The LASER Model

A Systemic and Sustainable Approach for Achieving High Standards in Science Education

A Validation Grant Proposal prepared by

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Smithsonian Institution and the National Academies

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Competitive Preference Priority

8—Innovations that Serve Schools in Rural LEAs.

The project will improve teacher effectiveness and student achievement in rural schools. The schools in Indiana have significant numbers of rural and urban students living in poverty. In Indiana's Region 9, for example, 71% of students are minorities, and 24% of students live below the poverty line. The schools in North Carolina serve both rural and urban student populations, including a high-poverty rural community with a majority African-American population and another composed of a transient Hispanic migrant population.

The realities in these rural communities demonstrate the need to address systems of coordination to support student achievement and teacher effectiveness. The project provides rural teachers the opportunity for professional development using a research-based approach to science. The project provides an avenue toward establishing a professional learning community that allows for collaboration among otherwise isolated rural teachers and administrators. Teachers will receive instructional materials and materials support systems not often available in rural localities. Participation in this project creates and sustains a supply of materials and provides high-quality professional development to this underserved population.

A. Need and Project Design

A.1 The Need for Systemic Science Education Reform

Effective science education is, in itself, an innovation engine, and more urgently needed now than ever to address such major issues as climate change, international/national security, conservation of resources, disease epidemics, and other health threats, trade, and more. In President Obama's words, "… we know that the nation that out-educates us today will out-compete us tomorrow. And I don't intend to have us out-educated" (Obama, 2009).

Unfortunately, decades of efforts to raise standards in science education have had only modest impacts in classrooms. During the past decade the amount of time students in elementary and middle school spend studying science has significantly declined. This lack of commitment to science education is reflected in student performance on national tests, which increasingly attempt to measure not just content knowledge, but scientific thinking. On the 2005 U.S. National Assessment of Educational Progress (NAEP, 2005), the "Nation's Report Card," only 29% of fourth graders, 29% of 8th graders and 18% of 12th graders nationally scored "proficient" in science (NAEP, 2005).

Why hasn't science education reform been successful? The answer, we believe, is that our education system still operates in a vacuum, in isolation from its customers, and primarily accountable only to government. We need to break the vacuum seal, open communication, and establish mutual accountabilities between all stakeholder groups, connecting and engaging the formal education system with the workplace and informal learning environments. We need to implement a truly *systemic* approach to the problem, one that engages participants at every level, from students and classroom teachers up through the highest levels of district, state, and national leadership. We need a validated "proof of concept" that all elements of the system need to be engaged for transforming science education programs in urban, rural, and suburban communities.

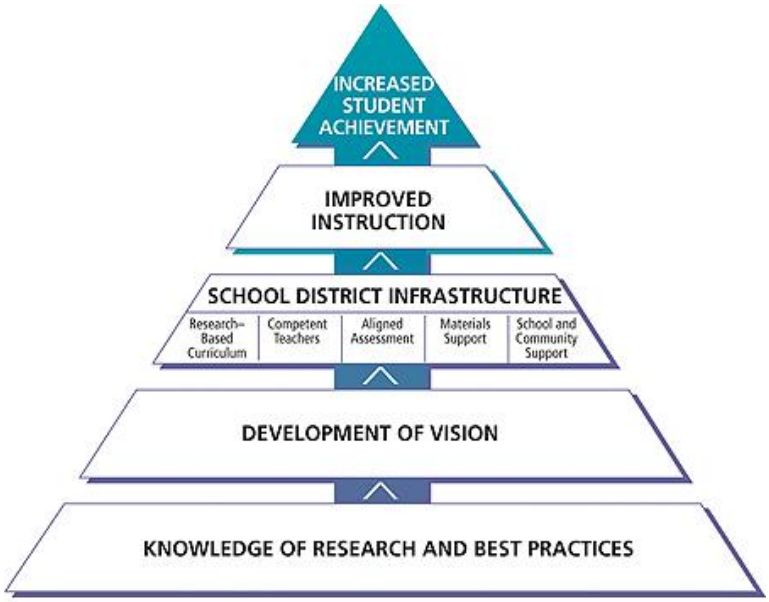
Once validated, both private and public leaders will have critical questions answered and can support future expansion, thus leveraging government funding on a national dimension. As Table 1 suggests, we need a paradigm shift from a traditional to a systemic approach.

Table 1: System reform in science education

Change Area	Traditional System ➔	Reformed System
Leadership	Generally top down and autocratic with little to no involvement of other stakeholder groups	Distributive leadership team representing all levels of system and community working together
Vision	Poor awareness and knowledge of research and best practices	Shared vision based on research and best practices
Infrastructure	Fragmented approach to science education reform; infrastructure consistent with text-based learning	Coherent systems in place support and promote reform at every level
Curriculum and Teaching Materials	Text book or teacher-developed instruction	Research-based units aligned with standards
Professional Development	No long-term goals or strategic approach; content and pedagogy not integrated	Long-term, differentiated programs moving teachers from novice to competency
Assessment	Aligned with recall of facts	Tests aligned with deep conceptual knowledge; problem-solving
Equipment and Supplies	Teacher provided; not cost-effective or sustained	Centralized management and refurbishment; cost-efficient
Administrative and Community Support	Local administrators working alone; community leaders not involved strategically	Diverse leadership supporting and sustaining research-based program; leveraged resources
School-Based Professional Learning	Teachers implementing instructional programs in isolation; principals not instructional leaders	All staff working collaboratively to assess and continuously improve learning and teaching
Instruction	Teaching primarily through lecture, text, and demonstration; focused on facts and memorization	Teaching with research-based materials and focused on student understanding and use of scientific knowledge, ideas, and inquiry processes; continuous assessment.
Student Learning	Use of traditional textbook Learning by memorizing superficial, fact-based ideas with limited scientific thinking or opportunity to apply to new problems	Use of research-based instructional materials; learning by doing science; deep content knowledge with good ability to think scientifically and solve problems

With 25 years of experience in improving science education in the United States, the National Science Resources Center (NSRC) is committed to helping educators at every level make this shift. Unlike most education institutions and organizations that focus exclusively on one or another aspect of reform, such as professional development, we employ a systems approach.

NSRC Theory of Action



The NSRC developed this theory of action to guide school districts in the process of establishing research-based science education programs that result in improved instruction and increased achievement for all students.

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Our Leadership and Assistance for Science Education Reform (LASER) model provides diverse leadership teams with actionable knowledge about research and best practices. Teams of teachers, administrators, parents, academics, museum leaders and business officials are actively engaged in experiences for learning how to implement a new vision of effective science learning and teaching that includes areas of the system that need to be in place for improving student achievement. The five areas include: (a) research-based instructional materials; (b) differentiated professional development programs that help teachers move them from novice to competency; (c) aligned and cognitively-demanding assessments; (d) cost-efficient and sustainable systems

for supplying equipment and supplies; and (e) programs for developing and maintaining support from educational leaders and community organizations.

A.2 Goals and Approach

The overarching purpose of the proposed project is to develop the capacity for full national scale-up of the LASER model. To this end we have identified four important goals.

1. First, we need to further test and refine our existing materials, including the benchmarking tools we use to help leaders develop a shared vision for successful reform of science education throughout their jurisdictions.
2. Second, we want to "stress test" our model in a range of sites, including high-poverty urban and rural schools that are known to be resistant to change.
3. Third, we want to work with researchers to conduct a definitive study of our work, including a rigorous, cross-state evaluation consisting of a carefully-designed, randomized controlled trial complemented by multiple case studies.
4. Finally, we want to gain a better understanding of the constellation of factors at every level of the system that will be critical to the success of subsequent national scale-up.

The project will take the LASER model to three geographically and ethnically diverse regions of the country: Houston, Texas; Indiana, and North Carolina. The Houston Independent School District (HISD) serves 200,000 students, nearly 80% of whom qualify for free or reduced meals. The schools in Indiana have significant numbers of rural and urban students living in poverty. In Indiana's Region 9, for example, 71% of students are minorities, and 24% of students live below the poverty line. The schools in North Carolina serve both rural and urban student populations, including a high-poverty rural community with a majority African-American population and another composed of a transient Hispanic migrant population. The NSRC will work with leaders in these sites and the urban and rural schools that have agreed to participate in

this important initiative to plan and implement each of the components of the LASER model. These are described briefly below, and in more detail in Appendix H.1a-l.

A.2.1 Needs Analysis

All participating schools and districts in all three sites will be invited to participate in a needs analysis of their science education programs. Conducted by a third-party evaluator, the needs analysis will consist of a set of surveys and student assessments designed to identify the degree to which schools have already successfully implemented high-quality science programs. The results will be compiled into a set of district and school-level reports. As explained in Section D, the evaluation team will use the results of the needs analysis to identify a set of matched pairs of schools, and schools within each pair will be randomly assigned to treatment and control conditions. Beginning in Year 2, teachers in the control schools will receive kit-based units, training, and site-based support (see below); training of teachers in the treatment schools will be delayed until Year 4. The needs analysis will be conducted annually in both treatment and control sites, thus providing *all* participating schools with an important benefit, while at the same time providing the evaluation team with data on infrastructure development, instructional strategies, and student learning in both treatment and control sites.

A.2.1 Leadership Development, Strategic Planning, and Sustainability Strategies

The results of the needs analysis will be discussed with participating district leaders, and will form the basis for a series of events aimed at building a shared vision and strategic plan for the reform of local science education. These events will include (a) an NSRC Awareness Building Conference with annual follow-up activities; (b) an NSRC Science Education Leadership Development and Strategic Planning Institute and Next Steps Institute; and (c) the development of district STEM Advisory Board with quarterly meetings to establish materials center and

strategies for sustaining support. These activities will engage leaders in all participating districts, regardless if schools are in the treatment or control group.

A.2.3 Teacher Professional Development and Long-term Support

Teachers in treatment schools (Grades 1-8) will receive two specialized levels of professional development and ongoing site-based support to implement three research-based, inquiry-oriented units in life, earth, and physical sciences. They will also be expected to take part in annual professional development workshops, with follow-up support of ongoing, site-based professional learning opportunities such as lesson study and the collaborative review of student work. Teachers in control schools will begin receiving this training and support in Year 4.

A.2.4 Expected Outcomes

As a result of this work, we expect to see substantial increases in participating schools' capacity to deliver high-quality, inquiry-based science instruction in every classroom. This will include (a) a cadre of some 300 principals with substantially increased ability to promote and support this kind of science instruction in their classrooms; (b) more than 15,000 teachers with substantially increased ability to deliver this kind of instruction (as measured by classroom observations); and (c)—as a result of (a) and (b)—a substantial number of students becoming at least "proficient" in science, as measured by rigorous measures such as the NAEP.

Specifically, Table 2 shows that roughly 75% of students in Indiana, North Carolina, and Texas scored below proficient on the NAEP science assessment in 2005.

Table 2: Percentage of students scoring at or above "proficient" on NAEP Science (2005)

	Indiana	**North Carolina**	**Texas**
Grade 4	27	25	25
Grade 8	29	22	23

Source: National Assessment of Educational Progress

Given that we will be working primarily in high-poverty urban and rural districts, we assume that the numbers in these districts will be even lower. Given also the existing evidence (Section B) of the impact of high-quality, inquiry-based science instruction on student achievement — with effect sizes of as high as a full standard deviation— we think it is not unreasonable that, over a period of five years, participating schools will be able to help at least an additional 25% of students become proficient. Since some 75,000 students will be affected, of whom at least 56,000 would be expected to be scoring below proficient, this means something on the order of 15,000 students might move into the "proficient" category.

We also predict a substantial increase in students' positive attitudes and perceptions about science and interest in science careers, thus potentially increasing the number of students seeking post-high school degrees and pursuing careers in the fields of science, technology, engineering and mathematics.

A.3 Consistency with Research Evidence

As documented in the following section, there is already at least modest scientific evidence (as defined by the What Works Clearinghouse) that inquiry-oriented science instruction, backed by research-based materials and ongoing professional development, leads to higher levels of student learning than traditional text-based instruction. There is also evidence that teachers who receive more intensive professional development are more likely to successfully implement this kind of instruction than those who don't. We expect that the researchers will find significantly higher levels of learning on aligned outcome measures in the treatment schools. The *combination* of the randomized controlled trial and a series of case studies of selected treatment schools the evaluation team will be able to provide a detailed picture of the critical factors that tend to distinguish successful implementations from less successful ones.

B. Strength of Research, Significance of Effect, Magnitude of Effect

As explained in the preceding section, the NSRC promotes science education reform at two levels simultaneously. We provide classroom teachers in a given site with the materials and professional development they need to effectively engage their students in scientific inquiry. Second, we work with state and district leadership on infrastructure development, focusing on critical success factors such as alignment of curriculum, assessment, and instruction; and community and university partnerships.

From a research perspective, there are at least two important questions regarding this work: (1) What is the evidence that an activity-based, inquiry-oriented approach to science learning, combined with research-based materials and ongoing professional learning, leads to student mastery of the new standards?; and (2) What is the evidence that the LASER approach itself has been successful in helping promote systemic change? In this section we address the first question, arguing that there is indeed at least moderate evidence (as defined by the What Works Clearinghouse) that the inquiry model is effective. We address the second question in Section C.

B.1 Strength of Research

Table 2 summarizes a set of relevant studies, sorted in descending order of reported effect size. (While we do not claim that the list is comprehensive, we believe it represents the range of published findings reasonably well.)

Table 3: Representative research on the relationship between inquiry instruction and student science learning

Study	Type	E.S.	Notes
Rivet & Krajcik (2004)	Pre/Post Tests	1.36-1.61	A longitudinal study involving 24 teachers and over 2500 students looked at pre- and post-tests over a period of four years for teachers using materials and professional development emphasizing "real-world" problems. *There was no comparison group*.
Vanosdall, Klentschy, Hedges &Weisbaum (2007)	ED	1.09-1.39	Well-designed experiment comparing inquiry vs. textbook instruction. 24 elementary teachers randomly assigned to treatment and control groups, treatment teachers receiving kits and training; outcome measures included aligned assessment (*e.s.*=1.09) and standardized science test (*e.s.*=1.39).
Cuevas, et al (2005)	Pre/Post Tests	0.10-1.79	Looked at the impact of activity-based intervention on science-inquiry and narrowing gaps between student-types. Limitation: *Lack of control or comparison group*. Overall effect size=1.51.
Banilower (2007)	Q-ED	0.61-1.03	Quasi-experimental design found that students with trained teachers using inquiry-oriented materials made greater gains on aligned assessments than students not receiving such instruction, controlling for pre-test scores and student demographics.
Ferguson (2009)	Q-ED	.374	Quasi-experimental design with teachers in three treatment schools (N=88) receiving kits, training, and ongoing activities to promote formation of a "professional learning community;" and three comparison schools where teachers (N=110) received the kits and written instructions, but not the targeted professional development. Students of treatment teachers gained more on pre-post content test than those of control teachers.
Bredderman (1983)	Meta-analysis	0.35	Summary of research on three major activity-based science programs, comparing outcomes for textbook-based programs; larger mean effects with aligned assessments, process skills.
Shymansky et al. (1990)	Meta-analysis	0.30	Summary of research on "post-Sputnik" looked at activity-based vs. textbook-based material. The study included "poorly controlled" quasi-experiments and small number of randomized experiments.
Ruby (2006)	Q-ED	0.20	Quasi-experiment involving a science curriculum using NSF-supported materials, teacher development, and peer coaches. Researchers compared cohort of 3 middle schools (treatment), from end-of-fourth through 7th grade, with 3 matched control schools and 23 district middle schools.
Young & Lee (2005)	Q-ED	N.S.	Compared achievement of students in districts using kit-based science supported by extensive professional development with achievement in districts that using traditional materials without intensive professional development. No significant differences in achievement; however, classrooms with kits scored significantly higher than those without kits. Classrooms without kits spent more time on broader topics, while kit-based classrooms covered fewer topics, but in more depth.

As can be seen, these findings range considerably. Arguably the most important study is Vanosdall, Klentschy, Hedges & Weisbaum (2007). This was a well-designed experiment comparing "scaffolded guided inquiry" with traditional textbook instruction. A total of 24 elementary teachers were assigned to treatment and control groups, with treatment teachers receiving kits and training. Students receiving inquiry-based instruction outperformed students in control classrooms on a curriculum-based assessment (*e.s.*=1.09) and a standardized science test (*e.s.* =1.39).

In another important study, using a quasi-experimental design, Banilower (2007) found that students with trained teachers using inquiry-oriented materials made greater gains on aligned assessments than students not receiving such instruction, controlling for pre-test scores and student demographics. Effect sizes for the various components of the assessments ranged from 0.61 to 1.03.

In another quasi-experimental study, Ferguson (2009) looked at teachers (N=88) in three treatment schools receiving kits, training, and ongoing activities designed to promote formation of a "professional learning community;" and three comparison schools where teachers (N=110) received the kits and written instructions, but not the targeted professional development. Treatment students gained more on pre-post content test than controls (*e.s.* =.374).

In a summary of research comparing three major activity-based science programs with outcomes for textbook-based programs, Bredderman (1983) found an overall mean effect size of .35, with larger mean effects for aligned assessments and process skills. In a summary of research on "post-Sputnik" science instruction, Shymansky, Hedges, & Woodworth (1990) looked at activity-based vs. textbook-based materials and found an average effect size of .30.

B.2 Estimated Magnitude of Effect

In short , research findings regarding the relationship between professional development, inquiry-based science, and student science learning are mixed, ranging from studies that detected no effect to those reporting effect sizes of more than one standard deviation—a large effect in educational research. For the studies we looked at that reported statistically significant findings and used at least a quasi-experimental design, effect sizes were in the range 0.20-1.39, i.e., "small" to "large." Here we must also acknowledge the "file drawer problem," i.e., the tendency for researchers not to publish non-significant results, meaning that the true effect could be lower than that estimated by the mean of reported studies (Rosenthal, 1979). That said, we believe that the true effect of this type of instruction is more likely to be toward the *upper* end than the lower end of the reported range. Our reasoning is based on common sense: If the expected outcome is that students will be ultimately be able to *do* science, and think scientifically, then it stands to reason that instruction that engages them in scientific inquiry is more likely to have the intended outcome than instruction that does not, as reported in the small number of well-designed studies that detected medium to large effects (e.g., Vanosdall, Klentschy, Hedges & Weisbaum, 2007; Banilower, 2007). Similarly, given the relative difficulty of organizing inquiry-based science instruction in the classroom (as opposed to teaching from a textbook), it also stands to reason that teachers require intensive professional development and support, and that when they receive it, their ability to deliver inquiry-based science instruction will increase.

Since the proposed initiative is large-scale and systemic, designed to promote change at every level of the system in three diverse regions of the United States, there is reason to believe the overall *magnitude* of the effect will be substantial. Given our prior work in this field, we have every reason to believe that we can be successful. This is the subject of the following section.

C. NSRC Experience

The NSRC was founded in 1985 by the Smithsonian Institution and the National Academies of Science, Engineering and the Institute of Medicine to ensure that every student in the United States has access to high quality science education. In accordance with this mission, the NSRC has successfully directed five major multi-year, multi-million dollar initiatives during the past two decades. All projects involved numerous sites, hundreds of leaders, and the need to form and sustain dozens of strategic partnerships with schools, districts, academic institutions, corporations, foundation, government agencies, and museums. The added value of NSRC products and services, including impact on student achievement, has been confirmed by studies conducted by independent evaluators and corporations and foundations that have invested in the NSRC for more than two decades. See Appendix H.3.e for additional information.

C.1 NSRC Past Performance in Implementing Complex, Long-Term Projects

In 1997, the NSRC launched the Leadership and Assistance for Science Education Reform (LASER) Center, a $13 million, seven-year initiative supported by NSF and numerous corporations and foundations. The LASER Center was unique in that the NSRC began working with diverse regions and states to develop another level of expertise needed to work effectively with all levels of the education system.

The LASER model has now been implemented in numerous regions and states, including Alabama, southern California, Delaware, regions of New Jersey, Pennsylvania, northern New Mexico, Rhode Island, and Washington State. Self sustaining, statewide LASER projects in Pennsylvania (ASSET, Inc.), Alabama (AMSTI), Washington State (Washington LASER), and Delaware (Delaware Science Coalition) were all started through the NSRC's NSF-funded LASER grant consisting of eight regional sites in 1997. Of those original LASER sites, four have scaled statewide and have student achievement data supporting the impact of the LASER model.

In all of these cases, the NSRC has consistently demonstrated an ability to form strategic regional partnerships leveraging local education agencies, institutes of higher education, other non-profit agencies, businesses and state leaders to implement and sustain the LASER model of science education reform for a decade or longer. Self sustaining, statewide LASER projects in Pennsylvania (ASSET, Inc.), Alabama (AMSTI), Washington State (Washington LASER), and Delaware (Delaware Science Coalition) were all started through the NSRC's NSF-funded LASER grant consisting of eight regional sites in 1997. Of those original LASER sites, four have scaled statewide and have student achievement data supporting the impact of the LASER model.

As a result of the leadership development programs the NSRC has conducted over the past two decades, thousands of leaders representing more than 1500 districts are now implementing systemic reform programs for millions of students. These districts represent 30% of the U.S. student population.

C.2 Impact on Student Achievement

Studies and independent evaluations of LASER demonstrate its effectiveness in various states and school districts and impact on teacher competency and student achievement. Two evaluations stand out among the state and regional case studies of LASER: Washington State and Pennsylvania. In 2008-2009, third-party evaluators looked at the impact of Washington State's LASER program on student achievement. The study found that inquiry-based science instructional materials (in this case STC) coupled with aligned teacher professional development was a "small but significant predictor" of a school's student achievement on the Washington Assessment of Student Learning (WASL) at grades 5 and 8 (RMC Research Corporation, 2010:10).

Under the leadership of Pittsburgh-based ASSET (Achieving Student Success through Excellence in Teaching) Inc., a nonprofit educational leadership group, 164 school districts,

charter and private schools throughout Pennsylvania (ASSET, 2008-09) have followed the NSRC LASER model for science education reform. A 2010 independent evaluation of an ASSET spin-off program, "Science: It's Elementary" conducted by Horizon Research, Inc., focused on 4th graders in 50 school districts. The evaluation confirmed that students who participated in the STC inquiry-based science education program "significantly outperformed their peers on the Pennsylvania School System Assessments (PSSA scoring "significantly higher than students in demographically similar comparison schools" (Horizon Research, Inc., 2010, ASSET Results Report).

This pattern of improved student achievement using the NSRC LASER model was confirmed in two randomized experiments conducted in California's El Centro Unified School District, a "geographically isolated rural area having an economically disadvantaged student population with a large proportion of English language learners." As cited in Section B, these studies concluded that "scaffolded guided-inquiry used in conjunction with kit-based materials dramatically improved fifth grade science achievement compared to either text-based instruction or instruction using kit-based materials alone" (Vanosdall, Klentschy, Hedges and Weisbaum, 2007:19). In short, the NSRC experience in developing a model for systemic science education reform, LASER, shows promising results in improving student achievement in science for students from kindergarten through 8th grade. The case studies and experimental research analyses justify proceeding to the large-scale, cross-state validation study described in the next section.

D. Evaluation Plan

The proposed study will employ a carefully-designed, randomized controlled trial (RCT) complemented by multiple case studies (Baxter & Jack, 2008; Yin, 2003). The RCT will involve a carefully selected sample of the full population of participating schools in Houston, Indiana, and North Carolina, consisting of approximately 100 schools, 600 teachers, and 9,000 students. The RCT will allow the researchers to test the causal relationship between inquiry-based science instruction and student science learning. The case studies will provide vertical slices through a sub-sample of approximately 30 treatment schools, providing a rich, contextualized picture of the individual and intermeshed experiences of students, teachers, and instructional leaders as they engage in the reform process. Cross-case, collaborative analysis by multiple researchers will be used to test propositions, triangulate data sources and analyses, identify generalizable patterns and themes, and assure trustworthiness of findings (Baxter & Jack, Knafl & Breitmayer, 1989).

Figure 1: Mixed methods evaluation design combining RCT with multiple case studies

		Multiple Case-Study Analysis									
Levels		Case 1			Case 2			Case 3			Case N
National		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site N
State											
District											
School	Rx										
	C	**Randomized Controlled Trial**									

Note: Rx= treatment; C=control; shading represents relative data density.

This design will allow the researchers to test causation and also look at causal mechanisms and factors affecting variation in outcomes within both the treatment and control groups (Chatterji, 2004; Feur et al., 2002; Maxwell, 2004; Rudd & Johnson, 2008; Stufflebeam, 1983). This understanding of critical success factors will be essential to subsequent national scale-up.

D.1 The Randomized Control Trial (RCT)

The RCT will test the following two research-supported hypotheses: (1) Teachers who receive intensive professional development in high-quality, inquiry-based science instruction are more likely to provide this type of instruction in their classrooms than similar teachers in similar schools who do not receive this kind of professional development; and (2) Students who receive high-quality, inquiry-based science instruction are more likely to score higher on tests of science learning than similar students in similar schools who do not receive such instruction.

D 1.1 Needs Analysis, Site Recruitment, and Randomization

The NSRC is in the process of recruiting implementation partners in Houston, Indiana, and North Carolina to participate in the RCT. To facilitate data collection and gain cooperation (see Cook, 2002; Rudd & Johnson, 2008), potential sites will be invited to take part in an annual *needs analysis* of their science programs. The needs analysis will pull together data from a combination of teacher surveys, a leadership survey, scores on standardized tests, and customized, curriculum-based assessments of student science learning. Data from these sources will be compiled into a series of annual needs analysis reports, which will be provided free of charge to each participating district and school.

Needs analysis data gathered in Spring 2011 will be used to identify a set of matched pairs of approximately 100 schools. Schools will be matched on factors such as grade levels taught, prior student performance on tests of science learning, geographic context (e.g., urban vs. rural), SES, and the extent to which inquiry-based science learning is already established at the school. These data will be used to create *quantified school profile scores*, constructed from values of the intervening variables weighted in accordance with evidence-based estimates of their relative impact on student science learning. The matched pairs of schools will then be randomly assigned to treatment and control conditions. Over a period of three years, the NSRC will engage science

teachers in the treatment schools in a process of intensive professional development in the use of inquiry-based science instruction. Teachers in the control schools will not receive this kind of professional development from NSRC, but will not be prevented from receiving it elsewhere. Site visits to randomly selected treatment and control schools will be used to measure the extent to which teachers in these schools engage students in high-quality inquiry-based science instruction. The curriculum-based science assessments, combined with the results of standardized tests, will be used to measure student science learning in both treatment and control sites.

D 1.2 Power Analysis to Determine Sample Size

The decision to use 100 schools in the RCT is based partly on a power analysis (Liu, Spybrook, Congdon, Martinez, & Raudenbush, 2009) to determine the minimum number of schools required to detect an effect size of 0.25 at $p < .05$, which the What Works Clearinghouse considers the minimum that is "substantively important" (U.S. Department of Education, 2008). The power analysis was based on an estimate of 90 students per school (i.e., 30 students per grade for three grade levels per school). It was assumed that 12 percent of the variation in student outcomes would be accounted for by clustering at the school level, and 88 percent at the individual student level, meaning the ICC (i.e., intra-class correlation or variance explained at the school level) is estimated to be 0.12. This 0.12 estimate was based on the average variance explained by schools in the study by Taylor, Pearson, Peterson, and Rodriguez (2004) on the effects of teacher professional development on three literacy outcomes. From this, an optimal minimum total sample size for schools in a three-level longitudinal Hierarchical Linear Model analysis would be 69 for a 0.25 effect size and power of .80, with 35 schools in the treatment group and 34 in the control group. To protect against the likely attrition of schools and students, the researchers have set an arbitrary goal of 100 schools in the RCT, 50 treatment and 50 control.

D 1.3 Analysis of RCT Data

The researchers will use multiple Hierarchical Linear Model (HLM) analyses to test both hypotheses (page 17). To evaluate the impact of NSRC's professional development on classroom instruction, a two-level model will be used (i.e., teachers (Level 1) nested within schools (Level 2)), incorporating relevant data at both the teacher level (e.g., teacher self-reported comfort with inquiry based instruction) and the school level (e.g., school-level reports of perceived level of district support and the extent to which the school has already implemented an inquiry-oriented approach) to gain a more clear picture of the impact of the intervention, controlling for the effects of these teacher and school level factors. For each of the three years of the study, results from classroom observations in treatment and control schools will be evaluated as the outcome to determine any differences in the use of inquiry based instruction between the two teacher groups.

To evaluate the outcomes for the second research question, a series of longitudinal HLM analyses as well as correlational analyses will be conducted. These will include multiple longitudinal analyses of student learning using a customized curriculum-based measure and local standardized tests. Finally, three sets of correlational analyses will be carried out for each of the three sites (Indiana, North Carolina, and Houston) to determine the strength of the relationship between scores on the customized NSRC assessment and each state's own assessment where the two assessments were administered at the same grade level.

D.2 Collection of Implementation Data and Feedback to Program Staff

Beginning in 2011-2012, results of the ongoing survey data, assessments of student and teacher learning, and results of observations of classroom instruction and professional development sessions will be compiled into a series of bi-annual (semester) project reports. These reports will also include progress indicators (such as estimates of the numbers of instructional leaders, teachers, and students affected and the magnitude of these effects), and will

also identify areas of strength and challenge, with evidence-based recommendations for NSRC program staff. These interim reports will also be provided to U.S. Department of Education program staff and will serve as evidence of progress toward achieving intended outcomes.

D.3 Multiple Case Studies: Identification of Key Elements and Interactions

Findings from the RCT will allow our researchers to test causal relationships between the professional development provided by the NSRC, levels of inquiry-based science instruction at the school sites, and student science learning; however, the RCT alone will not provide the deeper understanding of causal relationships and contextual factors that the NSRC will need as it prepares for replication and national scale-up. The researchers will therefore complement the RCT with a multiple case study approach (Baxter & Jack, 2008; Yin, 2003) that will allow them to examine the embedded and inter-related experiences of individual teachers and instructional leaders within schools, districts, and states. Cross-case, collaborative analysis by multiple researchers will be used to test propositions, triangulate data sources and analyses, identify generalizable patterns and themes, and assure trustworthiness (validity) of findings (Baxter & Jack, Knafl & Breitmayer, 1989). Given the intention of national scale-up, generalizability of findings is especially important in this situation.

D 3.1 Selection of Case Study Schools

Case study schools will be selected during the academic year 2011-2012, once sufficient data has been collected to identify suitable sites. Because the primary interest will be in the success of the NSRC intervention, case studies will be developed only for treatment schools. The primary consideration will be to select cases that (a) represent a range of contexts (e.g., large urban districts as well as small rural ones; elementary schools and middle schools; schools with single science teachers, multiple science teachers, etc.); and (b) represent both unusually

successful and less successful implementations. (A secondary consideration will be how accessible the site is to site researchers.)

Table 4 shows a possible sampling design involving a total of 36 cases, representing contrasting pairs of successful and less successful implementations in nine different contexts (e.g., a K-5 school in a large urban district with a single science teacher, a K-5 school in a small *rural* district with a single science teacher, etc.).

Table 4: Tentative sampling design for case study selection

District:	Large urban district							Medium-sized district							Small rural district						
Grade level:	K-5				6-8			K-5				6-8			K-5				6-8		
#Science teachers:	1		>1			>1		1		>1			>1		1		>1			>1	
Success:	+	-	+	-		+	-	+	-	+	-		+	-	+	-	+	-		+	-
N (Total=36):	2	2	2	2		2	2	2	2	2	2		2	2	2	2	2	2		2	2

Note: Shaded cells represent no expected instances.

D 3.2 Case Study Data Collection

Tentatively, data for the case studies will be collected by the same site researchers who conduct the site visits in conjunction with the RCT. To supplement the needs analysis data and the data collected on these visits (classroom observations¸ interviews with teachers and instructional leaders, etc.), the site researchers will seek to engage selected teachers and instructional leaders at study sites in ongoing email correspondence.

D 3.3 Organization and Analysis of Case Study Data

Case study data will be organized in categories following an emerging classification scheme informed by the initial conceptual framework (as described above), and developed jointly by the site researchers, their mentors, and the lead evaluators. For example, categories may include "professional development experiences," "teacher collaboration," "scheduling issues" and so forth. A common database organized around these categories will be housed on a secure server

and made available to all members of the research team. Developing a common set of categories will allow cross-site analysis of cases.

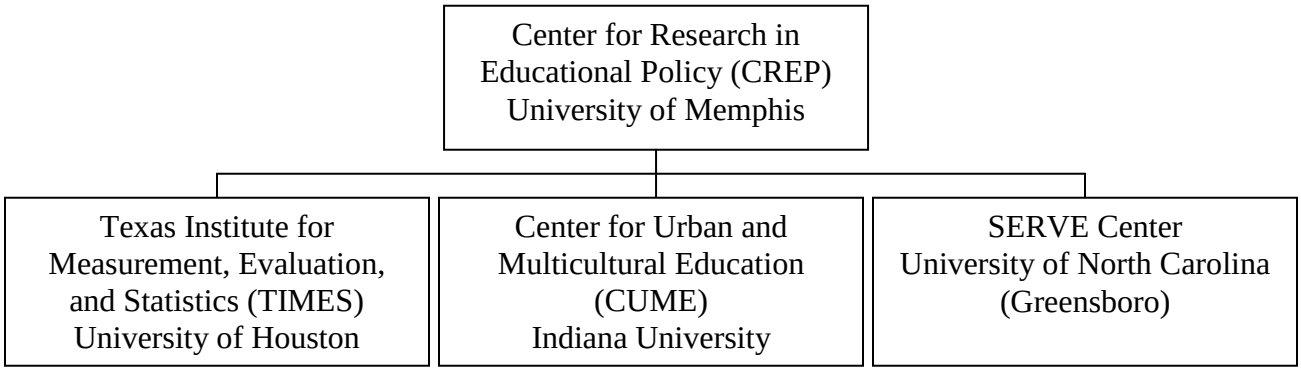
D 3.4 Reporting of Case Study Data

Working under the direction of local mentors, the site researchers will draft their own case studies, following guidelines developed collectively by the research team as a group. The basic structure will be that of a longitudinal narrative, i.e., each case will tell the story of the experiences of teachers, students, and instructional leaders, both individual and collective, over the course of the core three-year study. Site researchers, their mentors, and the lead evaluators will meet periodically to share these developing stories and discuss emerging cross-cutting patterns and themes. In Year 5, the multiple case studies will be merged into a single report, which will also report findings from the RCT.

D.4. Resources for Program Evaluation

The evaluation will be led by researchers at the Center for Research and Educational Policy (CREP), who intend to work in close collaboration with colleagues at the Texas Institute for Measurement, Evaluation, and Statistics (TIMES), University of Houston; the Center for Urban and Multicultural Education (CUME), Indiana University; and the SERVE Center, University of North Carolina (Greensboro).

Figure 2: Organization of the Evaluation Team



As explained below, the combined resources of this evaluation team would be more than adequate to the needs of the ambitious study proposed above. These combined resources include: (a) extensive experience with large, state- and district-level evaluations, including well-designed studies of inquiry-based science instruction; (b) highly-trained statisticians with experience using HLM and other sophisticated techniques to analyze the results of experiments and quasi-experimental designs; (c) systems for conducting and reporting the results of large-scale online surveys; (d) access to graduate students, STEM faculty, and other university resources; and (d) extensive local experience working with schools on the ground in Houston, Indiana, and North Carolina.

D 4.1 The Center for Research in Educational Policy (CREP)

Established in 1989, CREP is an independent research and evaluation unit within the College of Education, University of Memphis. CREP currently employs a staff of nearly 40 trained researchers, practitioners, and research assistants. CREP is well positioned to carry out the planned evaluation. Qualifications include: (a) extensive experience carrying out large-scale evaluations of federally-funded programs in over 20 states, including evaluations of Supplementary Educational Services (SES) in IL, MD, NV, and LA; (b) a state-of-the art online data collection and reporting system; (c) a fully-staffed statistics department with extensive experience managing and analyzing large data sets using a range of tools from simple *t*-tests to Hierarchal Linear Modeling (HLM); (d) experience running quasi-experimental and Randomized Control Trials (RCTs); (e) extensive experience conducting and managing site-based research in hundreds of schools throughout the United States.

D 4.2 SERVE Center (University of North Carolina at Greensboro)

The SERVE Center at the University of North Carolina at Greensboro is a university based research, development, dissemination, evaluation, and technical assistance center. Funded by the

U.S. Department of Education's Institute of Education Sciences, the SERVE Center operates REL-Southeast. The Center is currently engaged in two large-scale RCTs focusing on the effectiveness of interventions seeking to improve teaching and learning in mathematics and science, and kindergarten vocabulary development.

D 4.3 The Texas Institute for Measurement, Evaluation, and Statistics (TIMES)

Founded in 1986, TIMES is a university-wide research center at the University of Houston, with a mission of conducting basic research on cognitive and psychological processes related to student learning, developing and testing educational interventions, testing them at scale, developing guidelines for practitioners, and working in the policy arena to develop federal, state, and local policy that is supported from the research. TIMES staff have extensive experience working in Houston Independent School District.

D 4.4 The Center for Urban and Multicultural Education (CUME)

Founded at Indiana University in 1979, The Center for Urban and Multicultural Education (CUME) has extensive experience facilitating evaluations, including evaluations of statewide programs such as Indiana Twenty-first Century Scholars, International Education in Indiana, and the New Tech High School Initiative in Indiana. CUME's expertise lies particularly in conducting evaluations of educational reforms in diverse school settings. CUME has an extensive training infrastructure for graduate students, including seminars on conducting observations, interviews, using research software such as SPSS and NVIVO, and report writing.

D.5 Evaluator Independence

CREP has no prior history with the NSRC and has no vested interest in the outcome of the study, other than a firm commitment to identifying what works best for teachers and children. CREP and its evaluation partners will work in close collaboration with the NSRC, and will provide us with the results of formative evaluations, so as to ensure timely feedback to the

implementation team. In the interest of strengthening reliability and validity of findings, draft versions of interim and summative reports will be shared with NSRC staff and selected project participants (e.g., instructional leaders at the case study sites). However, CREP and its evaluation partners will make final judgments, and it is agreed that CREP itself will assume final, independent responsibility for the quality of the research and the research findings.

E. Strategy and Capacity to Bring to Scale

E.1 Total Number of Students and Project Impact

This project seeks to transform science teaching and learning in approximately 300 schools across a variety of communities and student populations in the three regional sites of Houston, Indiana, and North Carolina. It will impact 75,000 students in Grades 1-8, 3000 teachers, and 300 principals. The NSRC has the capability and experience to manage the scale of this project based on prior experiences in simultaneously scaling eight regional sites under a five-year National Science Foundation Grant from 1997–2002. This project will allow us to take our shared vision of science education to scale in each region while contributing to the research validating the impact of the LASER model.

E.2 NSRC Capacity

Through its parent institutions, the Smithsonian Institution and the National Academies, the NSRC will bring expertise, resources, prestige, and credibility to the effort. Moreover, the NSRC itself has the organizational capacity to bring this project to scale through highly qualified and experienced staff, a national network of hundreds of experienced professionals, a distinguished National Advisory Board, and the NSRC i3 Advisory Board.

E.2.1 Senior NSRC Leadership

The NSRC has 20 employees who oversee a national network of hundreds of professionals and consultants specialized in science and education to efficiently deliver its products and services. Our three top managers have a collective 50 years of experience managing projects of $10 million or larger in scale. The NSRC is governed by a five-member senior team from the Smithsonian Institution and the National Academies in cooperation with the Executive Director.

E.2.2 Key Project Staffing

Principal Investigators

Sally Goetz Shuler, Executive Director, National Science Resources Center

David Marsland, Director of Professional Development, National Science Resources Center

Thomas Emrick, Deputy Executive Director, National Science Resources Center

Karen Collias, Deputy Director, National Science Resources Center

Donald Morrison, Senior Researcher, Center for Research in Educational Policy

Regional Site Directors

Regional Site Directors for this Project are as follows: (1) North Carolina: Sam Houston, President and Chief Executive Officer for the North Carolina Science, Mathematics, and Technology Education Center; (2) Indiana: William S. Walker, Executive Director for the Indiana Science, Technology, Engineering, and Mathematics Resource Network; and (3) Houston: Tracy Weeden, Assistant Superintendent for Elementary Curriculum, Instruction and Assessment for the Houston Independent School District.

Regional Site Managers (Based at NSRC)

Regional Site Managers will be responsible for managing the project to insure they are meeting timelines, goals, and objectives and within budget. Responsibilities will include working with the Regional Site Director, Regional Site Coordinators, the NSRC, and program evaluators to plan, organize, implement and evaluate the project.

Regional Site Coordinators (Based at Regional Site)

Each site will have a dedicated coordinator to work with the local school district administrators, teachers, and other partners needed to accomplish project goals. A major responsibility will be to work collaboratively with the NSRC team to organize and implement the

comprehensive program development program of workshops and other related activities for more than 3,000 teachers at the three sites.

Financial Resources

The NSRC is an organization of two prestigious scientific institutions, the National Academies and the Smithsonian, both of which are non-profits. The NSRC is a robust and financially healthy organization with a strategic business plan supported by multiple funding sources including corporate gifts; government and non-government grants; contracts; fees provided for program services; royalties and fees from the sale of publications; and interest from two quasi-endowments. Through its work, the NSRC has served as a model for how to obtain significant resources from multiple sources to sustain and scale strategic programs with measurable impacts.

E.3 Feasibility of Project Replication

The continuation and replication of the project is an embedded objective within the LASER model. Creating regional advisory boards, building corporate awareness and support for science education, building local capacity to deliver teacher professional development and strategic planning institutes, establishing science instructional materials distribution centers and other objectives of the project will insure that the work of the project continues after the grant period has ended.

E.4 Estimated Per-Student Project Costs

The following costs in Table 5 represent an average cost of $122 per student for validating the impact of the LASER model over a five-year period. For a total cost of $30,697,329, this project will impact 75,000 students in Grades 1-8, 3000 teachers, and 300 principals. The costs in Table 6 represent an estimate of the costs to scale the project to reach 100,000, 250,000, and 500,000 students respectively.

Table 5

Total Costs for the Proposed Validation Project						
	Year One	**Year Two**	**Year Three**	**Year Four**	**Year Five**	**Total**
Cost Per Year	$4,208,609	$4,805,928	$5,853,414	$9,084,214	$6,745,164	**$30,697,329**
Number of Students	37,500	37,500	37,500	75,000	75,000	
Cost Per Student	$112	$128	$156	$121	$90	

Table 6

Per Student Costs for Scale Up Project					
(Assumptions: Large-Scale Research and Evaluation is not included)					
	Year One	**Year Two**	**Year Three**	**Year Four**	**Year Five**
100,000 Student Scale Up					
Cost Per Student	$98	$128	$156	$191	$163
250,000 Student Scale Up					
Cost Per Student	$98	$128	$156	$191	$163
500,000 Student Scale Up					
Cost Per Student	$98	$128	$156	$191	$163

E.5 Project Dissemination to Support Development, Expansion and Replication

Working in collaboration with project partners and using the resources of the Smithsonian Institution, we plan to leverage technology such as websites to disseminate the work of project. Our plans include several interactive components supported by existing digital resources of the Smithsonian Institution, including webinars, online discussion groups, and a new feature, online curriculum showcases, to reinforce onsite conferences and project implementation. We plan to begin providing these services by the first quarter of Year 2.

In addition, both during and after the grant period, the NSRC will provide traditional published materials – brochures, newsletters, project updates, research findings, school and classroom models – to be disseminated through NSRC meetings, Smithsonian Institutes, National Academies events, professional conferences, professional teacher organizations, and state science education action committees. Online versions will be made available to the public through the project and partner websites. The NSRC will conduct presentations on the project at a variety of venues.

Finally, in collaboration with its evaluation partners, the Center for Research in Educational Policy will prepare annual project reports and one or more summative reports. Findings will also be summarized in academic papers, submitted for publication in peer-reviewed academic journals, and presented at appropriate conferences.

F. Sustainability

It is our intention to use Validation Grant funding to prepare for a scale-up of our activities, so that the NSRC becomes truly national in scope, reaching every state and region of the country, and helping to improve the quality of science education for every young person in the United States. As we argue in this section, the NSRC has already established a strong foundation for continuing scale-up, which will continue to grow during and beyond the period of funding.

F.1 Resources and Stakeholder Support

The prospects for project sustainability are strengthened by the existing LASER infrastructure, which is an outgrowth of the work of the NSRC over the past 25 years. The LASER model directly supports ongoing project sustainability through its emphasis on engaging leaders to garner community, government, and business support for reform.

F.1.1 Instructional Materials

The STC® Program instructional materials and kits, which will be used in this project for targeted schools in Grades 1-8, are research-based curricula that have been developed and refined according to principles of inquiry-based learning. The NSRC will provide selected schools with the instructional materials and kits for the duration of the grant. In addition, the NSRC has already developed an infrastructure to update materials and refurbish kits that will enable schools to continue using the instructional material packages.

F.1.2 Differentiated professional development for teachers

Districts and schools implementing comprehensive science education reform find professional development to be an essential part of sustainability (Dietz: 2000). The differentiated professional development called for in the LASER model centers around the need for intensive and sustained training of both teachers and administrators to build content knowledge and pedagogical expertise. The NSRC has cultivated a national network of hundreds

of professionals representing education, business, and government who are trained in delivering LASER professional development programs. This network will be used to help build capacity in the regions for this project.

F.1.3 Materials support systems

Regional materials support centers systemically buttress the continued use of STC® Program instructional materials by project schools. Instructional materials and kits will be supplied to teachers participating in levels one and two professional development. Refurbishment and replacement of consumable materials will be provided by materials resource centers through project partnerships. We will leverage existing materials support centers such as located in Indiana (Encouraging Technology and Hands on Science (ETHOS)) and in North Carolina (Duke University Center for Inquiry-based Learning (CIBL)) and the Hollingsworth Science Center in Houston. These centers are the building blocks of state infrastructures, which will be strengthened by the planning and support activities embedded in LASER strategic planning institutes scheduled for each year of the five-year grant cycle.

F.1.4 Administrative and community involvement

The primary stakeholders in the project: the NSRC, the Houston Independent School District, the Indiana Science Technology Engineering and Mathematics Resource Network (I-STEM), and the North Carolina Science, Mathematics and Technology Education Center will form the center of a web of stakeholders from government, higher education, business, and local communities. Shell Oil Company is involved with the Houston School District and has indicated that support for an i3 project would leverage investments in Houston. In Indiana, for example, the Indiana Department of Education, Purdue University, and Indiana University Purdue University at Indianapolis (IUPUI) are already actively involved in the project. A major infrastructure-building goal in Indiana is the involvement of local chambers of commerce. The

North Carolina Science, Mathematics and Technology Education Center is already working closely with the Burroughs-Wellcome Fund and Duke University. One of our goals in North Carolina is to integrate the North Carolina Department of Education in to this project, as well as recruit interested leaders of local chambers of commerce.

F.2 Potential for Sustaining the Project beyond the Grant Period

Sustainability is an embedded goal of the LASER model, which will be addressed throughout the duration of this project. When the five-year grant has ended, the research data gathered from this project will be disseminated to support the continued implementation and scale-up of LASER in Houston, Indiana, and North Carolina. From the first year of the project, building administrative and community support is a primary activity to create a diverse leadership and funding base. Establishing regional advisory boards to support science education in these communities, having awareness events to garner corporate support, and continuously engaging administrators, corporate leaders and institutions of informal education and higher learning in the strategic planning process are ways to support the project beyond the grant period.

G. Management Plan

G.1 Management Plan

The NSRC will coordinate and manage the project in close cooperation with our external evaluator—the Center for Research in Educational Policy (CREP) at the University of Memphis—and with the three site directors. The NSRC, CREP, and the three site directors all have a strong record working with districts, schools, and teachers. The project will be overseen by an experienced, external Advisory Board who will provide counsel on the management and organizational issues required to implement and sustain this important work. Advisors include teachers, principals, superintendents, a state chief, a governor, and three states with statewide experience in scaling LASER, corporate organizations representing every economic sector, and senior executives from diverse industries with strong scaling experience.

Figure 3: Project Organization

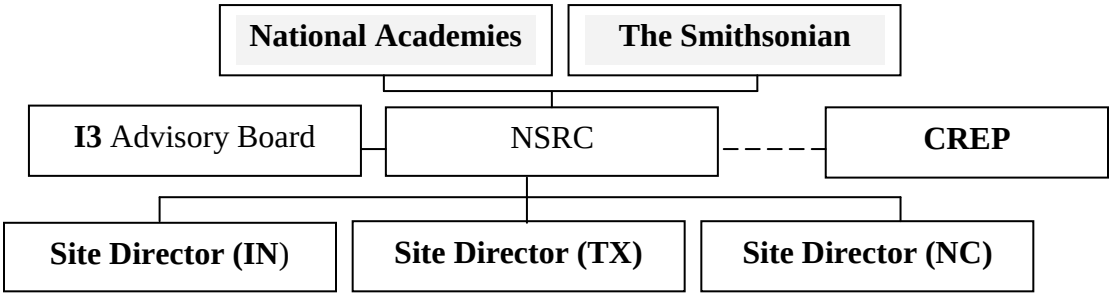


Table 7 outlines the roles and responsibilities of the NSRC and its partner organizations, and Table 8 shows a timeline for project milestones.

Table 7: Roles and Responsibilities

NSRC Responsibilities
1. Provide overall project management responsibility 2. Act as the primary fiscal agent for the project 3. Provide staff to execute the project 4. Deliver portfolio of services for planning and implementing research-based instructional programs to each site. 5. Work strategically with the evaluator and each individual site to monitor the design and execution of the research plan. 6. Develop infrastructure for program sustainability a. Build an advisory board for each site b. Assist each site in developing and updating a strategic plan c. Assist in the development of partnerships to ensure effectiveness and sustainability.
CREP Responsibilities
1. Lead the evaluation effort. 2. Establish a common set of instruments and protocols with partners. 3. Work with evaluation partners to conduct surveys and local observations of classrooms and professional development sessions. 4. Create sets of matched pairs of teachers and classes and make random assignments. 5. Perform pre- and post-tests for students in both treatment and control sites, and compare pre- and post-treatment gains and longitudinal gains. 6. Assess any school district- and state-level gains in student achievement (e.g. beyond the focal sites), and collect qualitative and quantitative data on the infrastructure development, professional learning, and other variables of interest for each of the implementation partners. 7. Prepare and disseminate evaluation reports.
Schools and Regional Site Responsibilities for Texas, Indiana, and North Carolina
1. Schools and Teachers: Work collaboratively with partners to implement all components of the project defined in the proposal and supplementary materials. . 2. Regions: Appoint a Site Director who will ensure that participants engage in required activities needed to accomplish project goals. 3. Regions: Provide office space and relevant office equipment for the Regional Site Coordinator, who will work manage the program on-site. 4. Regions: Work with the NSRC to obtain a minimum of $1.5 million ($300,000 per year) in matching funds from the private sector

Table 8: Project Timeline and Milestones

	Year 1				Year 2				Year 3				Year 4				Year 5			
NSRC Activities	**F**	**W**	**Sp**	**Su**	**F**	**W**	**Sp**	**Su**	**F**	**W**	**Sp**	**Su**	**F**	**W**	**Sp**	**Su**	**F**	**W**	**Sp**	**Su**
Site Strategic Planning and SWOT		■				■				■				■				■		
Awareness Conference (T)			■																	
Site Advisory Board Meetings			■		■	■	■		■	■	■		■	■	■		■	■	■	
Strategic Planning Institute (T)				■																
Level One PD Workshops (T)				■				■				■				■				
Implementation of Unit A (T)					■	■	■		■	■	■		■	■	■		■	■	■	
School-Based PLCs meet (T)					■	■	■		■	■	■		■	■	■		■	■	■	
PLC Workshop (T)							■				■				■				■	
Next Steps Institute (T)								■								■				
Implementation of Unit B (T)									■	■	■		■	■	■		■	■	■	
Level Two PD Workshops (T)									■				■				■			
Implementation of Unit C (T)													■	■	■		■	■	■	
Awareness Conference (C)															■					
Strategic Planning Institute (C)																■				
Level One PD Workshop (C)																■				
Implementation of Unit A (C)																	■	■	■	
Implementation of Unit D Grades 6-8 (T)																	■	■	■	
School-Based PLCs meet (C)																	■	■	■	
PLC Workshop (T)																			■	
Next Steps Institute (C)																				■
Evaluation Activities																				
Instrument Development	■	■																		
Needs Analysis			■				■				■				■					
Site Selection			■	■																
Pre-Post Testing			■				■				■				■					
Site Visits			■		■	■	■		■	■	■		■	■	■					
PD Observations				■				■				■				■	■	■	■	■
RCT Analysis																■	■	■	■	■
Case Studies																■	■	■	■	■
Annual Reports			■				■				■				■				■	■
Summative Report																			■	■

Key: SWOT="Strength, Weakness, Opportunity, Threat;" T=Treatment; C=Control; PLC=Professional Learning Community

G 1.1 Financial Management

The Smithsonian Office of Sponsored Projects will help the NSRC meet the financial management and financial reporting aspects of the grant. Funds will be dispersed by the NSRC to the sub-awardees on an annual basis. All dispersed funds will be processed by the NSRC's Finance and Administration Division and approved by the Executive Director of the NSRC. Accounting procedures will follow standard Smithsonian Institution guidelines.

G 1.2 Reporting

The Smithsonian Office of Sponsored Projects will provide support and advice with the reporting process. NSRC assumes responsibility for maintaining and adhering to the project timeline. Any changes in the project timeline or procedures that result from adjustments in research or other procedures will be decided among the parties cooperating in the program, but the final decision will rest with the NSRC.

G 1.3 Communications

Because the roles of the collaborators are interdependent, we anticipate that all collaborators will work closely throughout the course of the project; however monthly meetings with collaborators will be scheduled on the project calendar. After the initial building awareness event, schools will select representatives to act as conduits for communication with the collaborators.

G. 2 Key NSRC Personnel

Sally Goetz Shuler, Principal Investigator

The Principal Investigator for this project will be Sally Goetz Shuler, the NSRC Executive Director. Ms. Shuler was one of the co-founders of the NSRC, and has formed numerous strategic partnerships with national academies, academic institutions, corporations, and museums

that are resulting in the development, implementation, and evaluation of research-based products and services for improving science education programs for school districts, states, and countries.

David Marsland, Co-Principal Investigator

David Marsland has 32 years experience working with K-12 science educators in implementing hands-on science programs in the U.S. and abroad. For the past 8 years he has coordinated the professional development center at the NSRC. Using faculty drawn from the NSRC's network he has organized numerous STC and other workshops nationwide.

Thomas Emrick, Ed.D, Co-Principal Investigator

Dr. Thomas Emrick is the NSRC Deputy Executive Director. He will in his capacity manage the finance and administration of this project. Dr. Emrick has managed both fiscally and pedagogically more than 20 multi-million dollar projects in his career.

Karen Collias, Ph.D., Co-Principal Investigator

Dr. Karen Collias, the NSRC Deputy Director, was formerly an international educational consultant and worked as an advisor for business-education collaboration in the private and non-profit sectors. Dr. Collias has taught at both the secondary school and university levels.

G. 3 Key Evaluation Personnel

Donald "Chip" Morrison, Ed.D., Co-Principal Investigator, CREP

Dr. Morrison Senior Researcher at the Center for Research in Educational Policy and will oversee the activities of the evaluation team. Dr. Morrison helped found Co-nect, a national school reform organization that worked with a network of more than 300 schools throughout the United States.

Carolyn Ransford, Ph.D., Project Director, CREP

Dr. Morrison will be assisted by Dr. Carloyn Ransford, who will direct the RCT. Dr. Ransford, a Senior Researcher at CREP, currently serves as the Principal Investigator for a multi-

site, randomized control study of a targeted, small-group literacy intervention, Leveled Literacy Intervention, examining the relationship between LLI and student achievement in literacy.

Todd Zoblotsky, Ed.D., Chief Statistician

Dr. Zoblotsky, head of the CREP Statistics Department and former Research Evaluator with Memphis City Schools, will direct the statistical analysis of the RCT data. Zoblotsky has extensive experience in providing accurate and meaningful data and reports to aid in the accountability and decision-making process regarding initiatives and programs affecting student success at the local, state and federal level.

David Francis, Ph.D., Director, Texas Institute of Measurement, Evaluation, and Statistics

Dr. David Francis is the Hugh Roy and Lillie Cranz Distinguished University Professor and Chairman, Department of Psychology, University of Houston, and directs the Texas Institute for Measurement, Evaluation, and Statistics, which he founded in 1986. Dr. Francis has considerable experience conducting randomized trials and evaluation research nationally, and has been involved in numerous projects in the Houston area, including the Houston Independent School District. He has expressed an interest helping to guide the evaluation effort in Houston.

Joshua S. Smith, Ph.D., Director, Center for Urban and Center for Urban and Multicultural Education, Indiana University

Dr. Smith has been principal investigator or co-investigator on over 30 externally funded research and evaluation grants. His research expertise is in the area of educational transitions, including the transition from middle school to high school and the transition from high school to college. Dr. Smith also works with schools and community-based organizations to evaluate educational programs on student and organizational outcomes. He has expressed interest helping to guide the evaluation effort in Indiana.

Ludwig "Ludy" van Broekhuizen, Ph.D., Director, SERVE Center

Dr. Ludwig "Ludy" van Broekhuizen joined the SERVE Center at the University of North Carolina at Greensboro as its Executive Director in September 2004. Previously, he was the Director of the Pacific Regional Educational Laboratory Program in Honolulu, Hawaii. He has also served a Senior Evaluator for the first national evaluation of the federally funded Star Schools Program and Partnerships in Education Program. Dr. Broekhuizen has expressed interest in helping to guide the evaluation effort in North Carolina.

Nancy P. Moreno, Ph.D, Project Consultant

Dr. Moreno, Senior Associate Director, Center for Educational Outreach, Baylor College of Medicine, Houston, has agreed to serve as an advisor to the evaluation team. Her research focuses on developing effective collaborations among scientists and educators to improve science teaching and learning. She leads the development of interdisciplinary science educational materials for students, the creation of local and national partnerships to promote systemic change in school science teaching, and most recently, the application of web-based technologies for teacher support and professional development.

Note: See letters of interest in Appendix D. Should the project be funded, CREP will enter into subcontract discussions with external evaluation partners, including, but not necessarily limited to, those identified here. CREP reserves the right to make final decisions regarding the composition of the evaluation team and the roles and responsibilities of team members.