Results of the 2001–2002 Study of the Impact of the Local Systemic Change Initiative on Student Achievement in Science

by

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Introduction

Pressure has been growing on federally-funded education initiatives to demonstrate their effectiveness, particularly on student achievement. In response, beginning in 1998, the National Science Foundation (NSF) incorporated into the solicitation for Local Systemic Change Initiatives (LSC) a requirement that each project examine its effects on student achievement or other student outcomes. Being sensitive to differences in local contexts, NSF is allowing projects flexibility in how they choose to show evidence of effects on student outcomes. Differences in the nature of relevant student achievement data available to each project, as well as differences in the availability of other data about students, teachers, and schools make this flexibility a necessity. The range of studies that projects will produce will provide a wealth of evidence about the variety of effects the LSCs are having on student outcomes. Studying program-wide effects systematically, however, will be made more difficult due to the varying instrumentation and designs of the studies.

Horizon Research, Inc. (HRI) proposed a study to meet this challenge for investigating program-wide effects on student achievement in science, without imposing undue burden on projects. The study is limited to only those projects that include an upper elementary (grades 4–6) science component. This choice was made for three reasons: the majority of LSC science projects are included in this group, few projects already have student achievement data in science available, and items for measuring science achievement, although limited, are available for these grade levels. This report presents results from the 2001–2002 study. HRI will repeat this study in 2002–2003 and 2003–2004.

The study uses longitudinal data to control for students' prior knowledge of the science content being tested, with a pre-test being administered near the beginning of the school year, and a post-test at the end. Several demographic factors are also controlled, including eligibility for free/reduced-price lunch, limited English proficiency, whether the student has an individualized education plan, grade level, race/ethnicity, and gender. These data also allow HRI to examine the extent of any "achievement gaps" by gender, race/ethnicity, English-language proficiency and SES.

The study uses a series of hierarchical linear models (HLM) to test relationships among the independent variables measured at the student and teacher levels and the outcomes measured on the assessment instrument. Models include overall science achievement gains, and science achievement gains on each of five sub-scales (earth science, electricity and magnetism, life science, nature of science, and physical science).[1]

The models include three levels of equations: student, classroom, and project. Independent predictor variables are included at the student-level and classroom-level. The project-level equations, with no independent predictors, serve only as a means to account for variance in outcomes that lies across projects. No specific analyses are performed at the project level.

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[1] The physical science scale focuses on properties of matter, motion, and simple machines and does not include electricity and magnetism items.

The main outcome of interest in the study is science achievement, including achievement on the sub-scales, on the post-test administration of the assessment instrument. Individual scores on the pre-test are used to adjust the post-test outcome scores for initial achievement levels (prior knowledge), yielding estimates of the "gain scores" in achievement for the time period between the pre-test and post-test administrations of the assessment instrument.

The original study plan called for gain scores of students receiving instruction in a content area to be compared to gain scores of students not receiving instruction in that area, also basing comparisons on the extent to which instruction delivered used the LSC-designated instructional materials. However, data quality concerns arose during analysis and it was decided that the information collected on teachers' science instruction was problematic. Thus, the analyses presented in this report focus solely on the relationship between teachers' participation in LSC professional development and student achievement.

Instrumentation

The study employed an achievement test in science made up of multiple-choice items primarily taken from the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS). Items from these sources have been through extensive validity, reliability, scaling, and item functioning analyses as measures of science achievement. The items were selected, with the assistance of an expert in science assessment and the Principal Investigators of the K–8 science LSCs, to represent the science content areas central to the units of LSC-designated instructional materials most frequently taught in the 4th, 5th, and 6th grades.

A few additional items were developed for topics covered by the LSCs, but not found in the NAEP or TIMSS item sets. In addition, all of the items were reviewed for language accessibility to help ensure that the assessment measured science knowledge, not reading ability.
As a whole, the items represent a range of difficulty, allowing appropriate testing of students' science achievement across a broad range of achievement levels.

The assessment yields several scale scores: overall science, earth science, life science, physical science, nature of science, and electricity and magnetism. Each scale score is computed as the percent of items correct. Table 1 shows the number of items and reliability (Cronbach's alpha) for the assessment scales; each scale has an acceptable reliability (≥ 0.60). (A copy of the assessment and scale definitions are located in Appendix A and B, respectively.)

A teacher questionnaire was used to gather information regarding which science units each teacher taught during the school year and the extent of their participation in LSC professional development. Projects also provided demographic information about the students in the participating classes, including eligibility for the free/reduced lunch program, limited English proficient status, and whether the student has an individualized educational plan.[2] A student

[2] HRI received individual student demographics data for 483 of the 491 classes. Two projects that work with consortia of districts could not get individual student demographic information for all of the classes participating in

questionnaire was used to gather race/ethnicity and gender data. Copies of the teacher and student questionnaires are located in Appendix C.

Table 1
Assessment Scale Reliabilities

	Number of Items	Reliability (Cronbach's Alpha)
Overall	52	0.90
Earth Science	11	0.61
Electricity and Magnetism	10	0.71
Life Science	11	0.63
Nature of Science	10	0.63
Physical Science	10	0.60

The Sample

Twelve of the 47 current and past LSC projects targeting 4th, 5th, or 6th grade science teachers elected to participate in the 2001–2002 study, including 8 of the 16 that are required to assess impact on students, and 4 of the 31 for whom studies of impact on students are optional. Three projects administered the assessment to 4th grade classes, 3 to 5th grade classes, and 6 to 6th grade classes. Seven projects administered the assessment to all classes at the grade level they selected; the remaining 5 projects administered the assessment to a sample of classes.

The projects that administered the assessment to a sample of classes submitted the names of teachers at the selected grade level along with treatment information (number of hours participating in LSC professional development), teacher leader status (yes/no), and number of classes taught at the selected grade level. Because 8 of the 12 participating projects were funded in Cohort 5 or later and had been providing professional development for two years or less (the majority of the teachers in these projects had yet to participate in a substantial number of LSC professional development activities), a stratified sampling approach was used in order to maximize the variation in teacher treatment levels in the sample.

With the exception of one project,[3] for each project sampling a subset of their classes HRI created two lists: classes taught by teachers participating in relatively more hours of LSC professional development (i.e., above the median number of hours of professional development provided by the project) and classes taught by teachers with relatively fewer hours of LSC professional development (i.e., below the median number of hours of professional development provided by the project), randomly ordering classes within teacher treatment level. Projects were instructed to select half of their classes from each list, attempting to get classes from as close to

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the study. In these cases, the projects provided the most disaggregated data the districts would release, for 5 classes, classroom averages and for 3 classes, district averages.

[3] Project 12 sampled one treated and one untreated teacher from each of 20 participating schools in order to control for school level effects in their analysis of their project's data.

the top of each list as possible. In general, the projects were able to recruit the classes at or very near the top of their sample lists, offering a measure of confidence that the samples were not biased.

Table 2 shows some characteristics of the participating projects. Note that although HRI incorporated several steps in the data collection process to help ensure data quality, a number of students and classes were excluded from the final analyses. In some cases, classes were administered the pre-test, but not the post-test. In other cases, teachers did not follow instructions for administering the assessment and HRI was unable to match students' pre-test and post-test data. Finally, classes in which the teacher administering the post-test was not the same as the one administering the pre-test were excluded since it was not possible to determine how much science instruction the students received or if the instruction was provided by a LSC-trained teacher. The analyses described in this report are based upon 491 classes and 8,823 students who submitted complete pre- and post-test data. To account for unequal probabilities of classes being selected to participate in the study, weights were used in all analyses.

Table 2
Descriptive Information for Participating Projects

Project	Cohort	Number of Years Providing Professional Development	Grade Level Selected	Sample or Population	Number of Classes† at Selected Grade Level	Number of Classes Administering the Assessment	Number of Classes Returning Usable Data
1	2	5	6	Sample	227	12	5
2	2	5	6	Population	86	86	67
3	4	3	5	Sample	88	6	5
4	4	3	6	Population	64	64	45
5	5	2	6	Population	96	96	86
6	5	2	6	Population	47	47	32
7	5	2	4	Sample	44	6	4
8	6	1	5	Population	227	227	179
9	6	1	4	Sample	212	6	5
10	7	0	5	Population	29	29	21
11	7	0	6	Population	23	23	21
12	7	0	4	Sample	100	40	21

† Number of classes refers to the number of sections of students. In many cases, a single teacher administered the assessment to several classes of students. Thus, the number of unique teachers is smaller than the number of classes.

It is important to note that the LSC science projects covered a wide range of topics and skills. Table 3 shows the number of projects that implemented at least one unit in each scale content area during the 2001–2002 school year. Of the 12 projects that participated in the study, 11 were implementing at least one earth science unit, 11 were implementing at least one life science unit, 9 were implementing one or more units focusing on electricity and magnetism, and 5 were using at least one unit covering other physical science topics.

Table 3
Number of Participating LSC Projects Implementing at Least One Curriculum Unit in Various Topic Areas

	Number of Participating Projects (N = 12)
Earth Science	11
Life Science	11
Electricity and Magnetism	9
Physical Science	5

Teacher participation in LSC professional development was measured on a categorical scale (e.g., 0 hours, 1–19 hours, 20–39 hours, etc.). Since this scale did not contain equal intervals and because teachers were not distributed well across the scale, teachers were classified into one of 4 levels of treatment: no treatment (0 hours of LSC professional development), low treatment (1–19 hours), moderate treatment (20–79 hours), and extensive treatment (80 or more hours). Table 4 shows the percentage of classes included in the study taught by teachers of each treatment level.

Table 4
Classes Taught by Teachers with Various Hours of Participation in LSC Professional Development

	Percent of Classes (N = 491)
0 hours	9
1–19 hours	20
20–79 hours	45
80 or more hours	25

It is important to note that nearly half of the teachers with extensive treatment were teacher leaders selected by the projects to receive leadership training in addition to professional development in science content and pedagogy. Further, many of the teachers chosen by projects to be teacher leaders are selected because of their enthusiasm for or skill at teaching science and they may not be representative of a "typical" teacher. Ideally, the analyses presented in this report would have controlled for teacher leader status. However, a large majority of classes participating in this study came from projects that were funded relatively recently, and only a small number of their non-teacher leaders had received extensive treatment. Thus, the extensive treatment group would have contained too few classes for a meaningful analysis of the relationship between extensive treatment and student achievement.

In addition to teacher and class information, the study controlled for a number of student characteristics. As can be seen in Table 5, the sample was comprised equally of males and females. Fifty-seven percent of the students were white and 40 percent were non-Asian minority. One third of the students were eligible for free or reduced-price lunch, eight percent were classified as limited English proficient, and eight percent had an individualized education plan.

Table 5
Student Demographics

	Percent of Students (N = 8,823)
Gender	
Female	50
Male	50
Race/Ethnicity	
White	57
African-American	21
Hispanic or Latino	16
Asian	3
American Indian or Alaskan Native	0
Hawaiian or Other Pacific Islander	0
Other	1
Free/Reduced-Price Lunch Eligible	33
Limited English Proficient	8
Individualized Education Plan	8

Analysis and Results

Descriptive statistics for pre- and post-test scale scores are shown in Table 6. Overall, students scored higher on each post-test scale than they did on the pre-test, an indication that the assessment is sensitive to instruction. It is important to note that mean scores are not comparable across the scales—each scale contains a relatively small sample of the content domain it attempts to measure and scale difficulties were not equated.

Table 6
Descriptive Statistics for each Assessment Scale

	Minimum	Maximum	Mean	Standard Deviation
Pre-Test				
Overall score	7.69	98.08	59.02	16.97
Earth science	0.00	100.00	52.05	19.27
Electricity and magnetism	0.00	100.00	67.18	20.99
Life science	9.09	100.00	63.95	19.63
Nature of science	0.00	100.00	55.78	24.11
Physical science	0.00	100.00	56.37	20.60
Post-Test				
Overall score	13.46	100.00	64.70	16.89
Earth science	0.00	100.00	58.18	21.39
Electricity and magnetism	0.00	100.00	72.44	19.68
Life science	0.00	100.00	69.09	20.11
Nature of science	0.00	100.00	63.12	23.33
Physical science	0.00	100.00	60.90	19.62

For each scale, a three-level hierarchical linear model (students nested within classes nested within projects) was used to investigate the relationship between the extent of teacher participation in LSC professional development and changes in student scores. HLM 5.01[4] was used for all analyses. The analysis for each scale included a number of student level predictors:

- pre-test score on that scale;
- gender;
- race/ethnicity (white/Asian vs. non-Asian minority);
- whether the student was eligible for free/reduced-price lunch (FRL);
- whether the student had an individualized education plan (IEP); and
- whether the student was classified as limited-English proficient (LEP).

The factor of most interest in these analyses was extent of teachers' participation in LSC professional development which was investigated using a set of dummy coded variables at the classroom level. The classroom level predictors included in these analyses were:

- grade level (6^{th} grade vs. $4^{th}/5^{th}$ grade);
- class size;
- teacher experience level (6 or more years of teaching experience vs. 0–5 years prior experience); and
- extent of teacher participation in LSC professional development (none, 1–19 hours, 20–79 hours, or 80 or more hours).

In addition to examining the relationships between the variables listed above and post-test scores, each student level control variable was tested to determine if its slope varied across classes (e.g., if the relationship between the post-test score and the FRL status was different for different classes) and projects. When there was significant variation across classes in the slope of a student demographic variable, classroom level predictors (class size, teacher experience, and extent of teacher participation in LSC professional development) were used in an attempt to explain the variation. Further, classroom level variables were tested to determine whether their effects varied across projects, though because of the small number of projects participating in the study, no project level predictors were included to try to explain any of these variances.

Table 7 shows the results of the HLM models for the prediction of intercept terms (adjusted mean scores) controlling for student and classroom factors. A number of patterns emerge across the models. Not surprisingly, students who scored higher on the pre-test tended to score higher on the post-test. Low SES students (those eligible for free or reduced-price lunch), non-Asian minorities, LEP students, and students with an IEP tended to score lower than their respective counterparts. With the exception of the physical science scale, female students performed just as well as male students. At the classroom level, 6^{th} grade classes tended to score higher than 4^{th} and 5^{th} grade classes. Class size and teacher experience level were not significant predictors of student scores.

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[4] Raudenbush, Stephen, Bryk, Anthony, Cheong, Yuk F., Congdon, Richard, Scientific Software International, 2000.

In regard to teacher participation in LSC professional development, the factor of most interest in this study, the results are encouraging. Although the relationship is stronger for some scales than others, there is a pattern of higher achievement gains by students of LSC-trained teachers on all of the scales, especially for those classes whose teachers had participated extensively in LSC professional development. It is interesting to note that this relationship is strongest on the earth science and life science scales, the two areas covered by the largest number of participating projects. The relationship is also relatively strong for the nature of science scale, a topic that permeates nearly all of the units that were being implemented by the LSCs.

Table 7
HLM Results for each Assessment Scale: Intercepts

	Overall Score	Earth Science	Electricity and Magnetism	Life Science	Nature of Science	Physical Science
Intercept	65.94 (0.47)	58.45 (0.96)	72.74 (0.94)	69.01 (0.60)	62.65 (0.69)	63.34 (0.73)
Student Level Predictors						
Pre-test score	0.76*** (0.02)	0.47*** (0.02)	0.48*** (0.03)	0.55*** (0.02)	0.52*** (0.01)	0.44*** (0.01)
Free or reduced-price lunch eligible	-1.88~ (0.90)	-2.65*** (0.49)	-1.28 (1.79)	-2.99*** (0.44)	-1.84* (0.84)	-2.23** (0.71)
Individualized education plan	-3.24* (1.05)	-5.18*** (0.67)	-5.77* (1.94)	-3.41* (1.27)	-5.02* (1.95)	-7.35** (2.04)
Limited-English proficient	-0.63 (0.71)	-2.45~ (1.32)	-2.96*** (0.66)	-0.02 (0.64)	-3.95*** (0.74)	-4.48*** (0.64)
Non-Asian minority	-2.09** (0.49)	-4.01* (1.72)	-5.55*** (0.93)	-4.69*** (0.41)	-5.19*** (0.64)	-2.43~ (1.18)
Female	-0.25 (0.20)	-0.12 (0.78)	-0.87 (0.62)	0.34 (0.43)	-0.18 (0.47)	-2.73*** (0.32)
Classroom Level Predictors						
6th grade	1.29~ (0.70)	5.73** (1.61)	3.22*** (0.88)	2.18* (0.85)	2.29* (1.00)	3.17** (0.91)
Class size	-0.00 (0.03)	0.07 (0.06)	0.09 (0.10)	0.07 (0.05)	0.08 (0.06)	0.06 (0.05)
Teacher with 6 or more years experience	0.55 (0.35)	0.94~ (0.56)	0.62 (0.54)	0.46 (0.51)	0.77 (0.75)	0.93~ (0.52)
Teacher with 1–19 hours of LSC PD	-0.01 (0.67)	2.96** (1.05)	1.13 (0.95)	1.90* (0.95)	1.21 (1.15)	-0.07 (0.98)
Teacher with 20–79 hours of LSC PD	0.48 (0.60)	2.78** (0.94)	1.40~ (0.84)	2.55** (0.84)	1.72~ (1.04)	0.51 (0.87)
Teacher with 80+ hours of LSC PD	1.06~ (0.63)	3.40** (1.00)	2.18* (0.91)	1.72~ (0.89)	2.42* (1.09)	1.88* (0.91)

~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

In addition to examining the relationship between teacher participation in LSC professional development and student scores, the study looked at whether teacher participation was related to changes in any achievement gaps. For each scale, the FRL, IEP, female, and non-Asian minority terms were tested to see if their slopes varied across classes (e.g., did females in some classes do better than females in other classes).[5] Table 8 presents a summary of which slopes varied across classes for each scale as well as the relationship between teacher participation in LSC professional development and those slopes.

Table 8
HLM Results for each Assessment Scale: Slopes

	Overall Score	Earth Science	Electricity and Magnetism	Life Science	Nature of Science		Physical Science
	IEP†	*Non-Asian Minority*†	*Non-Asian Minority*†	*Female*†	*FRL*	*Female*†	*IEP*†
Class size	0.12 (0.09)	0.09 (0.11)	0.02 (0.10)	-0.05 (0.08)	-0.25* (0.11)	0.13 (0.09)	0.16 (0.16)
Teacher with 6 or more years experience	-1.62~ (0.95)	-1.38 (1.01)	-2.16 (2.61)	-0.18 (0.87)	-0.70 (2.75)	-0.35 (0.97)	-1.95 (3.66)
Teacher with 1–19 hours of LSC PD	-2.78~ (1.62)	-5.21** (1.82)	-5.35** (1.65)	1.90 (1.53)	-0.10 (1.83)	-0.04 (1.69)	0.44 (3.19)
Teacher with 20–79 hours of LSC PD	-1.65 (1.37)	-5.22** (1.56)	-4.34** (1.42)	1.40 (1.32)	0.29 (1.38)	-0.39 (1.46)	1.27 (2.92)
Teacher with 80+ hours of LSC PD	-3.89** (1.46)	-3.65* (1.80)	-2.57 (1.65)	0.72 (1.43)	-0.00 (1.82)	-1.61 (1.59)	-4.65 (3.17)

~ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
† Model fit was improved significantly by allowing for this slope to vary across classes even after the inclusion of the predictor variables.

In 3 of the 7 instances where there was variation in slopes across classes, teacher participation in LSC professional development is associated with a slight widening of the achievement gap, even after controlling for initial knowledge. For the overall scale score, students with IEPs tended to score lower in classes of LSC-trained teachers. Similarly, on the earth science and electricity and magnetism scales, non-Asian minorities in classes taught by LSC trained teachers tended to score lower than non-Asian minorities in classes taught by teachers not trained by the LSC. LSC professional development was not a predictor, either positively or negatively, of achievement gaps on the life science, nature of science, or physical science scales.

There are a number of possible explanations for this finding. It may be that it is more difficult for disadvantaged students to make the transition to a new style of teaching and learning. Another possible explanation is that the transition to an activity-based, student-centered method of teaching is difficult for teachers and that they must first deal with general implementation

[5] The LEP slope was not included in these analyses as nearly all LEP students were clustered within one of the participating projects.

issues before they can turn their attention to issues of equity. The latter hypothesis is supported by the fact that the magnitude of the achievement gaps tend to get smaller with greater amounts of professional development. However, further research is needed before a definitive conclusion can be made.

Conclusions

The results of this study provide some evidence that the LSC program is having a positive impact on student achievement in science. On the overall test score and each of the sub-scales, after controlling for a number of student demographics, a positive relationship was found between increases in student scores and teacher participation in LSC professional development. Further, this relationship tends to get stronger with increased participation in LSC professional development.

The results in relation to closing achievement gaps were less encouraging. Even when controlling for initial knowledge, students with IEPs in classes taught by LSC-trained teachers tended to have lower overall test scores than students with IEPs in non-LSC classes. Similarly, non-Asian minority students in LSC classes tended to score lower on the Earth science and electricity and magnetism scales than non-Asian minority students in non-LSC classes. However, these differences tend to get smaller with increased professional development.

It is important to acknowledge some of the threats to the validity of this study. In regards to the study's internal validity (i.e., the extent to which the results can be attributed to the LSC program), there are two major concerns. The first is the lack of information on how much science instruction students received and how much of that instruction was based on LSC-designated instructional materials. Although the study intended to control for these quantities, inconsistencies and irregularities in teachers' responses to the questions designed to measure these factors made these data unreliable. Other evaluation studies of the LSC have shown that extent of participation in LSC professional development is positively correlated with amount of science instruction,[6] and it is possible that an increased quantity of science instruction is responsible for the gains observed in this study rather than an increase in the quality of that instruction. However, increasing the amount of science taught at the elementary level is itself a positive outcome of the LSC program. The teacher questionnaires have been revised, which should allow for the control of these variables in the second and third year of this study.

The second threat to the internal validity of this study is the fact that, due to the relatively recent funding of many of the participating projects, a large proportion of teachers in the sample who had received extensive treatment (80 or more hours of LSC professional development) were teacher leaders. Many of the teachers chosen by projects to be teacher leaders are selected because of their enthusiasm for or skill at teaching science and they may not be representative of a "typical" teacher. However, as a positive relationship was found on some of the scales between student achievement and lower levels of professional development (where few or none

[6] Weiss, Iris R., Arnold, Elizabeth, E., Banilower, Eric R., and Soar, Eugene H., Local Systemic Change through Teacher Enhancement: Year Six Cross-site Report, Horizon Research, Inc., May 2001.

of the teachers are teacher leaders), this threat may not be very significant. It is expected that a greater number of non-teacher leaders will have participated extensively in LSC professional development by the second and third year of this study, allowing for the testing of this alternative hypothesis.

In addition to the threats to internal validity, there is an important threat to the external validity (i.e., generalizability) of this study. To date, the NSF has funded 47 LSC projects that target science teachers at the 4^{th}, 5^{th}, or 6^{th} grade level. Only 12 of these projects elected to participate in this study. Although there is no reason to suspect that the projects that did participate are substantially different from the ones that did not, there is no practical means to determine the veracity of this assumption. If the results of this year's study are replicated in years two and three, greater confidence in the generalizability of the results will be warranted. In addition, a companion study examining the impact of the LSC on student achievement in science at grades 7 and 8 planned for the 2003–2004 academic year should provide further information regarding the impact of the LSC program.

Appendix A

Student Assessment Test Booklet

(for information on the Student Assessment, email hri@horizon-research.com)

Appendix B

2001–2002 Science Assessment Scale Definitions

Table B-1
2001–02 Science Assessment Scale Definitions

Earth Science (11 items)	Electricity & Magnetism (10 items)	Life Science (11 items)	Nature of Science (10 items)	Physical Science (10 items)
Q3	Q4	Q1	Q5	Q2
Q8	Q7	Q6	Q9	Q10
Q12	Q13	Q11	Q15	Q14
Q16	Q17	Q18	Q20	Q19
Q24	Q23	Q21	Q25	Q22
Q26	Q27	Q28	Q30	Q29
Q35	Q32	Q31	Q34	Q33
Q39	Q40	Q36	Q38	Q37
Q43	Q45	Q41	Q42	Q44
Q46	Q47	Q48	Q50	Q49
Q51		Q52		

Appendix C

Teacher and Student Questionnaires

LSC Science Program Study*
Teacher Questionnaire *(Pre-Test)*

Instructions:

Please use a #2 pencil or a blue or black pen to complete this questionnaire. Darken ovals completely, but do not stray into adjacent ovals. Be sure to erase completely any stray marks.

A. Teacher Demographic Information

1. Are you: ○ Male ○ Female

2. Race - Are you: (Darken one or more.)
   - ○ American Indian or Alaskan Native
   - ○ Asian
   - ○ Black or African-American
   - ○ Hispanic or Latino
   - ○ Native Hawaiian or Other Pacific Islander
   - ○ White

3. How many college science courses have you completed? (Darken one oval.)
   - ○ None
   - ○ 1 semester
   - ○ 2 semesters
   - ○ 3 semesters
   - ○ 4 semesters
   - ○ 5 or more semesters

4. Did your college science coursework include the equivalent of at least one semester of: (Darken one oval on each line.)

		Yes	No
a.	Life science	○	○
b.	Earth and space science	○	○
c.	Physical science	○	○

B. Your Science Teaching

5. How many years have you taught prior to this school year? (Darken one oval.)

0-2	3-5	6-10	11-15	16-20	21-25	26 or more
○	○	○	○	○	○	○

6. What grade levels are represented in this class? (Darken all ovals that apply.) ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

7. How many students are enrolled in this class, including students absent on the day of the test? (Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter your answer as a 2-digit number; e.g., if 9 students, enter as 09.)

8. Approximately how many minutes is a typical science lesson in this class? (Darken one oval.)

Average Number of Minutes per Lesson

10 or fewer	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81 or more
○	○	○	○	○	○	○	○	○

** See the cover letter accompanying this questionnaire for a description of the LSC.*

PLEASE DO NOT WRITE IN THIS AREA

9. How many science units has this class worked on so far this academic year? (We are defining a "unit" as a series of related activities, often on a single topic such as sound, rocks, or genetics.) (Darken one oval.)

0	1	2	3	4	5	6	7	8	9 or more
○	○	○	○	○	○	○	○	○	○

10a. List the publisher and title of each of the ***life science*** units this class has worked on so far this year (e.g., Publisher: "STC", Title: "Experiments with Plants") and the number of lessons devoted to each.

Life Science Unit - Publisher	Life Science Unit - Title	Number of Lessons

10b. Approximately what percent of this life science instruction has been based on LSC*-designated instructional materials? (Darken one oval.)

0	10	20	30	40	50	60	70	80	90	100
○	○	○	○	○	○	○	○	○	○	○

11a. List the publisher and title of each of the ***physical science*** units this class has worked on so far this year (e.g., Publisher: "Insights", Title: "Circuits and Pathways") and the number of lessons devoted to each.

Physical Science Unit - Publisher	Physical Science Unit - Title	Number of Lessons

11b. Approximately what percent of this physical science instruction has been based on LSC*-designated instructional materials? (Darken one oval.)

0	10	20	30	40	50	60	70	80	90	100
○	○	○	○	○	○	○	○	○	○	○

12a. List the publisher and title of each of the ***earth/space science*** units this class has worked on so far this year (e.g., Publisher: "FOSS", Title: "Landforms") and the number of lessons devoted to each.

Earth/Space Science Unit - Publisher	Earth/Space Science Unit - Title	Number of Lessons

12b. Approximately what percent of this earth/space science instruction has been based on LSC*-designated instructional materials? (Darken one oval.)

0	10	20	30	40	50	60	70	80	90	100
○	○	○	○	○	○	○	○	○	○	○

**** See the cover letter accompanying this questionnaire for a description of the LSC.***

13. How much emphasis have you given to each of the following topics in this class so far this year? (Darken one oval on each line.)

	None	A Little	A Fair Amount	A Lot
a. Animal behavior	○	○	○	○
b. Characteristics of living things	○	○	○	○
c. Classification	○	○	○	○
d. Ecology	○	○	○	○
e. Food and nutrition	○	○	○	○
f. Human body	○	○	○	○
g. Chemical and physical changes, including changes of state	○	○	○	○
h. Electric circuits	○	○	○	○
i. Energy	○	○	○	○
j. Floating and sinking	○	○	○	○
k. Forces and motion	○	○	○	○
l. Machines	○	○	○	○
m. Magnetism	○	○	○	○
n. Properties of matter, including mixtures and solution	○	○	○	○
o. Sound	○	○	○	○
p. Astronomy	○	○	○	○
q. Erosion, weathering, and deposition	○	○	○	○
r. Rocks, soils, minerals	○	○	○	○
s. Water cycle	○	○	○	○
t. Weather	○	○	○	○
u. Engineering and design principles (e.g., structures, models)	○	○	○	○
v. Measurement/using scientific tools	○	○	○	○
w. Nature of science/science inquiry	○	○	○	○

14. About how often do **you** do each of the following in your science instruction in this class? (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Use the LSC*-designated instructional materials as the basis of science lessons.	○	○	○	○	○
b. Arrange seating to facilitate student discussion.	○	○	○	○	○
c. Use open-ended questions.	○	○	○	○	○
d. Require students to supply evidence to support their claims.	○	○	○	○	○
e. Encourage students to explain concepts to one another.	○	○	○	○	○
f. Encourage students to consider alternative explanations.	○	○	○	○	○
g. Assign science homework.	○	○	○	○	○

15. About how often do **students** in this class take part in each of the following types of activities as part of their science instruction? (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Participate in discussions with the teacher to further science understanding.	○	○	○	○	○
b. Work in cooperative learning groups.	○	○	○	○	○
c. Make formal presentations to the class.	○	○	○	○	○
d. Answer textbook/worksheet questions.	○	○	○	○	○
e. Review homework/worksheet assignments.	○	○	○	○	○

Question 15 continues on back of page.

***** *See the cover letter accompanying this questionnaire for a description of the LSC.***

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15. (*continued*)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
f. Share ideas or solve problems with each other in small groups.	○	○	○	○	○
g. Engage in hands-on science activities.	○	○	○	○	○
h. Design or implement their *own* investigation.	○	○	○	○	○
i. Work on models or simulations.	○	○	○	○	○
j. Work on extended science investigations or projects (a week or more in duration).	○	○	○	○	○
k. Participate in field work.	○	○	○	○	○
l. Write reflections in a notebook or journal.	○	○	○	○	○
m. Work on portfolios.	○	○	○	○	○
n. Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	○	○	○	○	○

C. LSC Professional Development

16. In what year did you begin participating in professional development as part of the LSC*? (Darken one oval.)

- ○ 1995
- ○ 1996
- ○ 1997
- ○ 1998
- ○ 1999
- ○ 2000
- ○ 2001
- ○ Have not yet participated in the LSC. (SKIP to question 20.)

17. Approximately how many hours have you spent on formal LSC-provided professional development* *since the LSC project began*, focused on each of the following?

a. Life science content/instructional materials

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
○	○	○	○	○	○	○	○

b. Physical science content/instructional materials

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
○	○	○	○	○	○	○	○

c. Earth/space science content/instructional materials

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
○	○	○	○	○	○	○	○

d. Other issues related to science/science education

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
○	○	○	○	○	○	○	○

18. Approximately how many ***total hours*** have you spent on formal professional development in science/science education as part of the LSC* ***since the project began***? (Darken one oval.)

- ○ 0
- ○ 1-9
- ○ 10-19
- ○ 20-39
- ○ 40-59
- ○ 60-79
- ○ 80-99
- ○ 100-129
- ○ 130-159
- ○ 160-199
- ○ 200 or greater

19. Have you been identified as a teacher leader for your district's NSF-supported LSC project? ○ Yes ○ No

**** See the cover letter accompanying this questionnaire for a description of the LSC.***

D. Teacher Opinions and Preparedness

20. Please indicate how prepared you feel to do each of the following in the grades you teach. (Darken one oval on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Provide concrete experience before abstract concepts.	①	②	③	④
b. Develop students' conceptual understanding of science.	①	②	③	④
c. Take students' prior understanding into account when planning curriculum and instruction.	①	②	③	④
d. Make connections between science and other disciplines.	①	②	③	④
e. Have students work in cooperative learning groups.	①	②	③	④
f. Have students participate in appropriate hands-on activities.	①	②	③	④
g. Engage students in inquiry-oriented activities.	①	②	③	④
h. Engage students in applications of science in a variety of contexts.	①	②	③	④
i. Use performance-based assessment.	①	②	③	④
j. Use portfolios.	①	②	③	④
k. Use informal questioning to assess student understanding.	①	②	③	④

21. Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade levels you teach, whether or not they are currently included in your curriculum? (Darken one oval on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. The human body	①	②	③	④
b. Ecology	①	②	③	④
c. Rocks and soils	①	②	③	④
d. Astronomy	①	②	③	④
e. Processes of change over time (e.g., evolution)	①	②	③	④
f. Mixtures and solutions	①	②	③	④
g. Electricity	①	②	③	④
h. Sound	①	②	③	④
i. Forces and motion	①	②	③	④
j. Machines	①	②	③	④
k. Engineering and design principles (e.g., structures, models)	①	②	③	④

22. Please indicate how well prepared you feel to do each of the following. (Darken one oval on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Lead a class of students using investigative strategies.	①	②	③	④
b. Manage a class of students engaged in hands-on/project-based work.	①	②	③	④
c. Help students take responsibility for their own learning.	①	②	③	④
d. Recognize and respond to student diversity.	①	②	③	④
e. Encourage students' interest in science.	①	②	③	④
f. Use strategies that specifically encourage participation of females and minorities in science.	①	②	③	④
g. Involve parents in the science education of their students.	①	②	③	④

**** See the cover letter accompanying this questionnaire for a description of the LSC.***

8. Approximately how many minutes is a typical science lesson in this class? (Darken one oval.)

Average Number of Minutes per Lesson

10 or fewer	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81 or more
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

9. How many science units has this class worked on ***so far this academic year***? Include units you have begun but not completed. Do **not** include units you are planning, but have not yet begun. (We are defining a "unit" as a series of related activities, often on a single topic such as sound, rocks, or genetics.) (Darken one oval.)

0	1	2	3	4	5	6	7	8	9 or more
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

10a. List the title/topic of each of the ***life science*** units this class has worked on so far this year (include units you have begun but not completed; do not include units you are planning but have not yet started), the publisher(s) of all instructional materials used to teach each unit, and the number of lessons devoted to each.

Life Science Unit - Title	Life Science Unit - Publisher(s)	Number of Lessons
______________________	______________________	_____
______________________	______________________	_____
______________________	______________________	_____
______________________	______________________	_____

10b. Approximately what percent of this life science instruction has been based on LSC*-designated instructional materials? (Darken one oval.)

0	10	20	30	40	50	60	70	80	90	100
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

11a. List the title/topic of each of the ***physical science*** units this class has worked on so far this year (include units you have begun but not completed; do not include units you are planning but have not yet started), the publisher(s) of all instructional materials used to teach each unit, and the number of lessons devoted to each.

Physical Science Unit - Title	Physical Science Unit - Publisher(s)	Number of Lessons
______________________	______________________	_____
______________________	______________________	_____
______________________	______________________	_____
______________________	______________________	_____

11b. Approximately what percent of this physical science instruction has been based on LSC*-designated instructional materials? (Darken one oval.)

0	10	20	30	40	50	60	70	80	90	100
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

** See the cover letter accompanying this questionnaire for a description of the LSC.*

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12a. List the title/topic of each of the ***earth/space science*** units this class has worked on so far this year (include units you have begun but not completed; do not include units you are planning but have not yet started), the publisher(s) of all instructional materials used to teach each unit, and the number of lessons devoted to each.

Earth/Space Science Unit - Title	**Earth/Space Science Unit - Publisher(s)**	**Number of Lessons**

12b. Approximately what percent of this earth/space science instruction has been based on LSC*-designated instructional materials? (Darken one oval.)

0	10	20	30	40	50	60	70	80	90	100
○	○	○	○	○	○	○	○	○	○	○

13. How much emphasis have you given to each of the following topics in this class so far this year? (Darken one oval on each line.)

	None	A Little	A Fair Amount	A Lot
a. Animal behavior	○	○	○	○
b. Characteristics of living things	○	○	○	○
c. Classification	○	○	○	○
d. Ecology	○	○	○	○
e. Food and nutrition	○	○	○	○
f. Human body	○	○	○	○
g. Chemical and physical changes, including changes of state	○	○	○	○
h. Electric circuits	○	○	○	○
i. Energy	○	○	○	○
j. Floating and sinking	○	○	○	○
k. Forces and motion	○	○	○	○
l. Machines	○	○	○	○
m. Magnetism	○	○	○	○
n. Properties of matter, including mixtures and solution	○	○	○	○
o. Sound	○	○	○	○
p. Astronomy	○	○	○	○
q. Erosion, weathering, and deposition	○	○	○	○
r. Rocks, soils, minerals	○	○	○	○
s. Water cycle	○	○	○	○
t. Weather	○	○	○	○
u. Engineering and design principles (e.g., structures, models)	○	○	○	○
v. Measurement/using scientific tools	○	○	○	○
w. Nature of science/science inquiry	○	○	○	○

**** See the cover letter accompanying this questionnaire for a description of the LSC.***

14. About how often do **you** do each of the following in your science instruction in this class? (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Use the LSC*-designated instructional materials as the basis of science lessons.	○	○	○	○	○
b. Arrange seating to facilitate student discussion.	○	○	○	○	○
c. Use open-ended questions.	○	○	○	○	○
d. Require students to supply evidence to support their claims.	○	○	○	○	○
e. Encourage students to explain concepts to one another.	○	○	○	○	○
f. Encourage students to consider alternative explanations.	○	○	○	○	○
g. Assign science homework.	○	○	○	○	○

15. About how often do **students** in this class take part in each of the following types of activities as part of their science instruction? (Darken one oval on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Participate in discussions with the teacher to further science understanding.	○	○	○	○	○
b. Work in cooperative learning groups.	○	○	○	○	○
c. Make formal presentations to the class.	○	○	○	○	○
d. Answer textbook/worksheet questions.	○	○	○	○	○
e. Review homework/worksheet assignments.	○	○	○	○	○
f. Share ideas or solve problems with each other in small groups.	○	○	○	○	○
g. Engage in hands-on science activities.	○	○	○	○	○
h. Design or implement their *own* investigation.	○	○	○	○	○
i. Work on models or simulations.	○	○	○	○	○
j. Work on extended science investigations or projects (a week or more in duration).	○	○	○	○	○
k. Participate in field work.	○	○	○	○	○
l. Write reflections in a notebook or journal.	○	○	○	○	○
m. Work on portfolios.	○	○	○	○	○
n. Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	○	○	○	○	○

C. LSC Professional Development

16. In what year did you begin participating in professional development as part of the LSC*? (Darken one oval.)

- ○ 1995
- ○ 1996
- ○ 1997
- ○ 1998
- ○ 1999
- ○ 2000
- ○ 2001
- ○ Have not yet participated in the LSC. (SKIP to question 20.)

** See the cover letter accompanying this questionnaire for a description of the LSC.*

17. Approximately how many hours have you spent on formal LSC-provided professional development* *since the LSC project began*, focused on each of the following?

a. Life science content/instructional materials

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

b. Physical science content/instructional materials

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

c. Earth/space science content/instructional materials

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

d. Other issues related to science/science education

0	1-4	5-9	10-14	15-19	20-24	25-29	30 or more
⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭

18. Approximately how many ***total hours*** have you spent on formal professional development in science/science education as part of the LSC* ***since the project began***? (Darken one oval.)

⬭ 0	⬭ 10-19	⬭ 40-59	⬭ 80-99	⬭ 130-159	⬭ 200 or greater
⬭ 1-9	⬭ 20-39	⬭ 60-79	⬭ 100-129	⬭ 160-199	

19. Have you been identified as a teacher leader for your district's NSF-supported LSC project? ⬭ Yes ⬭ No

D. Teacher Opinions and Preparedness

20. Please indicate how prepared you feel to do each of the following in the grades you teach. (Darken one oval on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Provide concrete experience before abstract concepts.	⬭	⬭	⬭	⬭
b. Develop students' conceptual understanding of science.	⬭	⬭	⬭	⬭
c. Take students' prior understanding into account when planning curriculum and instruction.	⬭	⬭	⬭	⬭
d. Make connections between science and other disciplines.	⬭	⬭	⬭	⬭
e. Have students work in cooperative learning groups.	⬭	⬭	⬭	⬭
f. Have students participate in appropriate hands-on activities.	⬭	⬭	⬭	⬭
g. Engage students in inquiry-oriented activities.	⬭	⬭	⬭	⬭
h. Engage students in applications of science in a variety of contexts.	⬭	⬭	⬭	⬭
i. Use performance-based assessment.	⬭	⬭	⬭	⬭
j. Use portfolios.	⬭	⬭	⬭	⬭
k. Use informal questioning to assess student understanding.	⬭	⬭	⬭	⬭

**** See the cover letter accompanying this questionnaire for a description of the LSC.***

21. Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade levels you teach, whether or not they are currently included in your curriculum? (Darken one oval on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. The human body	⬭	⬭	⬭	⬭
b. Ecology	⬭	⬭	⬭	⬭
c. Rocks and soils	⬭	⬭	⬭	⬭
d. Astronomy	⬭	⬭	⬭	⬭
e. Processes of change over time (e.g., evolution)	⬭	⬭	⬭	⬭
f. Mixtures and solutions	⬭	⬭	⬭	⬭
g. Electricity	⬭	⬭	⬭	⬭
h. Sound	⬭	⬭	⬭	⬭
i. Forces and motion	⬭	⬭	⬭	⬭
j. Machines	⬭	⬭	⬭	⬭
k. Engineering and design principles (e.g., structures, models)	⬭	⬭	⬭	⬭

22. Please indicate how well prepared you feel to do each of the following. (Darken one oval on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Lead a class of students using investigative strategies.	⬭	⬭	⬭	⬭
b. Manage a class of students engaged in hands-on/project-based work.	⬭	⬭	⬭	⬭
c. Help students take responsibility for their own learning.	⬭	⬭	⬭	⬭
d. Recognize and respond to student diversity.	⬭	⬭	⬭	⬭
e. Encourage students' interest in science.	⬭	⬭	⬭	⬭
f. Use strategies that specifically encourage participation of females and minorities in science.	⬭	⬭	⬭	⬭
g. Involve parents in the science education of their students.	⬭	⬭	⬭	⬭

Thank you!

** See the cover letter accompanying this questionnaire for a description of the LSC.*

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Local Systemic Change
Student Assessment Answer Sheet

Instructions: Please use a #2 pencil. Darken ovals completely, but do not stray into adjacent ovals. Be sure to erase completely any stray marks.

Correct:

Incorrect:

1. Are you: ⬭ Boy ⬭ Girl

2. Which best describes you? (Darken one oval.)

- ⬭ White (not Hispanic)
- ⬭ Black (not Hispanic)
- ⬭ Hispanic or Latino (someone who is from a Mexican, Mexican American, Chicano, Puerto Rican, Cuban, or other Spanish or Hispanic background)
- ⬭ Asian (someone who is from a Chinese, Japanese, Korean, Filipino, Vietnamese, or other Asian background)
- ⬭ Native Hawaiian or Other Pacific Islander (someone who is from Hawaii or other Pacific Island)
- ⬭ American Indian or Alaskan Native (someone who is from one of the American Indian tribes or one of the original people of Alaska
- ⬭ Other, specify ____

3. What grade are you in? ⬭ 4th grade ⬭ 5th grade ⬭ 6th grade ⬭ Other, specify:__________

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0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9

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Thank you very much!

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