules have great potential for facilitating better content knowledge retention in general [4, 5, 6], and may be particularly relevant in STEM initiatives [3, 6].

Planning statements from the *Rock Cycle* resource team (i.e., the curriculum designers):

- **How would you describe your intention for the Investigation as a body?** *We wanted to make it as complete as possible, have students think and learn how to read rocks like geologists. We wanted to create a complete story, but teachers can use individual sections if necessary.*
- **What observations do you make about your work on this investigation that could inform other STEM initiatives operating at a similar scale as RITES?** *Curricula should be developed as teams and related workshops team-taught; projects like this need both higher education and K-12 perspectives. For classroom use of technology or materials, guidance from RITES staff (contact person when any issues arise) is necessary.*

Design rubric for Investigations:

1. **Structure:** Does the Investigation make full use of the RITES structure? (*i.e.*, Introduction, Materials, Engage, Explore, Explain, Wrap-Up, Assessment)
2. **Science:** Is the science accurate, current, and accessible to typical students?
3. **Standards Based:** Does the material address one GSE standard?
4. **Inquiry Based:** Does the material make good use of student inquiry?
5. **Student Motivation:** Do the materials motivate students?
6. **Teacher Support:** Is the Teachers Guide accurate and complete?
7. **Assessment:** Is the assessment section complete and appropriate?
8. **Technology:** Does the Investigation make good use of technology?



Modified RTOP Indicator	Score (0-4)
Instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein	2
This lesson encouraged students to seek and value alternative modes of investigation or of problem solving (more than one right possible answer)	4
Connections with other content disciplines and/or real world phenomena were explored and valued	3.5
Students used a variety of means (models, drawings, graphs, symbols, concrete materials, manipulatives, etc.) to represent phenomena	3
Students made predictions, estimations, and/or hypotheses (PEH) and devised means for testing them	3.5
Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures (quality)	2
Students were reflective about their learning (what do you think, and how do you know?)	0
Intellectual rigor, constructive criticism, and the challenging of ideas were valued (negotiating meaning/ debating ideas)	4
Students were involved in the communication of their ideas to others using a variety of means and media (variety of types and scales of delivery)	2.5
There was a high proportion of student talk and a significant amount of it occurred between and among students (quantity of interactions)	4

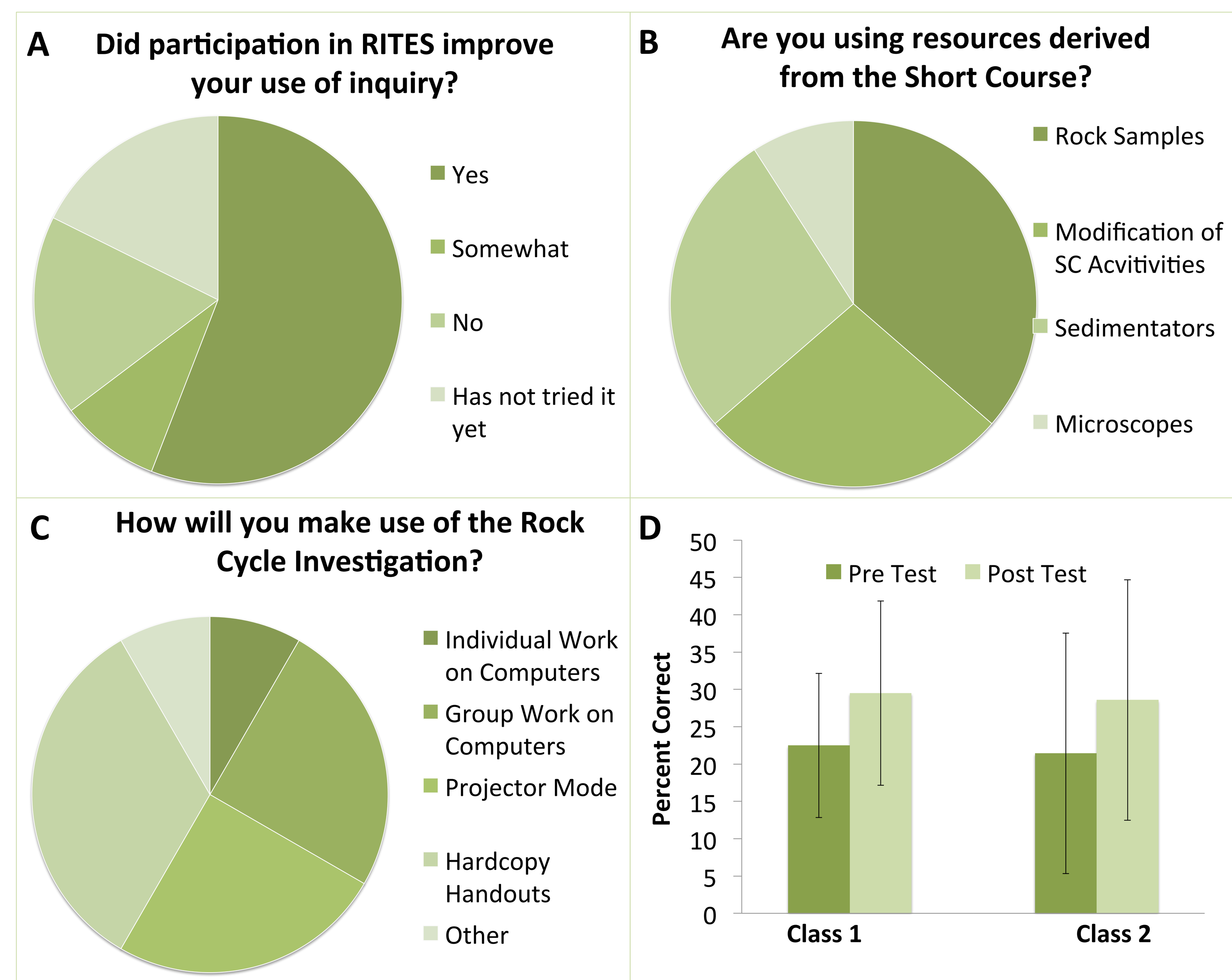
Figure 1. Screenshot of *Sleuthing through the Rock Cycle*, a cartoon of the Investigation structure, and Modified RTOP Results from the August 2011 Short Course.

Implementing *Sleuthing Through the Rock Cycle*: evidence from teachers and students

Preliminary data suggest there is mutual adaptation [7] of RITES innovations via individualized implementation by teachers. Congruent adaptations include how teachers buttress existing materials with new content knowledge and stronger confidence; hindrances to full fidelity include running the module largely offline , failure of school internet access, etc.

Teacher comments after the *Rock Cycle* short course (i.e., the implementers):

- **What information/resources were most useful in preparing to use *Sleuthing Through The Rock Cycle?*** *A binder and PowerPoint presentation provided during the RITES short course (SC) and activities that can be used to explain basic concepts. Also, examples of teacher handouts and student work are attached (see handouts).*
- **Which sections and activities do teachers plan to use in their classroom?** *Teachers wanted to use the entire investigation in their classes, but mentioned time related issues - curricula are demanding and teachers have to teach a lot of material. Depending on the earth science exposure the class had in previous years, teachers can move to more advanced sections in the investigation.*



Plan of Proposed Research:

Observations: Classroom observations were postponed due to shifts in teaching plans.
Revised RTOP: Compare modified RTOP scoring for inquiry based activities between different classes and the short course.
Engagement Counts: Establish the engagement of students throughout the activity and compare to pre-post test scores.
Pre-Post Test Scores: Calculate learning gains for students and overall effectiveness of the investigation through pre and post test scores from all observed classes.

Figure 2. A) Views on including inquiry in the class room from summer 2011 short course participants. B) Distribution of materials or activities introduced by teachers in preparation for teaching the Rock Cycle. C) Variation in techniques used to implement *Sleuthing through the Rock Cycle* in the classroom. Often computer resources are sparse. D) Results from a Pre-Post survey created by RITES administered along with the *Sleuthing Through the Rock Cycle* investigation.

Implications. *Sleuthing Through the Rock Cycle* has positive impacts: Teachers feel more prepared to teach the material after being provided with additional resources and are inspired to use more inquiry based activities in the classroom. Even given serious technology barriers in some schools, teachers still utilize components of the Investigation (e.g., rich use of inquiry, projection of the online module in front of the class, use vetted handouts, and rock and mineral specimen use, etc.).

References. [1] Piburn, M., Sawada, D., Falconer, K., Turley, J. Benford, R., Bloom, I. (2000). Reformed Teaching Observation Protocol (RTOP). ACEPT IN-003. [2] Furtak, E.M., 2006, The problem with answers: An exploration of guided scientific inquiry teaching: Science Education, v. 90, no. 3, p. 453-467. [3] Kim, M.C., Hannafin, M.J., and Bryan, L.A., 2007, Technology-enhanced inquiry tools in science education: An emerging pedagogical framework for classroom practice: Science Education, v. 91, no. 6, p. 1010-1030. [4] Guzzetti, B.J., 2000, Learning Counter-Intuitive Science Concepts: What Have We Learned From Over A Decade Of Research? : Reading & Writing Quarterly, v. 16, no. 2, p. 89-98. [5] Ketelhut, D.J., 2006; 2007, The Impact of Student Self-efficacy on Scientific Inquiry Skills: An Exploratory Investigation in River City, a Multi-user Virtual Environment: Journal of Science Education and Technology, v. 16, no. 1, p. 99 -111. [6] Kortz, K., Smay, J.J., and Murray, D.P., 2008, Increasing Learning in Introductory Geoscience Courses Using Lecture Tutorials, v. 56, no. 3, p. 280-290. [7] Yoon, S.A., Liu, L., and Goh, S., 2009, Exploring the process of convergent adaptation in technology-based science curriculum construction, *in* Proceedings of the 9th international conference on Computer supported collaborative learning - Volume 1: Rhodes, Greece, International Society of the Learning Sciences, p. 272-281. Acknowledgments. This research was funded by NSF Award #0831974. We thank in particular RITES teachers for helping make this work possible, and appreciate the support of RITES PIs Dan Murray, Glênisson de Oliveira, and Anne Veeger. We applaud with gusto the amazing RITES staff and student assistants

*Only RTOP questions pertaining to inquiry based learning included