Communities In Schools of North Carolina is leading the national network in providing the most effective student supports and wraparound interventions and supports directly in schools to support students and teachers. Working collaboratively with 400 schools across North Carolina, Communities In Schools impacts the lives of more than 230,000 youth each year. Driven by research-based practices surrounding the best predictors of student success – attendance, behavior, coursework and parent and family engagement – Communities In Schools is changing the picture of education for students across North Carolina. Learn more about Communities In Schools of North Carolina at www.cisnc.org.

The Nonprofit Evaluation Support Program (NESP) is a collaborative effort between two University of North Carolina Greensboro organizations – The SERVE Center and The Office of Assessment, Evaluation, and Research Services (OAERS). NESP's mission is to provide program evaluation services and program evaluation capacity building support to nonprofit and community-based organizations while providing authentic learning experiences for future leaders in the field of program evaluation.

The SERVE Center at The University of North Carolina Greensboro is a university-based research, development, dissemination, evaluation, and technical assistance center. For more than 24 years, SERVE Center has worked to improve K-12 education by providing evidence-based resources and customized technical assistance to policymakers and practitioners.

The University of North Carolina Greensboro (UNCG) is one of the sixteen university campuses of The University of North Carolina. UNCG holds two classifications from the Carnegie Foundation for the Advancement of Teaching, as a "research university with high research activity" and for "community engagement" in curriculum, outreach, and partnerships.

Communities In Schools of North Carolina
222 North Person Street, Suite 203 | Raleigh, NC 27601
Phone: (919) 832-2700 | Toll Free: (800) 849-8881 | Fax: (919) 832-5436
http://www.cisnc.org/

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Overview

CISNC Introduction

In the 2014-2015 school-year, Communities In Schools of North Carolina (CISNC) introduced a framework that aligns site and student metrics and interventions and supports to four areas that have been shown to have the greatest impact on student success: attendance, behavior, coursework, and parent involvement, or ABC+P. Both combined and individually, attendance, behavior, and coursework are among the best predictors of a student's academic success and on-time graduation. While collecting data around ABC+P is critically important to understanding the school and student, it is even more important to use the data to drive high impact intervention and support delivery to empower each student to reach their full potential. To this end, Communities In Schools of North Carolina has partnered with the SERVE Center at the University of North Carolina at Greensboro to design curricula specifically for CIS within the ABC+P framework to enhance student outcomes in school and success in life. This document is one of more than 50 modules developed to support local CIS staff and most importantly the students that are served. We encourage you to explore all of the modules available online at www.cisnc.org.

Using Evidenced-Based Strategies

There are a multitude of strategies that claim to address attendance, but there are few that actually do so for all students. We suggest that schools use an evidence-based, decision-making model to ensure that high quality information informs the decisions made.

The Institute of Education Sciences (IES) at the U.S. Department of Education defines evidence-based decision making as routinely seeking out the best available information on prior research and recent evaluation findings before adopting programs or practices that will demand extensive material or human resources (including both funding and teacher time) and/or affect significant numbers of students (Whitehurst, 2004).

Evidence-based practice means delivering interventions and supports to students (clients) in ways that integrate the best available evidence from data, research, and evaluation; professional wisdom gained from experience; and contextual knowledge of the particular classroom, school, district, or state that might impact the design or implementation.

This document will focus on one easy to implement STEM strategy intended to engage students and support science process skills; it can also be extended to link science and language arts.

Problem/Rationale

Science, technology, engineering and math (STEM) skills are critical to the 21st Century world we now live in. STEM drives everything around us, from the time we get up in the morning to the time we go to bed at night. To have a place in today's world, our young people must have a strong background in these skills, and effective abilities to use them.

Current information confirms the importance of STEM education. According to the US Department of Commerce (Langdon, McKittrick, Beede, Kahn, & Doms, 2011), STEM is where the jobs are—and STEM related jobs will grow by at least 17% over the next 10 years, compared to 9.8% for non-STEM related jobs. In addition, those in STEM related occupations will earn 26% more than non-STEM workers, on average, and will experience less risk of job loss. There is more at stake than our young peoples' success. Reports indicate that continued scientific leadership and economic growth in the United States is linked to STEM (National Research Council, 2011). Yet, our students have lost ground. Twenty-five years ago, the United States led the world in high school and college graduation rates; today, the US ranks 20th and 16th. In addition, the World Economic Forum ranks the U.S. as No. 48 in quality of math and science education. In 2013, only 42% of 4th graders and 35% of 8th graders performed proficiently in math; in 2009, 34% of 4th grade students and 21% of 12th grade students performed proficiently in science (National Math and Science Initiative, 2014). To compete, and to ensure our students a place in the world of the 21st century, we must provide them the advantage that a world class STEM education offers.

Research tells us a great deal about what comprises effective STEM education. Broadly, successful STEM education:

- Takes advantage of students' early interests and experiences,
- Identifies and builds on existing knowledge, and
- Provides students with engaging experiences that involve them in the practices of science and sustain their interest (National Research Council, 2011).

In such a setting, students are actively involved in STEM from the beginning of their education. Teachers begin where students are and help them apply scientific and engineering practices. Students carry out investigations and projects and gradually build an understanding of core STEM ideas and practices that are shared across disciplines throughout their education. Over time they assimilate core ideas and develop an identity as STEM learners that prepare them for the challenges of post-secondary education (National Research Council, 2011).

Research points to a set of key overarching ideas and practices that support effective STEM education:

- Consistent standards and curriculum,
- Teachers who are well prepared to teach in their subject area,
- A supportive system of assessment and accountability that does not limit what is taught based on assessment, and focuses on teacher practices as well as student outcomes,
- Adequate instruction time across disciplines, and
- Equal access to high quality STEM learning opportunities.

Research also identifies school practices that support effective STEM instruction:

- A supportive school culture and learning and teaching conditions,
- School leadership that drives change,
- High quality teachers and staff, capacity of staff to work together, and effective professional development,
- A student centered climate that is safe, welcoming, stimulating and focused on the learning of all students, and
- Support for instruction that incorporates the nature of the curriculum, academic demands and challenges to instruction and the tools supplied to teachers (National Research Council, 2011).

Districts and schools can examine their practice to incorporate these elements and provide students with high quality STEM education.

Purpose

A strong grounding in science, technology, engineering and math is critical to assuring that students will be successful in K-12 and beyond. Research tells us that STEM education can and should begin in the elementary grades. From a report issued in 2011 by the National Research Council, "According to the research, effective instruction actively engages students in science, mathematics, and engineering practices throughout their schooling" (p. 18). The skills and interests that begin in the elementary schools years are the foundation for critical education choices as students move into secondary education. The purpose of this guide is to provide teachers with information and activities that they can use to engage students and support science, technology, engineering and math learning.

Objectives: Students will use the Scientific Process to solve a problem.

Skills: Students will gather data, make inferences and draw a conclusion.

Implementation Plan

- Effective elementary STEM programs share the elements of strong leadership, professional capacity among teachers, strong ties to parents and the community, a student-centered learning climate, and instructional guidance for teachers. Out-of-class activities, a standard-based curriculum, and program sustainability are key characteristics as well.
- One way to motivate students and cultivate student interest in STEM subjects, particularly among underrepresented groups, is to offer various extracurricular activities to students. Such activities may include summer programs, after school enrichment activities, science fairs or Olympiads, and other competitions.
- As stated in a report released by Hanover Research: Professional development is particularly important for elementary teachers involved in STEM education, as research shows that these teachers typically do not

receive enough undergraduate education in mathematics and science. Furthermore, professional development for STEM teachers must be provided over an extended period of time (p. 3).

Uses

Elementary teachers teach science best when they provide students with opportunities to learn to observe and reason about the world. This lesson can help students develop the scientific way of thinking necessary for science learning (Allen, 2006). Elementary school students learn science best through hands-on activities that incorporate investigation and inquiry/process skills (National Science Teachers Association, 2002).

Audiences

The primary audience for the lesson is third through fifth grades.

Activities

The activity highlighted is designed to provide students with a hands-on activity that incorporates the scientific process. Teachers can use it to teach problem solving and critical thinking, as well as other skills applicable in a variety of situations. It supports the North Carolina State curriculum for Science as Inquiry.

- Vocabulary
- Problem solving
- Observation
- Hypothesis
- Data
- Record
- Conclusions

Materials/Equipment/Space

- Flip chart paper, Smartboard, or blank PowerPoint slide
- Educator guide – "What's Hidden Inside?" – refer to Resources Section for link
- Student activity sheet – "What's Hidden Inside?" – refer to Resources Section for link
- Tape
- Scissors
- Small paper bags
- Wooden skewers
- Safety glasses

Time

- Preparation Time: 10 minutes
- Lesson Time: 30 minutes

Lesson Plan of Activity

The scientific process is a key tool that can be used across STEM areas. Using the scientific process, students develop a range of skills, including observing, communicating, inferring, predicting, investigating that can be generalized to problems across disciplines. Using the activity below, teachers can not only help students learn to apply this process, but also help them to understand the role clear written communication plays in STEM.

Sample Lesson – *"What's Hidden Inside?"*

Activity	Process Notes
Teacher preparation	*Prior to the lesson:* • *Review the "What's Hidden Inside?" educator guide. Retrieve from:* http://www.nasa.gov/pdf/146856main_Hidden_Inside_Educator.pdf • *Read NASA's KSNN™ 21st Century Explorer Web Text Explanation titled "Why do robots travel places before people?" Retrieve from: https://education.jsc.nasa.gov/explorers/p6.html. Note: This link replaces link included in the "What's Hidden Inside?" lesson document.* • *Review NASA video "Why do robots travel places before people?" Retrieve from: https://archive.org/details/ksnn_21st_century_explorers_6* • *Download student handout, "What's Hidden Inside?" Retrieve from:* https://www.nasa.gov/pdf/146857main_Hidden_Inside_Student.pdf • *Gather other materials for activity.*
The day prior to the activity give students a small paper bag and provide instructions for the activity. Students will: • Collect a small, common object from home to place in the bag. • Write their name on their bag and fold the top over. • Prepare two clues about what's in the bag and record on an index card. • Not reveal to other students the contents of their bag.	*Each student should be given a small paper bag and instructed to place a small, common object from home in the bag (e.g. a comb, cup, marker, eraser, spoon, etc.).* *Teacher may want to have some items on hand in case some students forget to bring in their bag with the object.*
The day of the lesson provide a central collection place for the bags.	*Make sure students have recorded their names on their bag.* *Tape the bags shut.*

Activity	Process Notes
Introduce concepts of scientific method	*Follow the Instructional Procedures in the "What's Hidden Inside?" educator guide.* *Introduce the activity using the material found in the Resources section. Share the NASA video at* https://archive.org/details/ksnn_21st_century_explorers_6 *"Why do robots travel places before people?" to engage students and increase student knowledge about this topic (Instructional Procedure #1).*
Remind students about properties such as weight, shape, texture, sound, odor, appearance, etc. Review the problem with students – how can I determine what is in the bag?	*Tell students: "During this activity, we will solve a problem using the scientific method. Our problem is, How can I determine what's hidden inside the bag?" (Instructional Procedures #2 and #3).*
Students should work in small groups. Provide the student handout, "What's Hidden Inside?" the Bag?	*Have student read the Observation section of the student handout, "What's Hidden Inside?" with students. Retrieve from:* https://www.nasa.gov/pdf/146857main_Hidden_Inside_Student.pdf *Give students about 5 minutes to discuss it. Ask students for comments (Instructional Procedure #4).*
Students will make observations about the topic. Use flip chart paper, smartboard, or PowerPoint slide to record student observations.	*Encourage your students to discuss and make observations about the topic by completing the first two columns in the KWL (KNOW/WANT TO KNOW/LEARNED) chart on the "What's Hidden Inside?" student section. Use the KWL chart to help students organize prior knowledge, identify interests, and make real-world connections. As students suggest information for the "KNOW" column, ask them to share how they have come to know this information (Instructional Procedure #5).*
Help students refine their predictions into a hypothesis. Encourage students to share their hypothesis with their group.	*Ask your students if they have predictions relating to this activity and the "problem question". Help them refine their predictions into a hypothesis. In their Student Section, they should restate the "problem question" as a statement based upon their observations and predictions (Instructional Procedure #6).*

Activity	Process Notes
Students will work in pairs to test their hypothesis after sharing them with their group. Detailed procedures for the student observations/ investigation are included in the educator guide.	*Show an example of a completed worksheet.* *Tell students, "You will work in pairs to test your hypothesis. Use your senses to gather information about the properties of what's inside the bag. Investigate the properties that you listed in the data chart one at a time."* *Remind students again of possible properties.* *Conduct whole group brainstorm what senses can be used to gather information about these properties; how to use their senses without opening the bag; and how these might help them discover what is in the bag.*
Using the scientific method to test a hypothesis. Provide each student with a sealed bag and have them: • Follow the test procedures (11 steps) on their handout • Complete their data sheet	*Provide step by step procedures for testing the hypothesis (Instructional Procedure #7).* *Pace students to ensure they are on task.* • *Collecting data* • *Recording properties* • *Studying their data* • *Drawing conclusions* *Ask probing questions throughout the activity about their observations, discoveries in using senses, and changes in predictions and what caused their changes in thinking?*
Whole group discussion.	*Discuss the answers to the "What's Hidden Inside?" student section questions.* *Have the students update the LEARNED column in their KWL chart.*
This activity can be extended to incorporate a language arts component.	*Refer to links under additional resources in the Resources section.*

Lesson adapted from the NASA "What's Hidden Inside" lesson. Retrieved from: http://www.nasa.gov.

Tier 2 Intervention and Support Examples

While typical classroom activities such as the one detailed in this guide will be effective for many students, some may need additional support. Computer Assisted Instruction and Peer Tutoring are two strategies that can help struggling students.

Example 1: Computer Assisted Instruction (CAI)
Computer Assisted Instruction uses technology to either supplement or replace traditional classroom instruction. Research shows that it is a useful tool, as well as a cost efficient means to provide students who are struggling with support to help them make academic gains, particularly in math. Some research suggests that the individualized instruction and pacing offered by CAI may account for this. In addition, CAI can reduce the effects of frequent absences and larger classes that reduce the instructional time students receive.

Barrow, L. & Rouse, C. (2007). *Technology's edge: The educational benefits of computer-aided instruction.* Chicago, IL: Federal Reserve Bank of Chicago. Retrieved from: http://eric.ed.gov/?id=ED505645

Example 2: Peer Tutoring
Peer tutoring pairs low performing students with high performing students on a one to one basis to practice or complete academic tasks. The research on peer tutoring supports the practice. Students in a peer tutoring relationship make academic gains including improvements in math and reading performance. Peer tutoring also promotes higher order thinking and accommodates the diverse student needs in a classroom. In addition, peer tutoring has a positive impact on motivation and students' social skills.

Nguyen, M. (2013). *Peer tutoring as a strategy to promote academic success.* Durham, NC: Duke School Research Partnership Office, Center for Child and Family Policy. Retrieved from https://childandfamilypolicy.duke.edu/pdfs/schoolresearch/2012_PolicyBriefs/Nguyen_Policy_Brief.pdf

Resources

The following resources are identified as part of the activity. Read through these resources carefully to become familiar with any concepts and instructions as they pertain to the content and activity.

National Aeronautics and Space Administration (NASA) - http://www.nasa.gov/

- **"What's Hidden Inside?" educator lesson guide** http://www.nasa.gov/pdf/146856main_Hidden_Inside_Educator.pdf
- **"Why Do Robots Travel Places Before People?" article** https://education.jsc.nasa.gov/explorers/p6.html. Note: This replaces link listed in "What's Hidden Inside?" lesson document.
- **"What's Hidden Inside?" student handout** https://www.nasa.gov/pdf/146857main_Hidden_Inside_Student.pdf

The following resources will provide additional information and suggestions for enhancing STEM in the classroom. Read through the resources carefully to become familiar with any concepts and instructions as they may pertain to the content and the extension of activities.

Holmquist, S. (2014). A multi-case study of student interactions with educational robots and impact on Science, Technology, Engineering, and Math (STEM) learning and attitudes. (Dissertation). Retrieve from: http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=6239&context=etd

NASA – http://www.nasa.gov/
NASA Mars and Earth Educator's Guide
http://www.nasa.gov/pdf/145913main_Mars.and.Earth.Guide.pdf
Robotics activities from NASA
http://robotics.nasa.gov/edu/rover.php
Information on robots from NASA
http://prime.jsc.nasa.gov/ROV/

STEM-Works – http://stem-works.com/
Video describes the work of a Robotics engineer for students.
http://stem-works.com/subjects/1-robotics/cool_jobs/357
Articles on robots and robotics.
http://stem-works.com/subjects/1-robotics

Arizona State University – http://www.asu.edu/
Additional information and lesson plans on Mars – http://marsed.asu.edu/stem-lesson-plans

North Carolina Extended Essential Standards: Science – http://www.dpi.state.nc.us/

K-2 Extended Standards
http://www.dpi.state.nc.us/docs/acre/standards/extended/science/k-2.pdf
3-5 Extended Standards
http://www.dpi.state.nc.us/docs/acre/standards/extended/science/3-5.pdf

The following optional resources provide additional information and concepts, or may be used in sharing with others or to expand the activity. Read through these resources to become familiar with the information and to determine their of usefulness within the school setting.

Robotics projects ranging from beginner to hard.
http://www.sciencebuddies.org/science-fair-projects/Intro-Robotics.shtml?from=Blog

Short physics activities. Videos available.
http://www.iop.org/education/teacher/extra_resources/stem/file_60283.pdf

Free engineering curriculum from the Boston Museum of Science.
https://www.youtube.com/watch?v=hHtEbwIxDec&noredirect=1

Videos of STEM Projects.
https://www.teachingchannel.org/videos/teaching-stem-strategies

STEM related projects from NASA. Projects incorporate most STEM disciplines, as well as some language arts.
http://spaceplace.nasa.gov/classroom-activities/en/

Minecraft Challenges
http://stem.wesfryer.com/home/minecraft/redstone

Note: All posters, images, and activity guides identified are copyright cleared for non-commercial use.

Measuring Success

Identifying outcomes and collecting data to measure the success of PBIS strategies can help the school track quality of implementation as well as the effectiveness of these strategies. Following are some suggestions that schools may find useful to begin measuring success.

- Assess student knowledge through questioning.
- Assess student understanding through observation during the activity and application of the scientific method during other assignments.
- Observe and assess student performance throughout the activity using the Scientific Investigation Rubric included in "What's Hidden Inside?" educator guide.

Appendices

A. Glossary

B. References

C. Research Alignment

Appendix A: Glossary

21st Century Skills – The term 21st century skills refers to a broad set of knowledge, skills, work habits, and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world, particularly in collegiate programs and contemporary careers and workplaces (Great Schools Partnership, 2014).

Achievement Gap – Closely related to learning gap and opportunity gap, the term achievement gap refers to any significant and persistent disparity in academic performance or educational attainment between different groups of students, such as white students and minorities, for example, or students from higher-income and lower-income households (Great Schools Partnership, 2014).

Authentic Instruction – In education, the term authentic instruction refers to a wide variety of educational and instructional techniques focused on connecting what students are taught in school to real-world issues, problems, and applications**.**

Computer assisted Learning – Computer assisted instruction uses technology to either supplement or replace traditional classroom instruction. Research shows that it is a useful tool, as well as a cost efficient means to provide students who are struggling with support to help them make academic gains, particularly in math.

Cooperative Learning – Cooperative learning is a successful teaching strategy in which small teams, each with students of different s of ability, use a variety of learning activities to improve their understanding of a subject.

Engineering method – The engineering approach to identifying and solving problems, is (1) highly iterative, (2) open-ended, in that a problem may have many possible solutions, (3) a meaningful context for learning scientific, mathematical, and technological concepts, and (4) a stimulus to systems thinking, modeling, and analysis. In all of these ways, engineering design is a potentially useful pedagogical strategy K-12. Engineering habits of mind2 are aligned with what many believe are essential skills for citizens in the 21st century.3 These include (1) systems thinking, (2) creativity, (3) optimism, (4) collaboration, (5) communication, and (6) ethical considerations (Katehi, Pearson, & Feder, 2009).

Embedded Assessment – Embedded assessment is also called formative assessment. It takes place throughout a lesson or unit to assess student progress, and is used to determine skills students have mastered and where they may need support.

Hypothesis – In science, a hypothesis is an idea or explanation that you then test through study and experimentation. Outside science, a theory or guess can also be called a hypothesis. A hypothesis is something more than a wild guess but less than a well-established theory (“Hypothesis,” n.d.).

Integrated Learning – Refers to an instructional design that incorporates a range of teaching, learning and technological strategies. E.g., Students may work individually, in small groups, in large groups or whole class. Teachers may use direct instruction, distance learning, hands-on activities and a range of other strategies.

Opportunity Gap – Closely related to achievement gap and learning gap, the term opportunity gap refers to the ways in which race, ethnicity, socioeconomic status, English proficiency, community wealth, familial situations, or other factors contribute to or perpetuate lower educational aspirations, achievement, and attainment for certain groups of students (Great Schools Partnership, 2014).

Peer Tutoring – Peer tutoring pairs low performing students with high performing students on a one to one basis to practice or complete academic tasks.

Process skills – Process skills support learning and are essential to scientific investigations. They are observing, communicating, measuring, comparing, contrasting, organizing, classifying, analyzing, inferring, hypothesizing and predicting.

Project Based Learning – Project-based learning refers to any programmatic or instructional approach that utilizes multifaceted projects as a central organizing strategy for educating students. When engaged in project-based learning, students will typically be assigned a project or series of projects that require them to use diverse skills—such as researching, writing, interviewing, collaborating, or public speaking—to produce various work products, such as research papers, scientific studies, public-policy proposals (Great Schools Partnership, 2014).

Relevant – In education, the term relevant typically refers to learning experiences that are either directly applicable to the personal aspirations, interests, or cultural experiences of students (personal relevance) or that are connected in some way to real-world issues, problems, and contexts (life relevance) (Great Schools Partnership, 2014).

Scientific inquiry – "The diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world." (National Academies Press, 2015, p. 23)

STEM (Science, Technology, Engineering, Math) Education – Is an infusion of Science, Technology, Engineering, and Mathematics through project-based learning to understand complex problems and to prepare our next generation of innovators (North Carolina Department of Public Instruction, n.d.)

Student Centered Learning – The term student-centered learning refers to a wide variety of educational programs, learning experiences, instructional approaches, and academic-support strategies that are intended to address the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students, and groups of students. To accomplish this goal, schools, teachers, guidance counselors, and other educational specialists may employ a wide variety of educational methods, from modifying assignments and instructional strategies in the classroom to entirely redesigning the ways in which students are grouped and taught in a school (Great Schools Partnership, 2014).

School climate/culture – The term school culture generally refers to the beliefs, perceptions, relationships, attitudes, and written and unwritten rules that shape and influence every aspect of how a school functions, but the term also encompasses more concrete issues such as the physical and emotional safety of students, the orderliness of classrooms and public spaces, or the degree to which a school embraces and celebrates racial, ethnic, linguistic, or cultural diversity (Great Schools Partnership, 2014).

Student Engagement – In education, student engagement refers to the degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the of motivation they have to learn and progress in their education (Great Schools Partnership, 2014).

Appendix B: References

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Appendix C: Research Alignment

Citation	Brief Summary of Strategy	Sample Size	Impact/Evidence of Effectiveness	Implementation
Agodini, R., Harris, B., Atkins-Burnett, S., Heaviside, S., Novak, T. & Murphy, R. (2009). *Achievement effects of four early elementary school math curricula: Findings from first graders in 39 schools.* Washington, D.C.: US Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance.	The purpose of this large-scale, national study is to determine whether some early elementary school math curricula are more effective than others at improving student math achievement. The report also examines whether curriculum effects differ for student subgroups in different instructional settings. The curricula were: • Investigations in Number, Data, and Space • Math Expressions • Saxon Math • Scott Foresman-Addison Wesley Mathematics	39 schools, 131 1st grade teachers and 1309 students.	Student achievement was substantially higher in schools that used Saxon Math and Math Expressions. Average HLM-adjusted spring math achievement of Math Expressions and Saxon students was 0.30 standard deviations higher than Investigations students, and 0.24 standard deviations higher than SFAW students. For a student at the 50th percentile in math achievement, these effects mean that the student's percentile rank would be 9 to 12 points higher if the school used Math Expressions or Saxon, instead of Investigations or SFAW. Achievement was not significantly different between the two more effective curricula, Saxon Math and Math Expressions. There was also no significant difference between the two less effective curricula.	The study team provided some basic implementation support. The support began during the site recruitment process. The study team sought buy-in for all four of the study's curricula from all key district- and school staff. The team introduced the participating districts to the publishers. Publishers then worked with the districts and schools to deliver curriculum materials when study participants needed them. Publishers also worked with schools and teachers to establish training days, and the study

Citation	Brief Summary of Strategy	Sample Size	Impact/Evidence of Effectiveness	Implementation
				team provided logistical and financial support for the trainings. When teachers received training during noncontract time (during summer, evenings after school, or weekends) they were compensated for their time at district salary rates as required by teacher unions.
Le, V., Stecher, B. M., Lockwood, J. R., Hamilton, L. S., Robyn, A., Williams, V.,…Klein, S. P. (2006). *Does reform-oriented teaching make a difference? The relationship between teaching practices and achievement in*	This research study looks at the relationship between "reform oriented" teaching practices; those that emphasize hands-on learning and actively involving students in their own learning and student achievement in math and science. These	Five cohorts of elementary and middle school students in three school districts; three in math and two in science. A cohort consisted of all the students in a grade in one of the two selected subjects.	Students exposed over several years to reform oriented teaching practices performed better on math and science assessments than those who had less exposure. In both math and science, the strength of the relationship between teaching practices and performance was related to how performance was assessed; the relationship was strongest when open ended measures were used.	Mosaic II is an observational study, relying on naturally occurring variation in teaching practices as the basis for uncovering relationships between reform-oriented practice and student outcomes. Each year, all

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mathematics and science. Santa Monica, CA: RAND Corporation.	instructional practices center on inquiry based activities and "intellectual" conversation skills, such as questioning. For this study, cohorts of students were followed for three years, and achievement was measured using both multiple choice and open ended questions on end of year achievement tests. Items requiring problem-solving skills were differentiated from those requiring only procedural skills. Multiple measures were used to assess instructional practices. These were:			participating teachers completed a survey, filled out classroom logs, and responded to a set of vignette-based questions about instructional practices.

Citation	Brief Summary of Strategy	Sample Size	Impact/Evidence of Effectiveness	Implementation
	• Teacher surveys • Classroom vignettes • Teacher logs • Classroom observations			
Powers, S. & Price-Johnson, C. (2007). *Evaluation of the Waterford Early Math & Science Program for kindergarten: First-year implementation in five urban low-income schools.* Tucson, AZ: Creative Research Associates.	This is an examination of the Waterford Early Math & Science (WEMS) program. WEMS is a broad based software program designed to support math and science learning in K-2. It can be used alone or as a supplement. It has the capacity to individualize lessons, assess and track progress and re-teach where it is necessary. It is aimed at at-risk students. This experimental study	345 Kindergarten students that were part of a larger sample of K-2 students. The study took place in 5 schools in Tucson, Arizona.	WEMS students out performed control students on math and science measures by a significant margin; program effect sizes were moderate. Results were consistent across all demographic groups, including ELL.	Treatment classrooms were provided 4 to 6 computers loaded with the software. Teachers received training with the program, and were told to give students at least four 22 minute sessions per week with the program. Control classrooms used the program already in place in the schools.

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	used a stratified random selection process to assign classrooms to the study. The Stanford Achievement Test was used to collect pre- and post-test achievement information. Classroom observations, focus groups, surveys and interviews were also conducted.			
Rock, J., Courtney, R. & Handwerk, P. (2009). *Supplementing a traditional math curriculum with an inquiry-based program: A pilot of Math Out of the Box*. Princeton,	This quasi-experimental study looks at the achievement of elementary students when regular math instruction is supplemented with an inquiry based program, in this case,	The sample consisted of 767 New Jersey students in the third, fourth, and fifth grades. About one third used MTB. Five schools participated; all 3rd, 4th and 5th	Teachers were observed to be generally effective in using the program. Analysis showed that students who used Math out of the Box scored higher on the ETS assessment than students who did not, across all grades. When average scores were compared, for third graders, there was a statistically significant difference between those	To examine implementation of MTB in schools, algebra lessons in 10 classrooms were observed. While the observations do not provide a complete picture of the implementation, they

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N.J.: Educational Testing Service.	Math Out of the Box, a math curriculum developed by the College of Engineering and Science at Clemson University. Math out of the Box has four strands: Developing Algebraic Thinking, Developing Geometric Logic, Developing Measurement Benchmarks, and Developing Number Concepts. For this study, the Developing Algebraic Thinking and Developing Geometric Logic were used. The achievement of students who used Math out of the Box was compared to the achievement of	grade teachers (52) took part. 12 teachers volunteered to use the program and were trained.	who used the program and those who did not of 1.40 points. For 4th graders, the difference was 1.92, and for 5th graders the difference was 3.02. For the New Jersey state assessment (NJASK), there was a small but statistically significant effect of MTB on adjusted scores in the third grade and no effects for the fourth and fifth grade scores.	do provide a basic measure of effectiveness of implementing the program in the classrooms.

Citation	Brief Summary of Strategy	Sample Size	Impact/Evidence of Effectiveness	Implementation
	students in classrooms that did not use the program. Comparison was made within grades. An assessment developed by ETS, and New Jersey's standardized math test were used as assessments of achievement.			

Best/Promising Practices

Promising Practice	Citation(s)	Comments/Limitations
STEM Programs and Activities	Hanover Research. (2012). *Best Practices in Elementary STEM Programs*. Washington, DC. http://school.elps.k12.mi.us/ad_hoc_mms/committe_recommendation/4.pdf	The Compendium of Best Practice K-12 STEM Education Programs that target elementary students are: • Project Lead the Way • ASSET Inc. (Achieving Student Success through Excellence in Teaching) has demonstrated that the program has proven success in raising students' math and science standardized test scores. • Math Out of the Box • Seeds of Science/Roots of Reading Out of class STEM activities that promote participation of all

Promising Practice	Citation(s)	Comments/Limitations
		students but specifically minority and underrepresented groups in STEM: • School-based (math competitions, robotics competitions, science fairs) • After-school programs (connect math with household activities, build robots using Legos, study wildlife) • Weekend programs or Summer camps (engineering, astronomy, number theory)
Science Kits	Slavin, R., Lake, C., Hanley, P. & Thurston, A. (2014). Experimental evaluations of elementary science programs: A best-evidence synthesis. *Journal of Research in Science Teaching*. 51(7), 870-901.	Programs that provide science kits showed a limited impact on science achievement. Across six studies, the weighted overall mean was 0.02. Ten studies of programs that did not provide kits showed an impact of 0.36. The six studies of technology based programs included in the analysis did show positive impact. The weighted mean effect for these studies was 0.42. The researchers advise caution in interpreting these results because of the possibility of selection bias. A discussion of possible reasons for the results is included.