Results of the 2002–03 Study of the Impact of the Local Systemic Change Initiative on Student Achievement in Science

by

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INTRODUCTION

Increasingly, education initiatives are being pressured to demonstrate their effectiveness, particularly as it relates to increased student achievement and a reduction in achievement gaps among demographic groups. In 1998, in response to these demands, the National Science Foundation (NSF) initiated as part of their solicitation for Local Systemic Change Initiatives (LSC) a requirement that each project examine its effects on students. 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 various studies that projects will produce should 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 difficult due to the varying instrumentation and designs of the studies.

In response to this concern, Horizon Research, Inc. (HRI) proposed a study to meet the challenge of investigating program-wide effects on student achievement in science, with the additional request of not 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: (1) the majority of LSC science projects are included in this group, (2) few projects already had student achievement data in science available, and (3) items for measuring science achievement, although limited, are available for these grade levels.

This report presents results from the 2002–03 cross-project study. The study uses longitudinal data to control for students’ prior knowledge of the science content being tested, with a pre-test being administered at 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, 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.

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, 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. A copy of the student assessment is included in Appendix A.

Although the intent of the assessment was to measure student knowledge on several scales (physical science knowledge, life science knowledge, etc.), factor and cluster analyses indicated that, with the exception of four items, the assessment was measuring a single ability/trait. This trait was labeled “general science knowledge.” Item response theory (IRT) was then used to compute difficulty and discrimination parameters for each item. These parameters were then used to calculate “true test scores” for each student. The true score removes the error associated with day-to-day fluctuations in student performance, and is a better estimate of student knowledge. A more complete description of these processes can be found in Appendix B.

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, English proficiency status, and whether the student has an individualized educational plan. A student questionnaire was used to gather race/ethnicity and gender data. Copies of the teacher and student questionnaires are located in Appendix C.

**THE SAMPLE**

Ten¹ of the 47 current and past LSC projects targeting 4th, 5th, or 6th grade science teachers elected to participate in the 2002–03 study, including 7 of the 16 that are required to assess impact on students, and 3 of the 31 for whom studies of impact on students are optional. One project administered the assessment to 4th grade classes, 5 to 5th grade classes, and 4 to 6th grade classes. Half of the projects administered the assessment to all classes at the grade level they selected; the remaining half administered the assessment to a sample of classes.

The projects that elected to administer the assessment to a sample of classes submitted the names of all 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.

HRI designed a stratified sampling approach in order to maximize the variation in teacher treatment levels in the sample. With the exception of one project,² for each project sampling a subset of their classes HRI created two lists: 1) classes taught by teachers participating in relatively more hours of LSC professional development (i.e., above the median number of hours

¹ An additional project elected to participate in the study, but failed to return any usable data. This project is omitted from all data analyses presented in this report.

² One project 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.
of professional development for teachers in that project); and 2) classes taught by teachers with relatively fewer hours of LSC professional development (i.e., below the median number of hours of professional development for teachers in that project). Each list was randomly ordered and projects were instructed to select half of their classes from each list, attempting to get classes from as close to 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 1 provides information about the participation of the 10 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 481 classes and 8,207 students in 10 projects that submitted complete pre- and post-test data. Design weights were used in all analyses to account for the unequal probabilities of classes being selected to participate in the study.

<table>
<thead>
<tr>
<th>Project</th>
<th>Cohort</th>
<th>Number of Years Providing Professional Development</th>
<th>Grade Level Selected</th>
<th>Sample or Population</th>
<th>Number of Classes† at Selected Grade Level</th>
<th>Number of Classes Administering Assessment</th>
<th>Number of Classes Returning Usable Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>Population</td>
<td>86</td>
<td>84</td>
<td>72</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>Sample</td>
<td>85</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>Sample</td>
<td>98</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>Population</td>
<td>96</td>
<td>96</td>
<td>81</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>Population</td>
<td>46</td>
<td>43</td>
<td>39</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>Population</td>
<td>250</td>
<td>230</td>
<td>203</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>Sample</td>
<td>296</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>Population</td>
<td>30</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>Sample</td>
<td>23</td>
<td>26</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>Sample</td>
<td>134</td>
<td>40</td>
<td>32</td>
</tr>
</tbody>
</table>

† 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.

As can be seen in Table 2, about two thirds of the classes in this study were taught by teachers with at least 6 years of experience. Roughly 20 percent of the classes in this study were taught by teacher leaders. Teacher leaders are selected by the projects to receive leadership training in addition to professional development in science content and pedagogy. Further, many teachers chosen by projects to be teacher leaders are often selected because of their enthusiasm for science, skill at teaching science, or advanced knowledge of science. Thus, they may not be
representative of a “typical” teacher responsible for teaching science. Ideally, the analyses presented in this report would have excluded teachers that were teacher leaders. However, many 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. Without including classes taught by teacher leaders, there would be few classes in the sample receiving instruction from teachers with extensive levels of LSC professional development, making a meaningful analysis of the relationship between extensive treatment and student achievement impossible.

Table 2
Descriptive Statistics for Categorical Class Level Variables

<table>
<thead>
<tr>
<th>Percent of Classes</th>
<th>(N = 481)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher Experience Level</strong></td>
<td></td>
</tr>
<tr>
<td>0–2 years teaching</td>
<td>18</td>
</tr>
<tr>
<td>3–5 years teaching</td>
<td>15</td>
</tr>
<tr>
<td>6–10 years teaching</td>
<td>18</td>
</tr>
<tr>
<td>11–15 years teaching</td>
<td>14</td>
</tr>
<tr>
<td>16–20 years teaching</td>
<td>14</td>
</tr>
<tr>
<td>21–25 years teaching</td>
<td>10</td>
</tr>
<tr>
<td>26 or more years teaching</td>
<td>11</td>
</tr>
<tr>
<td><strong>Teacher Designated as a “Teacher Leader”</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>82</td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
</tr>
</tbody>
</table>

The classes included in this sample were taught by teachers who had accrued, on average, 63 hours of LSC professional development (see Table 3). On average, students received 2,100 minutes (35 hours) of science instruction during the academic year. The average class contained 24 students, of which roughly 40 percent were non-Asian minority students.

Table 3
Descriptive Statistics for Continuous Class Level Variables

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of hours of LSC professional development</td>
<td>0.00</td>
<td>200.00</td>
<td>62.88</td>
</tr>
<tr>
<td>Number of minutes of science instruction between pre- and post-tests</td>
<td>0.00</td>
<td>8,190.00</td>
<td>2,127.23</td>
</tr>
<tr>
<td>Percent of instruction based upon the LSC-designated instructional materials</td>
<td>0.00</td>
<td>100.00</td>
<td>71.89</td>
</tr>
<tr>
<td>Number of students in class</td>
<td>1.00</td>
<td>35.00</td>
<td>24.09</td>
</tr>
<tr>
<td>Percent non-Asian minority students in class</td>
<td>0.00</td>
<td>100.00</td>
<td>42.66</td>
</tr>
</tbody>
</table>

In addition to classroom and project features, the study included variables for a number of student characteristics. As can be seen in Table 4, the sample is comprised almost equally of males and females. Across all classes, 72 percent of the students are classified as White or of Asian descent; 28 percent belong to non-Asian minority groups. About 1 in 4 students
participating in this study are eligible for free or reduced-price lunch, seven percent have an individualized education plan, and three percent are classified as limited English proficient.

### Table 4

<table>
<thead>
<tr>
<th>Percent of Students (N = 8,207)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td><strong>Race/ethnicity</strong></td>
</tr>
<tr>
<td>White</td>
</tr>
<tr>
<td>African-American</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
</tr>
<tr>
<td>Hawaiian or Other Pacific Islander</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td><strong>Free/Reduced-Price Lunch Eligible</strong></td>
</tr>
<tr>
<td><strong>Individualized Education Plan</strong></td>
</tr>
<tr>
<td><strong>Limited English Proficient</strong></td>
</tr>
</tbody>
</table>

### ANALYSIS AND RESULTS

Descriptive statistics for pre- and post-test raw and true scores are shown in Table 5. Overall, students scored higher on the post-test than they did on the pre-test, an indication that the assessment is sensitive to instruction. Again, the true score is a better estimate of student knowledge as it removes the error associated with day-to-day fluctuations in student performance.

### Table 5

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Raw Score</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Test</td>
<td>0.00</td>
<td>97.96</td>
<td>64.81</td>
<td>18.35</td>
</tr>
<tr>
<td>Post-Test</td>
<td>0.00</td>
<td>97.96</td>
<td>70.20</td>
<td>18.75</td>
</tr>
<tr>
<td><strong>True Score</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Test</td>
<td>20.10</td>
<td>96.02</td>
<td>69.83</td>
<td>16.25</td>
</tr>
<tr>
<td>Post-Test</td>
<td>15.42</td>
<td>95.83</td>
<td>73.38</td>
<td>16.32</td>
</tr>
</tbody>
</table>

The science program study data have a nested structure with students nested within classes, and classes nested within projects. Statistical techniques that do not account for potential shared variance within groups in nested data structures can lead to incorrect estimates of the relationship between independent factors and the outcome. Hierarchical modeling is an appropriate
technique for apportioning and predicting variance within and across groups in a nested data structure.\textsuperscript{3}

A two-level hierarchical linear model (students nested within classes) was used to investigate the relationship between the extent of teacher participation in LSC professional development and student post-test scores, controlling for pre-test scores. MPLUS 3.01\textsuperscript{4} was used for this analysis. The analysis 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, a classroom level variable. The classroom level predictors included in these analyses were:

- Class size;
- Teacher experience level (6 or more years of teaching experience vs. 0–5 years prior experience);
- Teacher leader status;
- Amount of instructional time devoted to science;
- Percent of science instruction based upon the LSC-designated instructional materials; and
- Extent of teacher participation in LSC professional development.

An assumption of regression is that the variables are normally distributed. Thus, all continuous variables used in this study were assessed for deviations from normality. Variables that were non-normally distributed were transformed as necessitated by the level and direction of skewness and kurtosis. The transformed variables were:

- Total number of minutes of science instruction—transformed by converting to hours and taking the natural log;
- Number of students in the class—transformed by squaring and then dividing by 1000; and
- Percent of non-Asian minority students in the class—transformed by taking the arcsine of the square root.


Additionally, because the relationship between teacher participation in LSC professional development and student achievement may not be linear, variables representing the square and the cube of the number of hours of professional development a teacher received were tested in the analysis. Note that for these analyses, teachers’ level of professional development is treated as a continuous variable although it is measured on an 11-point scale. The midpoint of each response category was used as an approximation of the amount of professional development received by a teacher. For example, a teacher that indicated s/he received between 10 and 19 hours of LSC professional development was assigned a value of 14.5 hours of LSC professional development.

The evaluation of the LSC program has found that elementary science teachers who participate in LSC professional development tend to teach more science, and use the LSC-designated instructional materials more frequently, than teachers who have not participated in LSC professional development. Because of this finding, both the direct effect, and two indirect effects (mediated by amount of instruction and percent of instruction based on the LSC materials), of the extent of teacher participation in professional development were included in the model.

In addition to examining the relationships between the variables listed above and post-test scores, each student level variable was tested to determine if its slope varied across classes (e.g., if the relationship between the post-test score and the free/reduced-price lunch status was different for different classes). 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.

Due to limitations in modeling software, it was not feasible to include a third-level of nesting in the model to control for project membership. In an attempt to control for possible project effects, a set of dummy-coded project membership variables was included at the class level. Although this process does not allow for the testing of specific project effects (i.e., whether the effect of a certain variable on student achievement varies across projects), it should factor these effects out of the analysis.

Table 6 shows the regression coefficients and standard errors for the main variables included in the final model. Project membership variables are excluded for two reasons, both for space reasons and because the purpose of the study is to examine the impact of the LSC across the program, not for any individual project.

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<table>
<thead>
<tr>
<th></th>
<th>Regression Coefficient (Standard Error)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intercept</strong></td>
<td>73.10 (0.46)</td>
</tr>
<tr>
<td><strong>Student Level</strong></td>
<td></td>
</tr>
<tr>
<td>FRL</td>
<td>-1.44* (0.50)</td>
</tr>
<tr>
<td>IEP</td>
<td>-4.59* (1.42)</td>
</tr>
<tr>
<td>LEP</td>
<td>0.94 (1.11)</td>
</tr>
<tr>
<td>Non-Asian minority</td>
<td>-1.57* (0.73)</td>
</tr>
<tr>
<td>Female</td>
<td>1.28 (0.68)</td>
</tr>
<tr>
<td>Pre-test score</td>
<td>0.78* (0.02)</td>
</tr>
<tr>
<td><strong>Class Level</strong></td>
<td></td>
</tr>
<tr>
<td>Teacher Leader</td>
<td>-1.01 (0.70)</td>
</tr>
<tr>
<td>Teacher has 6 or more years experience</td>
<td>0.75 (0.42)</td>
</tr>
<tr>
<td>Number of students (transformed)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Percent of non-Asian minority students (transformed)</td>
<td>-2.34* (1.00)</td>
</tr>
<tr>
<td>Percent of FRL students (0 percent omitted)</td>
<td></td>
</tr>
<tr>
<td>&gt; 0 &amp; ≤ 25</td>
<td>1.61 (0.84)</td>
</tr>
<tr>
<td>&gt; 25 &amp; ≤ 50</td>
<td>1.93* (0.88)</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>0.87 (0.99)</td>
</tr>
<tr>
<td>Hours of LSC professional development</td>
<td>-0.09 (0.99)</td>
</tr>
<tr>
<td>Hours of LSC professional development cubed</td>
<td>-0.09 (0.23)</td>
</tr>
<tr>
<td>Amount of science instruction (transformed)</td>
<td>0.36 (0.19)</td>
</tr>
<tr>
<td>Hours of LSC professional development</td>
<td>0.43* (0.19)</td>
</tr>
<tr>
<td>Percent of instruction based on LSC materials (transformed)</td>
<td>-0.74 (0.85)</td>
</tr>
<tr>
<td>Hours of LSC professional development</td>
<td>0.79* (0.17)</td>
</tr>
<tr>
<td>Hours of LSC professional development squared</td>
<td>-0.33* (0.09)</td>
</tr>
</tbody>
</table>

* p < 0.05

There are a number of interesting findings. Controlling for all other variables, including pre-test scores, students eligible for free/reduced-price lunch tended to score lower than non-eligible students. Having an individualized education plan or being a member of a non-Asian minority group is also associated with a lower post-test score. Similarly, students in classes with a high percentage of non-Asian minority students tended to score lower.
In terms of the main variable of interest, there is no significant direct relationship between teacher participation in LSC professional development and student post-test scores. Participation in LSC professional development positively predicts the amount of instructional time devoted to science, and the proportion of science instruction that is based on the LSC-designated instructional materials. However, these two factors are not significant predictors of student achievement. Because the relationship modeled in this analysis is complex, interpretation of the regression coefficients is not straightforward. To assist in interpretation, predicted student true test scores were computed using the regression equation for various levels of teacher participation in LSC professional development (mean values of all control variables were used in this calculation). The graph of these scores, the prediction of how one would expect students to perform, is shown in Figure 1. As can be seen in the graph, there is essentially no difference in predicted post-test scores for students of teachers with varying levels of LSC professional development.

![Figure 1](graph.png)

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. The FRL, IEP, LEP, female, and non-Asian minority terms were tested to see if their slopes varied across classes (e.g., if females in some classes did better than females in other classes). None of these slopes varied significantly across classes, indicating that the relationships between these variables and student post-test scores was statistically the same across classes.
CONCLUSIONS

This study attempted to examine how the LSC program is impacting student achievement in science. The data show a positive relationship between teacher participation in LSC professional development and 1) the amount of instructional time devoted to science, and 2) the extent to which science instruction is based upon the LSC-designated instructional materials. However, controlling for a number of student and classroom characteristics, including pre-test scores, these data do not provide evidence for a relationship between the amount of LSC professional development and student post-test scores.

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, or lack thereof, can be attributed to the LSC program), there are two major concerns. First, although the analyses presented in this report may appear to be longitudinal, they are not. Teachers with varying degrees of professional development are different teachers, not the same teacher examined at different time points. This study was not designed, nor was it feasible, to follow teachers over time, and examine their “effectiveness,” as they participate in LSC professional development. Similarly, there is no feasible means to assess how similar, or different, teachers with varying degrees of participation in LSC professional development are to one another. Teachers participating the most in LSC professional development may be fundamentally different from teachers who participate to a lesser extent (e.g., more motivated to teach science, less experienced because they don’t feel they can say “no” to administrators, etc.).

In addition to the threats to internal validity, there is an important threat to the external validity (i.e., generalizability) of this study. The NSF has funded 47 LSC projects that target science teachers at the 4th, 5th, or 6th grade level. Only 10 of these projects elected to participate in this study. Thus, there is no way to determine whether these findings are indicative of the LSC program or are idiosyncratic to the set of projects participating in this study.
Appendix A

Student Assessment Test Booklet
To the student: Mark your answers on the answer sheet. Fill in only one circle for each question. Please do not write on this test booklet; you may use scrap paper if needed. Please think carefully about your answers. Do your best, but don’t be concerned if you do not know the answers to all of the questions. This test was designed for students in multiple grades and classes who may or may not have studied the topics being assessed.

If you finish before time is called, you should go over your work again.

WHEN YOUR TEACHER TELLS YOU TO, TURN THE PAGE AND BEGIN
1. When this caterpillar becomes an adult, what will it look like?

A.  
B.  
C.  
D.  
E.  

2. A metal spoon, a wooden spoon, and a plastic spoon are placed in hot water. After 15 seconds, which spoon will feel hottest?

A. The metal spoon
B. The wooden spoon
C. The plastic spoon
D. The three spoons will feel the same

3. The morning after a rain storm, Julio noticed a big puddle outside his door when he went to school, even though the sun was shining brightly. When he came home in the afternoon, the puddle was gone. What is the most likely explanation?

A. The water stuck to the shoes of people walking by his house.
B. Neighborhood dogs drank the water.
C. A westerly wind moved the puddle to another location nearby.
D. The liquid water went into the air as water vapor.
4. The picture shows the ways three students connected a battery and a bulb with wires. Which of the bulbs will light?

A. 1 only
B. 2 only
C. 3 only
D. 1 and 3

5. To find out whether seeds grow better in the light or dark, you could put some seeds on pieces of damp paper and

A. keep them in a warm, dark place.
B. keep one group in a light place and another in a dark place.
C. keep them in a warm, light place.
D. put them in a light or dark place that is cool.

6. Look at the picture of the organs on the left. What is the main job of the organ labeled 1?

A. Carrying air
B. Carrying food
C. Carrying blood
D. Carrying messages from the brain
7. Which will stick to a magnet?
   
   A. Penny
   B. Cardboard box
   C. Iron nail
   D. Basketball

8. How hot is it on the surface of the Sun?
   
   A. Not quite as hot as boiling water
   B. About as hot as fire
   C. About 100 °F
   D. Much hotter than almost anything on Earth

9. Karen tried letting a cart go from the top of a ramp three times, once empty, once with a single wooden block, and once with two wooden blocks. Each time, she measured how long it took for the cart to get to the bottom. What idea was she testing?
   
   A. The higher the cart is when you release it, the faster it will go.
   B. The heavier a cart is, the faster it will go.
   C. A cart's wheel size is not related to how fast it goes.
   D. What the block is made of is not related to how fast it goes.

10. Which of the following is NOT a form of precipitation?
    
    A. Hail
    B. Wind
    C. Rain
    D. Snow
11. A teacher taps lightly on the table. Which of the following best describes what her students hear?

A. All the students hear the sound at the same loudness.
B. The three students who are standing will hear the sound louder because the higher your head is, the better you can hear.
C. The three students with an ear on the table will hear nothing because the table is blocking the sound from reaching their ears.
D. The students with an ear on the table will hear the sound louder than those standing because sound travels better through solids than through gases like air.

12. John kept some seeds on moist cotton in a dish. Mike put the same kind of seeds in a dish beside John’s dish, and covered them with water. After two days, John’s seeds sprouted, but Mike’s did not. Which is the most likely reason?

A. Mike’s seeds needed more air.
B. Mike’s seeds needed more light.
C. Mike did not put the dish in a warm enough place.
D. Mike should have used a different kind of seed.

13. On which day was snowfall most likely to have occurred?

A. Monday
B. Tuesday
C. Wednesday
D. Thursday
14. Students in Mr. Wylee's class made electromagnets as shown in the diagram. Mr. Wylee challenged the class to make the electromagnet stronger. Which of the following would work?

1. Wrap more coils around the bolt
2. Use a stronger battery
3. Use a plastic bolt

A. 1 and 2
B. 2 and 3
C. 1 and 3
D. 1, 2, and 3

15. Which of the boxes X, Y, or Z has the LEAST mass?

A. X
B. Y
C. Z
D. All three boxes have the same mass

16. Whenever scientists carefully measure any quantity many times, they expect that

A. all of the measurements will be exactly the same.
B. only two of the measurements will be exactly the same.
C. all but one of the measurements will be exactly the same.
D. most of the measurements will be close but not exactly the same.
17. Iris found a piece of igneous rock while on vacation. Which of the following places was she most likely visiting?

A. The marble ruins in Greece  
B. An inactive volcano in Hawaii  
C. The limestone caves of Kentucky  
D. A sandy beach in California

18. When you go into your bedroom and flip a switch, your bedroom lamp comes on. The energy that lights your lamp is

A. magnetic energy.  
B. electrical energy.  
C. solar energy.  
D. nuclear energy.

19. Which of the following is a behavior of a bird?

A. A tree  
B. Singing  
C. Nest  
D. Worms

20. Keisha is pushing her bicycle up a hill. Where does Keisha get the energy to push her bicycle?

A. From the food she has eaten  
B. From the exercise she did earlier  
C. From the ground she is walking on  
D. From the bicycle she is pushing
21. Juan thinks that water will evaporate faster in a warm place than in a cool one. He has two identical bowls and a bucket of water. He wants to do an experiment to find out if he is correct. Which of the following should he do?

A. Place two bowls with the same amount of water in a warm place.

B. Place a bowl of water in a cool place and a bowl with twice the amount of water in a warm place.

C. Place a bowl of water in a cool place and a bowl with half of the amount of water in a warm place.

D. Place a bowl of water in a cool place and a bowl with the same amount of water in a warm place.

22. The diagram shows the life cycle of a mealworm. What would happen if this larva were eaten by a bird?

A. The mealworm would die before it could reproduce.

B. The bird would become sick.

C. The mealworm species would be wiped out.

D. The mealworm eggs would be spread by the bird.

23. Ken put a thermometer in a glass filled with hot water. Why does the liquid inside the thermometer rise?

A. Gravity pushes it up.

B. Air bubbles are released.

C. Heat from the water makes it expand.

D. Air pressure above the water pulls it up.
24. The picture shows a circuit for testing whether an object or material conducts electricity. When the wires touch the paperclip the bulb lights. What other objects will light the bulb?

A. Both a rubber band and a wooden cube
B. Both a penny and a silver spoon
C. Both a marble and a ping pong ball
D. Both a dime and a piece of thread

25. Beryl finds a rock and wants to know what kind it is. What information about the rock will best help her to identify it?

A. The size of the rock
B. The weight of the rock
C. The temperature where the rock was found
D. The minerals the rock contains

26. Some children were trying to find out which of three light bulbs was brightest. Which one of these gives the best START toward finding the answer?

A. “One bulb looks brightest to me, so I already know the answer.”
B. “All the bulbs look bright to me, so there cannot be an answer.”
C. “It would help if we had a way to measure the brightness of a light bulb.”
D. “We can take a vote and each person will vote for the bulb he or she thinks is the brightest.”
27. The Grand Canyon was most likely created by:

A. the plates of the earth moving past each other.
B. water flowing over rock over a long period of time.
C. an unusually strong earthquake.
D. a glacier moving down from the north during the last ice age.

28. The diagram shows three identical light bulbs, a switch, and a battery. When the switch is closed what will you observe?

A. Bulb A is the brightest because it is closest to the switch.
B. Bulb B is the brightest because it is getting electricity from both sides.
C. Bulb C is the brightest because it is closest to the battery.
D. All three are equally bright.

29. When you are riding a bicycle at night, your bicycle's reflectors help people in cars see your bicycle. How do bicycle reflectors work?

A. They are made of a special material that gives off its own light.
B. They are connected to batteries that allow them to produce light.
C. They bounce light back from other sources.
D. They are covered with paint that glows in the dark.
30. A girl wanted to play on a seesaw with her little brother. Which picture shows the best way for the girl, who weighed 50 kg (kilograms), to balance her brother, who weighed 25 kg?

A. 

B. 

C. 

D. 

31. A student observed a spider and its web. Which of the following is NOT an observation?

A. The web has some threads that are straight.
B. The spider has eight legs.
C. The spider did not make any noise.
D. The spider evolved from insects.

32. If you wanted to be able to look at the stars, the planets, and the Moon more closely, what should you use?

A. Telescope
B. Periscope
C. Microscope
D. Magnifying glass
33. Each of the three magnets shown has been dipped into the substance below it. Which of the substances could be coffee?

A. A only
B. B only
C. C only
D. A and B only

34. What do playing a guitar, banging a drum, and dropping a pebble in the water have in common?

A. They all produce light.
B. They all cause vibrations.
C. They all convert heat to energy.
D. They all need gravity to move.

35. Which of the following living things in the pond system uses the energy from sunlight to make its own food?

A. Insect
B. Frog
C. Water lily
D. Small fish
36. Which of the following should a science class do to find out which wind direction is most common during times of cloudy skies and wet weather in their town?

A. Check a weathervane, thermometer, and barometer daily.
B. Make a chart of the different cloud formations shown in an encyclopedia.
C. Keep a record of daily rainfall for an entire year.
D. Record wind direction, cloud conditions, and rainfall daily for at least 4 months.

37. Look at the picture of a sprouting seed. What is happening?

A. It is swelling and making flowers.
B. The seed coat is coming off and pulling in a stem.
C. It is performing photosynthesis and fruits are forming.
D. The root is growing down and the seed coat is coming off.

38. There is a thunderstorm close to your house. The windows rattle at the same time that you hear the thunder. What cause the windows to rattle?

A. Sound waves from the thunder
B. Light from the lightning
C. Rain from the clouds
D. The high humidity during the storm
39. According to the information in the table, which of the following should you do to decide whether an unknown powder is powder X or powder Y?

A. Examine the shape of the grains of powder.
B. Check the color of the powder.
C. Measure the melting point of the powder.
D. Dissolve the powder in water.

<table>
<thead>
<tr>
<th>Property</th>
<th>Powder X</th>
<th>Powder Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>White</td>
<td>White</td>
</tr>
<tr>
<td>Melting Point</td>
<td>80°C</td>
<td>120°C</td>
</tr>
<tr>
<td>Shape</td>
<td>Crystals</td>
<td>Crystals</td>
</tr>
<tr>
<td>Mixed with Water</td>
<td>Dissolves</td>
<td>Dissolves</td>
</tr>
</tbody>
</table>

40. Sally found a rock near the street by school. What two things below are most important for figuring out what type of rock she has found?

1. The size of the rock
2. The color of the rock
3. The texture of the rock
4. The shape of the rock

A. 1 and 2
B. 2 and 3
C. 2 and 4
D. 3 and 4

41. A bar magnet was placed near three objects. Object A moved toward the magnet until they touched. Object B did not move at all. Object C moved away from the magnet.

Which of the explanations below could explain why object A and object C moved?

A. Object A is light and object C is heavy.
B. Object A is a magnet and object C is not.
C. Object C is a magnet and object A is light.
D. Both object A and object C are magnets.
42. Seeds develop from which part of a plant?

   A. Flower  
   B. Leaf    
   C. Root    
   D. Stem

43. Mr. Smith’s class wanted to learn about the ducks in a pond near their school. The class decided to visit the pond each month during the school year, starting in September. Which of the following questions could the class answer by making observations?

   A. Which part of the pond do the ducks use for feeding?  
   B. How many years have pairs of ducks been together?  
   C. How many ducks were there last May?  
   D. Where do the ducks go when they migrate?

44. This table shows the temperature and precipitation (rain and snow) in four different towns on the same day. Where did it snow?

<table>
<thead>
<tr>
<th></th>
<th>Town A</th>
<th>Town B</th>
<th>Town C</th>
<th>Town D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest Temperature</td>
<td>13 °C</td>
<td>-9 °C</td>
<td>22 °C</td>
<td>-12 °C</td>
</tr>
<tr>
<td>Highest Temperature</td>
<td>25 °C</td>
<td>-1 °C</td>
<td>30 °C</td>
<td>-4 °C</td>
</tr>
<tr>
<td>Precipitation (rain or snow)</td>
<td>0 cm</td>
<td>5 cm</td>
<td>2.5 cm</td>
<td>0 cm</td>
</tr>
</tbody>
</table>

   A. Town A  
   B. Town B  
   C. Town C  
   D. Town D
45. A block is placed in a beaker of fresh water. It floats in the water as shown. If the same block is placed in oil and in seawater, it will:

A. float on the top of both.
B. sink to the bottom in both.
C. float on the top of the oil and sink to the bottom in the seawater.
D. float lower or sink in the oil and float higher in the seawater.

46. A paperclip is suspended from a magnet. If I want the paperclip to hold more washers, I should

A. add more magnets to the top.
B. place magnets under the cups.
C. link more paperclips together.
D. stack more cups together.

47. What property of water is most important for living organisms?

A. It is odorless.
B. It does not conduct electricity.
C. It is tasteless.
D. It is liquid at most temperatures on Earth.

48. In a box there is a mixture of iron filings and sand. Which is the easiest way to separate the iron filings from the sand?

A. Pour water on the mixture.
B. Use a magnifying glass.
C. Use a magnet.
D. Heat the mixture.
49. This question refers to an experiment in which moths were captured by attracting them to either white or yellow light. The graph shows that

A. moths prefer yellow light.
B. only white moths are attracted to white light.
C. the number of moths captured per day using yellow light decreased after Day 5.
D. the number of moths captured per day using white light decreased during the experiment.

50. A curved groove is placed on a level table as shown in the diagram to the left. A ball is pushed in the groove at P, so that it leaves at Q. These diagrams show the level table and the groove from above. Which shows how the ball will move when it leaves the groove?

A. ![Diagram A]
B. ![Diagram B]
C. ![Diagram C]
D. ![Diagram D]

51. You want to find out which will empty from a can fastest—water, alcohol, cooking oil, syrup, or soda pop. To answer this question you will need equal amounts of the liquids as well as

A. a can with a hole in the bottom and a stopwatch.
B. a stopwatch only.
C. cans with different size holes.
D. cans of different sizes, one for each liquid.
52. Mr. Conrad wanted to help his students understand how water takes part in the weathering of rocks. Mr. Conrad filled a glass jar with water and screwed the top on the jar. Then he put the jar in a clear plastic box, closed the lid, and put the box in the freezer. About three hours later, the students looked in the freezer. They observed that the water was frozen and the glass jar broken into many pieces. What property of water, that makes it an important weathering agent, was demonstrated by Mr. Conrad?

A. Water is a liquid, so that it can get into cracks easily.

B. Water is a solvent so when it gets into cracks in rocks it dissolves rock material and makes the cracks larger.

C. Water expands on freezing so when it gets into cracks in rocks and freezes, it exerts lots of force on the rock making it crack even more.

D. Water is all over the surface of the earth so it has many opportunities to interact with rock, including in frozen areas.

53. Data about the hair color of fifteen students are shown in the table. Which of the following bar graphs represents the data shown in the table?

<table>
<thead>
<tr>
<th>Hair Color</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blond</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. ![Bar Graph A]

B. ![Bar Graph B]

C. ![Bar Graph C]

D. ![Bar Graph D]
Appendix B

Description of Methods Used to Conduct the IRT Analysis
Item response theory (IRT) is the study of test and item scores based on assumptions concerning the mathematical relationship between abilities (or other hypothesized traits) and item responses. The probabilities of these responses are modeled as a function of separate parameters for the item and the person; item parameters represent such properties as item difficulty and discrimination whereas the person parameters generally represent the ability level of the examinee.

The first step of an IRT analysis is to determine the dimensionality of the assessment (i.e., the number of traits being measured). A number of procedures are available for assessing dimensionality including factor and cluster analysis. Prior to conducting the following analyses, the student achievement data was randomly split into two files, each containing roughly half of the students in the entire sample. Randomly splitting the data set allows for exploratory analyses to be conducted on one set, and confirmatory analyses on the other.

MicroFACT v. 2.0.1, a program designed for the factor analysis of binary data, was used to conduct an exploratory factor analysis of the 53 items on the assessment. Results suggested that all but four items loaded strongly (i.e., had loadings above 0.3) on a single 49 item factor which could be labeled “science knowledge.” The questions which did not load strongly were dropped from subsequent analyses.

Next, an exploratory cluster analysis on using DETECT was conducted. The cluster analysis also indicated that the assessment was essentially unidimensional, with the exception of the same four items identified as problematic in the factor analysis. DIMTEST was employed to statistically test the unidimensionality of the one-factor/cluster solution suggested by the Microfact and DETECT analyses. Results indicated that the 49 item scale was unidimensional.

After unidimensionality was confirmed, BILOGMG v. 3.0 was used to fit a 2-parameter IRT model to the data. BILOG also provides estimates of each student’s latent ability, and these estimates, along with the item parameters were used to calculate true test scores.

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2 The items that did not load on this factor were number 6, 7, 17 and 47.
5 Zimowski, Michele; Muraki, Eiji; Mislevy, Robert; Bock, Darrell; Scientific Software International, Inc., 2002.
Appendix C

Teacher and Student Questionnaires
LSC Science Program Study*
Pre-Test Teacher Questionnaire

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: ☐ American Indian or Alaskan Native ☐ Hispanic or Latino Native Hawaiian or Other Pacific Islander ☐ Asian ☐ White ☐ Black or African-American

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

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 ☐

B. Your Science Teaching

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

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.)

* See the cover letter accompanying this questionnaire for a description of the LSC.
8. Have you taught any science in this class so far this academic year? (Darken one oval.)

☐ Yes
☐ No (skip to question 14)

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

<table>
<thead>
<tr>
<th>Average Number of Minutes per Lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 or fewer</td>
</tr>
<tr>
<td>☐</td>
</tr>
</tbody>
</table>

10. 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 |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

11a. For each of the life science units this class has worked on so far this year, list the title/topic, the publisher of each of the instructional materials used to teach the unit, and the number of lessons devoted to it. Include units you have begun but not completed; do not include units you are planning, but have not yet started.

<table>
<thead>
<tr>
<th>Life Science Unit - Title</th>
<th>Life Science Unit - Publisher(s)</th>
<th>Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of Plants</td>
<td>Harcourt; STC</td>
<td>5</td>
</tr>
</tbody>
</table>

i) ___________________________  ___________________________  ________

ii) ___________________________  ___________________________  ________

iii) ___________________________  ___________________________  ________

iv) ___________________________  ___________________________  ________

11b. Approximately what percent of this life science instruction has been based on LSC*-designated instructional materials? If you have not taught any life science units yet this year, skip to question 12a. (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.
12a. For each of the **physical science** units this class has worked on so far this year, list the title/topic, the publisher of *each* of the instructional materials used to teach the unit, and the number of lessons devoted to it. Include units you have begun but not completed; do **not** include units you are planning, but have not yet started.

<table>
<thead>
<tr>
<th>Physical Science Unit - Title</th>
<th>Physical Science Unit - Publisher(s)</th>
<th>Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Example:</em> Magnets and Motors</td>
<td>FOSS; Scott Foresman; &amp; teacher-made materials</td>
<td>8</td>
</tr>
</tbody>
</table>

i) ____________________________ ___________________________________________ ________

ii) ____________________________ ___________________________________________ ________

iii) ____________________________ ___________________________________________ ________

iv) ____________________________ ___________________________________________ ________

12b. Approximately what percent of this physical science instruction has been based on LSC*-designated instructional materials? If you have not taught any physical science units yet this year, skip to question 13a. (Darken one oval.)

![Oval options](0 10 20 30 40 50 60 70 80 90 100)

13a. For each of the **earth/space science** units this class has worked on so far this year, list the title/topic, the publisher of *each* of the instructional materials used to teach the unit, and the number of lessons devoted to it. Include units you have begun but not completed; do **not** include units you are planning, but have not yet started.

<table>
<thead>
<tr>
<th>Earth/Space Science Unit - Title</th>
<th>Earth/Space Science Unit - Publisher(s)</th>
<th>Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Example:</em> Earth Features</td>
<td>EDC Insights; Silver-Burdett</td>
<td>9</td>
</tr>
</tbody>
</table>

i) ____________________________ ___________________________________________ ________

ii) ____________________________ ___________________________________________ ________

iii) ____________________________ ___________________________________________ ________

iv) ____________________________ ___________________________________________ ________

13b. Approximately what percent of this earth/space science instruction has been based on LSC*-designated instructional materials? If you have not taught any earth/space science units yet this year, skip to question 14. (Darken one oval.)

![Oval options](0 10 20 30 40 50 60 70 80 90 100)

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

14. 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
- 2002
- Have not yet participated in the LSC*. (SKIP to question 17.)

15. 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

16. 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

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

Thank You!

* See the cover letter accompanying this questionnaire for a description of the LSC.
LSC Science Program Study*
Post - Test Teacher Questionnaire

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. Your Science Teaching

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

2. 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.)

3. Have you taught any science in this class so far this academic year? (Darken one oval.)
  ☐ Yes
  ☐ No (skip to question 13)

4. 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

5. Have you been the teacher responsible for teaching science to these students for the entire academic year? (Darken one oval.)
  ☐ Yes (skip to question 7)
  ☐ No

6. When did you begin working with this class? (month/year) ______________________

Questions 7 through 10 ask about your science teaching since the pre-test. To assist you in answering these questions, we have enclosed your pre-test responses to these questions (see the green enclosure).

7. How many science units has this class worked on since the pre-test? Include units that you had begun but not completed at the time of the pre-test and units that you are currently working on but have not yet finished. Do not include units you completed prior to the pre-test or units you are planning but have not yet started. (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

* See the cover letter accompanying this questionnaire for a description of the LSC.
8a. For each of the **life science** units this class has worked on *since the pre-test*, list the title/topic, the publisher of each of the instructional materials used to teach the unit, and the number of lessons devoted to it since the pre-test. Include units that you had begun but not completed at the time of the pre-test and units that you are currently working on but have not yet finished. Do **not** include units you completed prior to the pre-test or units you are planning but have not yet started.

<table>
<thead>
<tr>
<th>Life Science Unit - Title</th>
<th>Life Science Unit - Publisher(s)</th>
<th>Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of Plants</td>
<td>Harcourt; STC</td>
<td>5</td>
</tr>
</tbody>
</table>

ii) __________________________________________________________________________  __________

iii) __________________________________________________________________________  __________

iv) __________________________________________________________________________  __________

8b. Approximately what percent of your life science instruction *since the pre-test* has been based on LSC*-designated instructional materials? If you have not taught any life science since the pre-test, skip to question 9a. (Darken one oval.)

9a. For each of the **physical science** units this class has worked on *since the pre-test*, list the title/topic, the publisher of each of the instructional materials used to teach the unit, and the number of lessons devoted to it since the pre-test. Include units that you had begun but not completed at the time of the pre-test and units that you are currently working on but have not yet finished. Do **not** include units you completed prior to the pre-test or units you are planning but have not yet started.

<table>
<thead>
<tr>
<th>Physical Science Unit - Title</th>
<th>Physical Science Unit - Publisher(s)</th>
<th>Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnets and Motors</td>
<td>FOSS; Scott Foresman; &amp; teacher-made materials</td>
<td>8</td>
</tr>
</tbody>
</table>

ii) __________________________________________________________________________  __________

iii) __________________________________________________________________________  __________

iv) __________________________________________________________________________  __________

9b. Approximately what percent of your physical science instruction *since the pre-test* has been based on LSC*-designated instructional materials? If you have not taught any physical science since the pre-test, skip to question 10a. (Darken one oval.)

* See the cover letter accompanying this questionnaire for a description of the LSC.
10a. For each of the earth/space science units this class has worked on since the pre-test, list the title/topic, the publisher of each of the instructional materials used to teach the unit, and the number of lessons devoted to it since the pre-test. Include units that you had begun but not completed at the time of the pre-test and units that you are currently working on but have not yet finished. Do not include units you completed prior to the pre-test or units you are planning but have not yet started.

<table>
<thead>
<tr>
<th>Earth/Space Science Unit - Title</th>
<th>Earth/Space Science Unit - Publisher(s)</th>
<th>Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Features</td>
<td>EDC Insights; Silver-Burdett</td>
<td>9</td>
</tr>
</tbody>
</table>

i) 

ii) 

iii) 

iv) 

10b. Approximately what percent of your earth/space science instruction since the pre-test has been based on LSC*-designated instructional materials? If you have not taught any earth/space science since the pre-test, skip to question 11. (Darken one oval.)

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

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

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| a. Use the LSC*-designated instructional materials as the basis of science lessons. | 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 |
| 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. |   |   |   |   |   |

12. 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.)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| a. Participate in discussions with the teacher to further science understanding. | 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 |
| 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. |   |   |   |   |   |

*See the cover letter accompanying this questionnaire for a description of the LSC.*
12. (continued)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely (e.g., a few times a year)</th>
<th>Sometimes (e.g., once or twice a month)</th>
<th>Often (e.g., once or twice a week)</th>
<th>All or almost all science lessons</th>
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<tbody>
<tr>
<td>j. Work on extended science investigations or projects (a week or more in duration).</td>
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<td>k. Participate in field work.</td>
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<td>l. Write reflections in a notebook or journal.</td>
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<td>m. Work on portfolios.</td>
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<td>n. Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).</td>
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</table>

B. LSC Professional Development

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

- ☐ 1995
- ☐ 1996
- ☐ 1997
- ☐ 1998
- ☐ 1999
- ☐ Have not yet participated in the LSC*. (SKIP to question 16.)

14. 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

15. 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
- 30 or more
- 40-59
- 60-79
- 100-129
- 130-159
- 160-199
- 200 or greater

16. 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.
### C. Teacher Opinions and Preparedness

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

<table>
<thead>
<tr>
<th></th>
<th>Not adequately prepared</th>
<th>Somewhat prepared</th>
<th>Fairly well prepared</th>
<th>Very well prepared</th>
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</thead>
<tbody>
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18. 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.)

<table>
<thead>
<tr>
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</table>

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

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<td>g.</td>
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</tbody>
</table>

Thank you!

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

Continued on back...
Thank you very much!

● ● ● ● ●