iEvolve with STEM

Annual Evaluation Report
Year One

Peggy J. Trygstad
R. Keith Esch
P. Sean Smith

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Submitted to: W. Robert Midden, PI
241A Math Science Building
Bowling Green State University
Bowling Green, OH 43403

Submitted by: Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514-2296

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EXECUTIVE SUMMARY

iEvolve

The *Inquiry and Engagement to Invigorate and Optimize Learning for Everyone with STEM* (iEvolve) project aims to impact teaching and learning in two collaborating school districts (Perkins Local Schools and Sandusky City Schools), such that student engagement, motivation, and achievement increase. The project will involve two cohorts of teachers spanning grades 3–8 for three years each. The first cohort (grades 3–5) joined the project in Spring 2013, and its members are now completing their first year of participation. The second cohort, which will involve grades 6–8 teachers, will join the project in Year Three.

iEvolve anticipates improvement in student outcomes as a result of enhanced teacher capabilities with regard to content knowledge, assessment of student learning, and hands-on, inquiry-based instruction. A major element of the project is the introduction of citizen science research projects (in Year Two) that allow students to experience science firsthand by participating in investigations that are fully integrated with their classroom curricula.

The project engages teachers in several ways, including a yearly summer institute and monthly evening meetings during the academic year. In addition, the project has organized cross-district, grade-level Professional Learning Teams (PLTs) that meet three times each month. The project has also organized monthly within-district, grade-level team (GLT) meetings.

Evaluation Activities

Horizon Research, Inc.'s (HRI's) role in the external evaluation of the iEvolve project is two-fold: (1) to give formative feedback on the quality of project activities that informs mid-course corrections; and (2) to provide summative evidence of the impact of iEvolve on teachers, their teaching practices, and student learning.

In Year One, the evaluation is focusing on formative feedback, guided by the following questions:

1. What are participants' perceptions of various aspects of the summer institute?
2. What are participants' perceptions of activities during the school year (monthly project meetings, PLTs, and GLTs)?
3. What are participants' concerns about citizen science research?
4. What is the change in participants':
    a. content knowledge?
    b. perceptions of preparedness to teach content standards?
    c. beliefs about science teaching?
    d. self-efficacy for science teaching?
5. What is the status of participant collaboration within and across schools?

To address these questions, HRI administered online questionnaires shortly before and after the 2013 summer institute. In addition, HRI observed four days of the eight-day institute, interviewed a sample of participants across grade levels about the institute experience and their expectations for the 2013–14 academic year, observed two monthly project meetings, observed a day-long curriculum design team meeting, interviewed six "Ambassadors" (i.e., facilitators of the six PLTs), and administered a mid-year feedback questionnaire.

Participant Perceptions of the 2013 Summer Institute

Content Accessibility

Consistent with HRI observations of the iEvolve summer institute, questionnaire data indicate that participants had positive impressions about the accessibility of the science content that was addressed. Nearly all agreed that they understood the content and found the content interesting. The vast majority also indicated that the instructors supported them and helped improve their understanding of the targeted science concepts.

Participant Interactions and Institute Culture

Also consistent with HRI observations were participants' positive impressions of their interactions with other participants and of the institute culture. Almost 9 in 10 participants felt that their contributions to discussions were valued. A similar number indicated that they felt supported by other participants as they developed understanding of the targeted concepts.

Clarity of Institute Requirements

Participants' perceptions of the clarity of the institute requirements were generally favorable, with over 80 percent indicating that the goals and work requirements were clear and that the work requirements were realistic. HRI's observation data support these findings.

Impacts of the 2013 Summer Institute

Survey and observation data suggest that the iEvolve summer institute had multiple positive impacts. Participants' content knowledge increased following the institute, as did their perceptions of preparedness to teach the content standards at their preferred grade level. These increases were particularly evident for 3rd and 4th grade physical science and 5th grade life science. The institute also appears to have had an effect on teacher beliefs about science teaching, with desirable changes seen in beliefs aligned with what has been learned about effective instruction from cognitive science. The emphasis on the 6E learning cycle was likely a significant contributor to these changed beliefs. Although impacts on teacher self-efficacy were not detected, it is possible that additional professional development and sufficient opportunities to implement new teaching strategies may impact efficacy beliefs in the future.

Collaboration Within and Across Schools

Participant Collaboration – Baseline Data

A major objective of iEvolve is to foster cross-school and cross-district interaction among participants as a means of promoting changes in science instruction. HRI conducted a social network analysis on baseline interaction data and found that although such connections already exist, there is substantial room for growth in within-school interactions, between-schools interactions, and frequency of interactions.

Professional Learning Teams (PLTs)

The iEvolve PLT meetings have helped create a culture of collaboration and collegiality between the two school districts in the project. PLT meetings are generally well attended, with opportunities for online meetings helping to alleviate some of the logistical concerns associated with scheduling face-to-face sessions. Although PLT discussions often center on the use of the FOSS kits, groups are also discussing topics such as alignment with state standards and opportunities for cross-curricular connections. In addition, PLT meetings provide teachers with opportunities to support one another and share teaching resources, information, and ideas.

FOSS Kit Implementation

iEvolve teachers identify both successes and struggles in implementing instruction centered on the use of FOSS kits. Nearly all feel that their teaching practice benefits from discussions with other teachers facing similar instructional decisions. However, constraints of teaching contexts make it difficult for teachers to devote the time they need to planning and implementing kit-based lessons. Nearly all teachers report omitting some elements of the kits they use, with these decisions based largely on learning standards and knowledge of their students' understandings. In addition, teachers generally feel only moderately well prepared to teach using the kits. Teachers anticipate improved kit-based instruction as their experience with the kits grows.

Conclusion

iEvolve has much to celebrate—a successful summer institute, a robust series of monthly support meetings, successful implementation of PLTs and GLTs, and project-wide rollout of kits. Other achievements include the ongoing efforts of the curriculum design team, organization of citizen science research projects for the coming year, and a wealth of positive media attention. With all of these accomplishments, the project is well positioned for the year ahead.

INTRODUCTION

Project Overview

The *Inquiry and Engagement to Invigorate and Optimize Learning for Everyone with STEM* (iEvolve) project aims to impact teaching and learning in two collaborating school districts (Perkins Local Schools and Sandusky City Schools) such that student engagement, motivation, and achievement increase. The project plans to involve two cohorts of teachers spanning grades 3–8 for three years each. Cohort 1 (grades 3–5) joined the project in Spring 2013, and its members are now completing their first year as iEvolve participants. Most participants teach multiple subjects to one group of students (i.e., they teach in self-contained classrooms). However, in keeping with the project's cross-disciplinary focus, some participants do not teach science on a regular basis or at all. These include teachers in semi-specialized situations (e.g., they teach only language arts and social studies to multiple groups of students), as well as interventionists and coaches.[1] The project plans to involve a second cohort of teachers (grades 6–8) beginning in Year Three.

The project leadership is centered at Bowling Green State University (BGSU) and draws on the expertise of BGSU Education and STEM faculty, as well as support from numerous area organizations (e.g., Toledo Zoo, The Ohio State University Stone Lab). iEvolve leaders are affiliated with the Northwest Ohio Center for Excellence in STEM Education (NWO) and aim to build on the successes of previous NWO projects that combined efforts of university scientists with STEM educators in teacher professional development.

iEvolve anticipates improvement in student outcomes as a result of enhanced teacher capabilities with regard to content knowledge, assessment of student learning, and hands-on, inquiry-based instruction. A major element of the project is the introduction of citizen science research projects (in Year Two) that allow students to experience science firsthand by participating in investigations that are fully integrated with their classroom curricula.

The project engages teachers in several ways, including a yearly eight-day summer institute. Each cohort will participate in three institutes; Cohort 1 participants completed their first in the summer of 2013 and will complete their second in the summer of 2014. In addition, participants are involved in three types of activities during the school year. Each month, the participants gather for a project-wide evening meeting. The project has also organized cross-district, grade-level groups that meet three times each month, either face-to-face (most frequently) or virtually via email or online discussion board. These Professional Learning Teams (PLTs) are a central project strategy. Finally, the project has organized monthly within-district, grade-level team (GLT) meetings in response to requests from project participants. Whereas PLTs tend to address such topics as cross-curricular issues and meeting grade-level standards, the GLTs focus primarily on the nuts and bolts of curriculum implementation.

[1] For the purpose of project participation, teachers who teach multiple grades were assigned to one grade, and attended project functions with other teachers in that grade.

The emphasis of Year One activities was implementing FOSS kits in grades 3–5 in all elementary schools in the two districts. The summer institute oriented teachers to the kits, and activities during the school year (monthly meetings as well and PLT and GLT meetings) were structured to support teachers' efforts. All told, participants experienced 4–6 hours of ongoing professional growth opportunities each month. As of the writing of this report, most teachers had implemented 2 of their 3 designated kits. With the foundation of kit-based instruction in place, the project's emphasis will shift in Year Two to supporting citizen science research projects in all participants' classrooms.

Description of the Evaluation

Horizon Research, Inc. (HRI) is conducting the iEvolve external evaluation. HRI's role is two-fold: first, to give formative feedback on the quality of project activities that informs mid-course corrections; and second, to provide summative evidence of the impact of iEvolve on teachers (their content knowledge, beliefs, and teaching practices) and student learning.

Early in Year One, the iEvolve leadership team and HRI evaluators discussed the project's vision, specific objectives, and strategies for achieving its objectives. Results of this discussion were documented in a logic model (see Appendix A), which shows relationships among project resources, planned activities and their specific outputs, project outcomes, and longer-term project impacts. Though not its primary purpose, the logic model highlights the overlap between data relevant to the project's own research questions and data that will inform HRI's evaluation efforts. To avoid duplication of effort, the project leaders, including the internal evaluator, and HRI divided primary data collection responsibilities and specified data-sharing expectations. In general, the iEvolve leadership team is responsible for collecting data from grade 3–8 students and BGSU STEM faculty, while HRI is responsible for collecting data from teachers and project staff.

In Year One, the evaluation is focusing on formative feedback, guided by the following questions:

1. What are participants' perceptions of various aspects of the summer institute?
2. What are participants' perceptions of activities during the school year (monthly project meetings, PLTs, and GLTs)?
3. What are participants' concerns about citizen science research?
4. What is the change in participants':
    a. content knowledge?
    b. perceptions of preparedness to teach content standards?
    c. beliefs about science teaching?
    d. self-efficacy for science teaching?
5. What is the status of participant collaboration within and across schools?

To address these questions, HRI conducted the following data collection activities between June 2013 and March 2014, listed chronologically:

- Administered a pre-institute questionnaire to participants, which included questions about instructional practices, beliefs about science teaching, and self-efficacy. The questionnaire also included a grade-specific content knowledge assessment.

- Observed four days of the eight-day institute.

- Administered a post-institute questionnaire, which included questions about the summer institute experience, collaboration among participants, concerns about citizen science research, pedagogical preparedness, and participation in professional learning teams. The questionnaire also repeated items about beliefs, self-efficacy, and content knowledge.

- Interviewed 11 participants from the three grade levels about the summer institute experience and their expectations for the 2013–14 academic year.[2]

- Observed two monthly project-wide meetings.

- Observed a day-long curriculum design team meeting.

- Interviewed six ambassadors (i.e., facilitators of the PLTs).

- Administered a mid-year feedback questionnaire to project participants in February 2014 regarding academic year activities.

All evaluation instruments are included in Appendix B. The baseline and post-institute questionnaires were administered on-line during three-week periods before and after the institute. Multiple-choice content knowledge questions were specific to each grade level, as were the topics included in the teacher preparedness questions on the post-institute questionnaire. All other questions were common across grades. All 56 iEvolve participants responded to the baseline questionnaire; 54 of 56 participants responded to the post-institute questionnaire, for a response rate of 96 percent. The response rate for the 2014 mid-year feedback questionnaire was 85 percent.[3]

The remainder of this report is divided into five main sections:

1. Participant perceptions of the 2013 summer institute;
2. Impacts of the 2013 summer institute;
3. Collaboration within and across schools;
4. FOSS kit implementation; and
5. Summary and recommendations.

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[2] The sample was chosen by randomly selecting three participants from each grade level. As interviews were done, it became clear that interventionists were overrepresented (4 of the 9). To balance the sample, two additional classroom teachers were selected randomly from the teacher participants.

[3] The survey was administered to 52 individuals; 4 of the 56 were no longer participating for various reasons. Forty-four individuals responded to the survey.

Overview of the 2013 Summer Institute

The summer institute is the project's professional development centerpiece. The eight-day experience was held over two weeks on the Firelands campus of Bowling Green State University. All 56 of the Cohort 1 participants attended at least a portion of the institute, and 45 participants were present all eight days. Six of the institute days were organized around science content sessions specific to the FOSS kits being introduced at each grade level (one each in Earth, life, and physical science; see Table 1). These sessions were typically led by teams that included a STEM educator and a scientist.[4] The opening day of the institute was used for orientation activities, including a presentation by a representative of FOSS. On the final day of the institute, participants developed supplementary lessons for content specified in Ohio state standards, but deemed to be insufficiently addressed by the selected kits.

Table 1
FOSS Modules Used in iEvolve

Grade	Subject	Kit
3rd	Life Science Physical Science Earth Science	Insects & Plants Measuring Matter Water
4th	Life Science Physical Science Earth Science	Structures of Life Energy & Electromagnetism Soils, Rocks & Landforms
5th	Life Science Physical Science Earth Science	Environments Motion, Force & Models Sun, Moon & Planets

Participants had opportunities to meet in their PLTs throughout the institute. The PLTs were organized by the project such that each included teachers from a single grade level across both school districts. Meetings typically lasted about one hour and were facilitated by iEvolve project leaders.

The project articulated four outcomes anticipated from the summer institute, and additional professional development activities, during Year One:

1. Mastery of the science content related to the state science standards for the teacher's grade level(s);
2. Effective participation in a PLT;
3. Mastery of the ability to guide and differentiate hands-on inquiry to increase student engagement and academic achievement of state science standards; and
4. Improved ability to perform valid authentic assessment of student learning.

[4] An intervention specialist was also on hand to address issues of differentiating instruction.

PARTICIPANT PERCEPTIONS OF THE 2013 SUMMER INSTITUTE

The post-institute questionnaire included a series of 15 items designed to elicit participant perspectives on various aspects of the summer institute, including the content, organization, and culture. Each item used six response options, ranging from strongly disagree to strongly agree. Related items in this series, as well as in other series on the pre- and post-institute questionnaires, were combined to form composite variables, which have the advantage of being more reliable than individual questionnaire items. Each composite has a maximum possible score of 100 and a minimum of 0. A score of 100 would indicate that a respondent selected strongly agree for each item in the composite; a score of 0 corresponds to a respondent selecting strongly disagree for each. Composite definitions and reliabilities are shown in Appendix C.

This section of the report summarizes data gathered to answer the evaluation question, "What are participants' perceptions of various aspects of the summer institute?"

Content Accessibility

The post-institute questionnaire included several items related to the accessibility of content addressed in the summer institute. Table 2 shows the mean composite score, which suggests that participants had generally positive impressions about this aspect of the summer institute.

Table 2
Mean Composite Score for Institute Content Accessibility

	N	Mean	Standard Deviation
Content Accessibility	54	83.43	21.67

Table 3 shows the percentage of respondents indicating moderate or strong agreement with each statement in the composite. (The full frequency distribution for each item in this and other composites is provided in Appendix D.) Nearly all moderately or strongly agreed that they understood the content, they found the content interesting, they felt supported by the instructors, and interacting with instructors helped them to better understand the concepts addressed at the institute.

Table 3
Participants Moderately or Strongly Agreeing[†] with Statements about Content Accessibility in the Summer Institute

	Percent of Respondents (N = 54)
I usually understood the content being addressed in the Institute.	89
The content of the Institute was interesting to me.	89
Interactions with the instructors helped me understand the concepts addressed in the Institute better.	87
I felt supported by the instructors as I developed my understanding of the concepts addressed in the Institute material.	85

† The table includes participants who responded 5 or 6 on a 6-point scale, from 1 (strongly disagree) to 6 (strongly agree).

HRI observations of the summer institute are consistent with participants' positive impressions of content accessibility. For example, in a session on the Environments kit, leaders engaged participants in the analysis of content-relevant probes and responses that promoted participants' understandings of target ideas. HRI also observed that an Insects and Plants session included a series of activities aligned with a set of focus questions, and at the end of the session, most if not all of the participants were able to correctly answer the questions.

Participant Interactions and Institute Culture

Other items on the post-institute questionnaire asked about interactions among participants and the broader institute culture. Table 4 shows the mean score for this composite variable, which is also quite high.

Table 4
Composite Mean Score for Participant Interactions and Institute Culture

	N	Mean	Standard Deviation
Participant Interactions/Institute Culture	54	83.15	21.59

Table 5 shows the percentage of respondents moderately or strongly agreeing with each statement in the series. Participants consistently indicated positive perceptions across multiple aspects of participant interactions and institute culture. For example, almost 9 in 10 participants felt that their contributions to discussions were valued and that they felt supported by other participants as they developed understanding of the targeted science concepts.

Table 5
Participants Moderately or Strongly Agreeing† with Statements about Participant Interactions and Culture of the Summer Institute

	Percent of Respondents (N = 54)
I felt my contributions to the Institute discussions were valued.	87
I felt supported by other participants as I developed my understanding of the concepts addressed in the Institute material.	87
I found the discussions during the Institute interesting.	87
Interactions with the participants helped me understand the concepts addressed in the Institute better.	87
Interactions with the participants helped me understand how to apply the Institute concepts in my teaching.	83
The Institute atmosphere encouraged me to make contributions to the discussions.	81

† The table includes participants who responded 5 or 6 on a 6-point scale, from 1 (strongly disagree) to 6 (strongly agree).

As with content accessibility, HRI observations correlate with participants' positive impressions of their interactions with other participants and the institute culture. Participants were encouraged to try additional experiments that they devised in their groups to learn more about insect behaviors. In the Magnetism and Electricity session, collaborative discussion and troubleshooting of electric circuit arrangements among participants produced hands-on experimentation and observations that appeared to develop understanding of series and parallel circuits. The culture established in the Environments session was such that participants appeared to feel at ease asking content-based questions in areas where their understanding was limited (e.g., "What is the difference between an ecosystem and a habitat?").

Clarity of Institute Requirements

A third group of items asked about the clarity of institute requirements. As shown in Table 6, the mean score for this composite was also quite high.

Table 6
Composite Mean Score for Clarity of Institute Requirements

	N	Mean	Standard Deviation
Clarity of Institute Requirements	54	81.85	28.71

Table 7 shows the percentage moderately or strongly agreeing with these statements. Responses to the individual items in the composite, as well as the composite mean, indicate that participants' impressions were again quite positive, with over 80 percent of the participants moderately or strongly agreeing with each item.

Table 7
Participants Moderately or Strongly Agreeing† with Statements about Clarity of Institute Requirements

	Percent of Respondents (N = 54)
The goals of the Institute were made clear.	83
The Institute work requirements were made clear.	81
The Institute work requirements were realistic.	81

† The table includes participants who responded 5 or 6 on a 6-point scale, from 1 (strongly disagree) to 6 (strongly agree).

HRI observed several aspects of the summer institute that seemed to contribute to the high ratings. Institute leaders outlined the goals for individual sessions. The amount and complexity of work expected from participants appeared reasonable; i.e., participants were typically able to complete the tasks/activities designated by the leaders within the times allotted. Participants often appeared to be challenged by the work, but not overwhelmed or frustrated. Homework assignments did not exceed the tasks that the leaders envisioned—rarely were extra tasks added as a result of incomplete coverage/treatment in sessions.

Taken together, these data suggest that the summer institute was a positive professional development experience for participants. This finding is supported by the fact that 90 percent of participants moderately or strongly agreed that they would recommend the institute to their colleagues.

IMPACTS OF THE 2013 SUMMER INSTITUTE

The pre- and post-institute questionnaires included several items intended to investigate impacts of the iEvolve summer institute on teachers':

- Content knowledge;
- Perceptions of preparedness to teach content standards;
- Beliefs about science teaching; and
- Self-efficacy for science teaching.

Impacts were also addressed in interviews with iEvolve teachers. In the following sections, we describe these categories and point out changes that occurred from pre- to post-institute.

Content Knowledge

HRI developed a series of multiple-choice assessment items to measure teachers' science content knowledge. The items are aligned with the Earth, life, and physical science content in the Ohio Revised Science Content Standards,[5] as well as the core science ideas in the 3rd Edition Full

[5] http://education.ohio.gov/Topics/Academic-Content-Standards/Science

Option Science System (FOSS) modules used by teachers in iEvolve (see Table 1). In addition, the teacher assessment items are set in instructional contexts to make it obvious that they were written for teachers rather than students.

Participants were presented with a series of 15 assessment items based on their assigned grade level.[6] A percentage correct score was calculated for each teacher. The pre- and post-institute scores were pooled and standardized at each grade level to remove variation caused by grade-specific versions of the assessment items.[7] The standardized pre-institute scores were combined across grade levels and compared to the standardized post-institute scores to look for changes in content knowledge.

As can be seen in Table 8, the post-institute mean is significantly different from the pre-institute mean (an effect size[8] of 0.36), suggesting that participation in the institute increased teachers' content knowledge. Figure 1 shows the grade-specific pre- and post-institute mean scores. However, due to the relatively small sample size at each grade level, differences within each grade were not tested statistically. As such, we are unable to make claims about the relative effects at each grade level.

Table 8
Standardized Teacher Content Knowledge Assessment Scores – Overall (N = 45)†

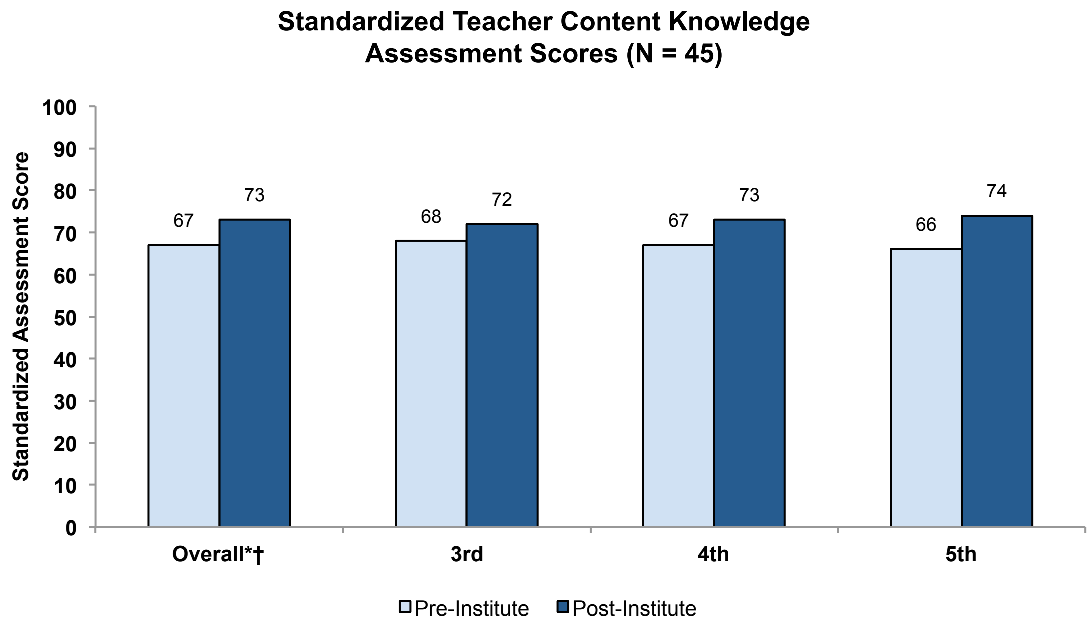
	Minimum	Maximum	Mean	Standard Deviation	Effect Size (in Standard Deviations)
Pre-Institute	20	100	69.63	20.53	0.36*
Post-Institute	40	100	75.85	16.53	

† Pre- and post-institute scores were standardized within each grade level before significance testing to reduce variation caused by grade-specific versions of the assessment items.
* Combining all three grade levels, there was a statistically significant difference between pre- and post-institute content knowledge scores (two-tailed paired-samples t-test; $p < 0.05$).

[6] Information about assigned grade levels was provided by the iEvolve project. Although each teacher was associated with a single grade level, eight individuals attended content sessions across grade levels at the summer institute. These individuals were excluded from the analyses because they did not have an equal opportunity to deepen their content knowledge across science topics at a single grade level.

[7] Scores were standardized within each grade level by converting them to z-scores and then rescaling them so that the lowest score was 0 and the highest score was 100.

[8] The effect size was calculated as the difference in gains, divided by the pooled standard deviation. Effect sizes of about 0.2 are typically considered small, 0.50 medium, and 0.8 large. Cohen, J. (1988). Statistical power analysis for the behavioral sciences. Hillsdale, NJ: Lawrence Erlbaum Associates.



* Combining all three grade levels, there was a statistically significant difference between pre- and post-institute content knowledge scores (two-tailed paired-samples t-test; $p < 0.05$) with an effect size of 0.36.

† Pre- and post-institute scores were standardized within each grade level before significance testing to reduce variation caused by grade-specific versions of the assessment items.

Figure 1

The change in percent correct for individual items from pre- to post-institute (see Appendix E) suggests particular topic areas where teachers appear to be more likely to answer items correctly following the institute; particularly, physical science at the 3rd grade level (e.g., matter, volume), physical science at the 4th grade level (e.g., conductors, electric circuits), and life science at the 5th grade level (e.g., food chains, producers and consumers). Sample items in these topic areas are shown in Figures 2–4, with the correct answers appearing in bold text. The percentage of teachers selecting each answer choice before and after the iEvolve institute, respectively, are shown in parentheses. We note that individual items were not tested for significance and caution the reader in interpreting results.

3rd Grade Physical Science Teacher Assessment Item

A teacher drops a small cube of ice into a small glass of water at room temperature. Students observe that the ice floats in the water. Next, the teacher asks her students to write a short explanation for why the piece of ice floats. One student writes:

"The ice floats because it weighs less than the water in the glass."

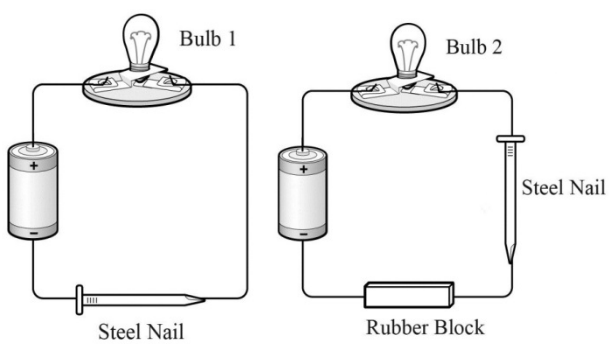
Which of the following ideas, if any, does this student appear to be missing?

- **A. The density of the ice is less than that of liquid water. (pre: 74%) (post: 95%)**
- B. The density of the ice is greater than that of liquid water. (5%) (0%)
- C. The shape of the ice piece determines whether it floats or sinks. (0%) (0%)
- D. None. The student appears to have an accurate understanding of why ice floats in liquid water. (21%) (5%)

Figure 2

4th Grade Physical Science Teacher Assessment Item

A teacher tells her students that a steel nail is a conductor and a rubber block is an insulator. She then shows her students the two drawings below and asks them to predict which of the bulbs will light.



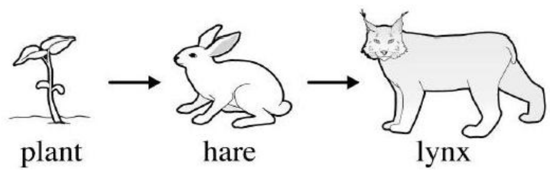
Which student response is correct?

- **A. Bulb 1 only (pre: 78%) (post: 94%)**
- B. Bulb 2 only (11%) (0%)
- C. Bulbs 1 and 2 (11%) (6%)
- D. Neither bulb will light. (0%) (0%)

Figure 3

5th Grade Life Science Teacher Assessment Item

A teacher displays the food chain below for her students:



The teacher states: *"A type of lynx lives in Canada and preys on hares, which eat plants. What is most likely to happen if a predator that eats only lynxes enters the ecosystem?"*

Which student response is correct?

A. The number of plants will increase. (6%) (13%)
B. The number of hares will increase. (pre: 53%) (post: 75%)
C. The number of lynxes will increase. (6%) (0%)
D. The numbers of lynxes and hares will both decrease. (35%) (13%)

Figure 4

Although it is not entirely clear why there appeared to be content knowledge gains in these topic areas and not the others addressed by the institute, there are several possible explanations. For example, research has shown that elementary teachers are more likely to indicate feeling well prepared to teach Earth and life science than they are to teach physical science.[9] Therefore, it is not surprising that two days of professional development focused on physical science would have a substantial impact on 3rd and 4th grade teachers' content knowledge. In addition, HRI researchers were able to observe portions of 4th grade physical science and 5th grade life science sessions during the iEvolve summer institute. The observed instruction was particularly strong in these topics (e.g., it included elicitation of prior knowledge, opportunities to engage with phenomena, and sense making), providing another possible reason for increased content knowledge in these topic areas.

Perceptions of Preparedness to Teach Content Standards

iEvolve participants were presented with a list of Earth, life, and physical science topics that align with the Ohio Revised Science Content Standards at their assigned grade level. Teachers were asked to indicate their level of preparedness to teach each topic both prior to and following the institute, with pre-institute preparedness collected retrospectively.[10] For each time point, the

[9] Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 national survey of science and mathematics education.* Chapel Hill, NC: Horizon Research, Inc.

[10] This "retrospective pre" approach is useful when respondents are likely to change their perceptions of initial knowledge/preparedness as they learn more about a topic (e.g., in cases where they did not realize how much/little they knew about a topic until after their participation in the program).

items were combined into two composite variables called Pre-institute Perceptions of Preparedness to Teach Grade-Specific Content and Post-institute Perceptions of Preparedness to Teach Grade-Specific Content. Like the content assessment scores, scores on these composites were standardized to remove variation due to teachers at each grade level being asked about different topics.

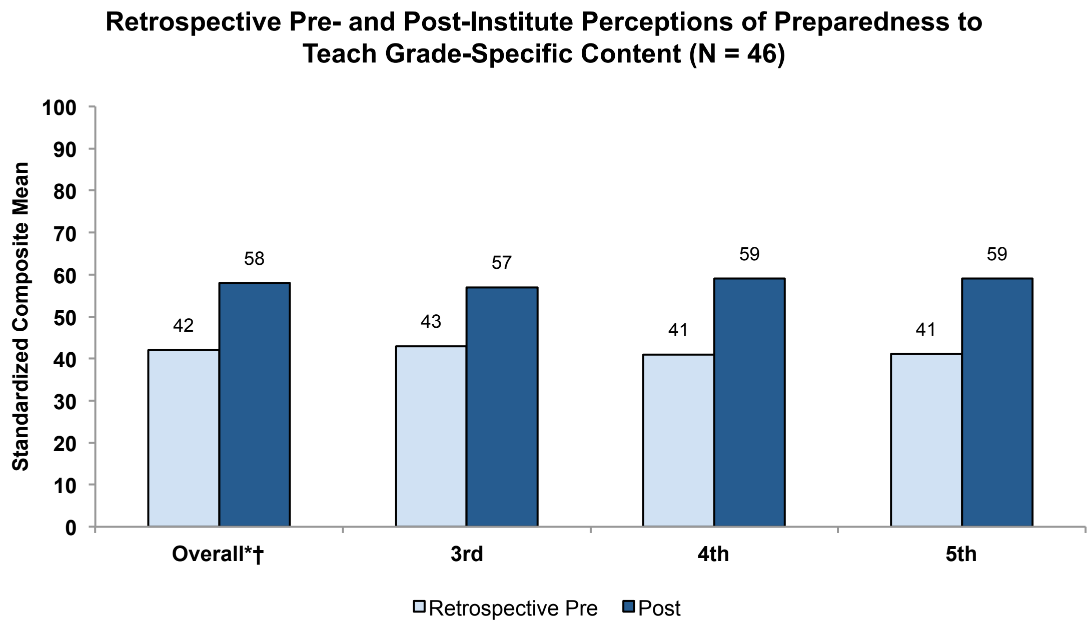
As can be seen in Table 9, there was a significant and substantial increase in teachers' perceptions of preparedness to teach grade-specific content after experiencing the iEvolve summer institute. Figure 5 shows the grade-specific retrospective pre- and post-institute mean scores (standardized). However, like the grade-specific content assessment scores, we cannot make claims about the relative effects at each grade level, as grade-specific changes were not tested statistically due to the small sample sizes.

Table 9
Teacher Preparedness to Teach
Grade-Specific Content Across Time – Overall (N = 46)†

Time	Min.	Max.	Mean	Std. Deviation	Effect Size (in Standard Deviations)
Retrospective Pre-Institute	3	83	41.67	21.07	1.34*
Post-Institute	31	85	58.33	14.32	

† Retrospective pre- and post-scores were standardized within each grade level before significance testing to reduce variation caused by grade-specific versions of this item.

* Combining all three grade levels, there was a statistically significant difference in perceptions of preparedness from retrospective pre-institute to post-institute (two-tailed paired-samples t-test; $p < 0.05$).



* Combining all three grade levels, there was a statistically significant difference in perceived preparedness from retrospective pre- to post-institute (two-tailed paired-samples t-test; $p < 0.05$) with an effect size of 1.34.
† Pre- and post-institute scores were standardized within each grade level before significance testing to reduce variation caused by grade-specific versions of this item.

Figure 5

An examination of frequency distributions for individual items in the composites from retrospective pre- to post-institute suggests increased perceptions of preparedness in particular topic areas for each grade level. Third- and fourth-grade teachers appear to experience more growth in perceived preparedness to teach physical science (e.g., states of matter and their associated properties; uses of energy in electric circuits), while fifth-grade teachers appear to experience more growth in preparedness to teach life science (e.g., the relationships among producers, consumers, and decomposers in an ecosystem). (See Appendix D.) These apparent changes in teachers' feelings of preparedness are quite consistent with apparent changes in teachers' content knowledge assessment scores.

Beliefs about Science Teaching

On the pre- and post-institute questionnaire, participants responded to a subset of items from the Teacher Beliefs about Effective Science Teaching (TBEST)[11] instrument. The full questionnaire consists of 21 statements, which fall into three factors, shown in Figure 6 with representative statements. (Note that two of the factors—Confirmatory Instruction and Hands-on Over All

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[11] Smith, P. S., Smith, A. A., & Banilower, E. R. (in press). Situating beliefs in the theory of planned behavior: The development of the teacher beliefs about effective science instruction questionnaire. In C. M. Czerniak, R. Evans, J. Luft, & C. Pea (Eds.), *The role of science teachers' beliefs in international classrooms: From teacher actions to student learning*.

Else—contain statements that contradict what cognitive science suggests about effective instruction.) To reduce response burden, iEvolve participants were given an abbreviated version of the TBEST, which included only 6 of the 11 items from the Learning-Theory-Aligned Instruction composite (see Appendix B).[12]

TBEST Factors and Representative Items

Learning-Theory-Aligned Instruction

- Teachers should ask students to support their conclusions about a science concept with evidence.
- Students should have opportunities to connect the concept they are studying to other concepts.

Confirmatory Instruction

- Students should know what the results of an experiment are supposed to be before they carry it out.
- When students do a hands-on activity and the data don't come out right, teachers should tell students what they should have found.

Hands-on Over All Else

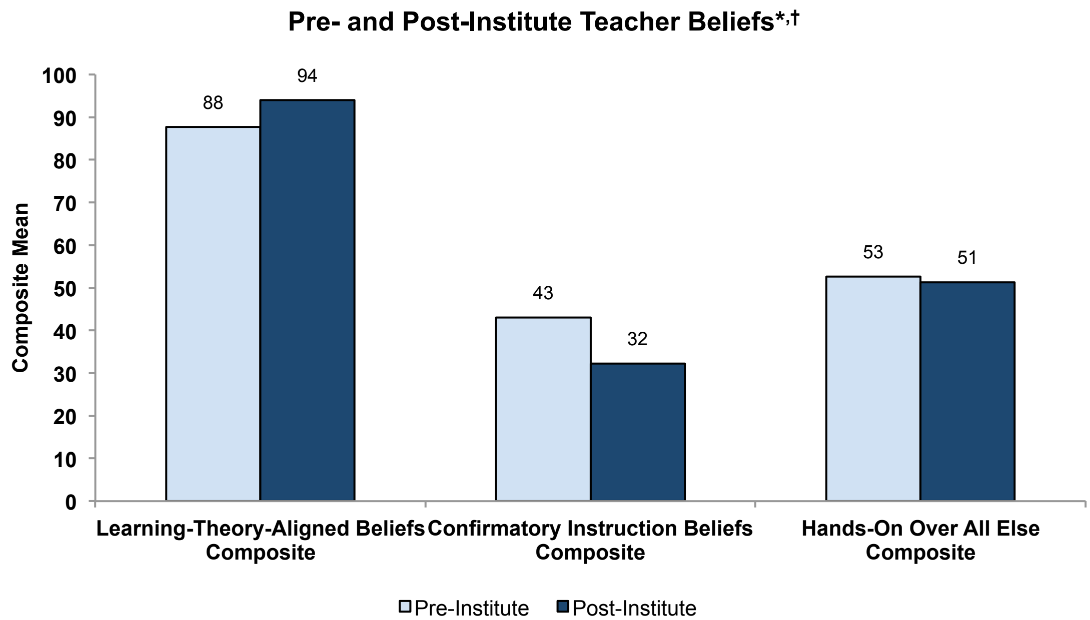
- Hands-on activities and/or laboratory activities should be used primarily to reinforce a science concept that the students have already learned.
- Students should do hands-on or laboratory activities, even if they do not have opportunities to reflect on what they learned by doing the activities.

Figure 6

As can be seen in Figure 7, comparing composite scores before and after the iEvolve summer institute reveals significant changes for two of the factors: Learning-Theory-Aligned Instruction and Confirmatory Instruction (effect sizes of 0.49 and 0.53, respectively). Both indicate a desirable change in teacher beliefs; an increase in Learning-Theory-Aligned Instruction beliefs and a decrease in Confirmatory Instruction beliefs. The increase in beliefs aligned with learning theory is particularly notable given the very high pre-institute mean;[13] i.e., there was not much room for improvement.

[12] These items were selected by choosing items with the highest factor loadings.

[13] The high pre-institute mean on this factor is typical for the TBEST.



* There were statistically significant differences in the Learning-Theory-Aligned Instruction and Confirmatory Instruction composite scores between pre- and post-institute administrations (two-tailed paired-samples t-tests; $p < 0.05$) with effect sizes of 0.49 and 0.53, respectively.

† There was no statistically significant difference in Hands-on Over All Else beliefs scores between pre- and post-institute (two-tailed paired-samples t-test; $p \geq 0.05$).

Figure 7

During HRI observations of the iEvolve summer institute, a consistent emphasis on the 6E learning cycle was noted. For many, if not most, of the participants, this model was new. Instructors made explicit connections between pieces of the 6E cycle and specific activities in the FOSS curriculum materials. For example, instructors pointed out how initial activities were intended to engage students in a topic and how culminating questions prompted students to explain what they learned. Furthermore, instructors regularly provided ideas for integrating each piece of this learning cycle into classroom instruction. For instance, participants were asked to think about various methods of evaluating student understanding, including journaling, partner/class discussions, and short quizzes. When asked whether the summer institute prepared them to use the 6E model in their science teaching, 7 of 11 teachers who were interviewed anticipated that the 6E model would impact their instruction. As two stated:

> *Yes, especially the explore and engage parts, yes…I'm not saying that all of it is [impacting my instruction], but I think those parts will really change the way we teach, I guess.*

> *Yes, I think so. I think it's a good model. I like how it goes around. It's circular, but yet you revisit things, and I think that is a good model for our kids.*

Eight interviewees indicated that the summer institute could have done even more to support their use of the model. In the words of two:

[The 6E model] was talked about, but I don't feel that I was able to use it, or I didn't use it during the Institute. I mean, it was just one of those things that was just kind of put out there: "use it, this is our philosophy." I'm trying, but it's one of those things that I don't feel like I used it enough at the Institute that I can truly apply it in the classroom yet…I go through the steps, but my confidence level is not there for that yet.

I'm a little bit yet confused on [the 6E model], but they kept going over it I felt...We really got to implement it in implementing a lesson. I'm even thinking if we got to do another lesson, at least going through it twice, it might be a little bit more easy to remember. I have to do a lot of referring back in my notes and papers that we got. But it might've been beneficial to do two lessons using that model.

In addition, three teachers suggested revisiting the 6E model in their academic year PLTs. Said one:

With these three-hour monthly meetings, I'm hoping that…maybe an hour could be devoted to something like [the 6E model] at one of these meetings. I would be all about that for sure. I think it would be a good idea for the [iEvolve leadership] to present something on that. To be honest with you, I didn't hear one teacher talking about that model at all. We're talking about how to keep the crayfish alive and our pacing and the time invested. No one has even brought up the model.

Although teachers wished for additional opportunities to focus on the 6E model, the majority expected this approach would impact their instruction. Therefore, it seems likely that this approach contributed to the significant changes in teacher beliefs.

Although the Hands-on Over All Else composite mean did not change, many teachers held pre-institute beliefs about hands-on instruction that were likely reinforced by the student-centered nature of the FOSS modules they engaged with during the iEvolve summer institute. For example, 6 of 11 interviewed teachers expressed positive opinions about the hands-on nature of the FOSS kits, which allow students to be actively engaged in learning. Said two:

The more hands-on the better. The more times students can learn in a discovery method by using hands-on, it's a deeper learning. It's a learning that will be a permanent memory, so it won't be a temporary memory. I think that is very important in teachers' instruction.

I like hands-on for our kids…Everything can't be hands-on, but the more that the kids can interact with something, the more they are going to increase their knowledge.

Further, the modules themselves stress engaging students with hands-on activities, giving less emphasis to the importance of ensuring that students have opportunity to make sense of the phenomena with which they are engaging. Consequently, teachers are likely finding themselves better equipped and supported to implement hands-on activities than they were in the past. For example, all four interviewees who had begun using the kits when they were interviewed described instructional changes resulting from use of the FOSS kits. Two indicated that their instruction has become more student centered and cohesive:

> *I think the kits just provide almost like a comfort, or a security background, or a foundation for me. Knowing that I don't have to just rely on a textbook and me finding other materials and hoping they get it through that…Me being able to take myself, take the teacher out of the instruction, and involve the students more in their own learning instead of me telling them, "This is what you need to know." Me being able to step back and say, "They're going to be able to learn it themselves." We've got the materials for it and they are going to be actively involved in their learning instead of me telling them what they need to know and then seeing if they get it by some model or some video.*
>
> *In the past, I have always done the teaching part and then done the application part with the hands-on. I think now we're trying to do it the other way around. Do the exploration part to get them thinking and then do the teaching part.*

Self-Efficacy for Science Teaching

Before and after the institute, participants also responded to a subset of items from the Science Teaching Efficacy Belief Instrument (STEBI),[14] a well-known instrument comprised of two scales intended to measure personal science teaching efficacy beliefs and science teaching outcomes expectancy. To reduce response burden, iEvolve teachers completed a modified version of the STEBI, in which the original 25-item instrument was reduced to 10 sub-items that best align with the iEvolve project goals. (See Appendix B.)

Items from the pre- and post-institute questionnaires were combined to create two self-efficacy composites: Personal Science Teaching Efficacy Beliefs[15] and Science Teaching Outcomes Expectancy.[16] Representative items are shown in Figure 8. The pre-institute composite scores were then compared to the post-institute scores to look for changes in self-efficacy beliefs. As can be seen in Figure 9, there were no statistically significant changes in self-efficacy beliefs. Perhaps an eight-day institute is not sufficient to bring about changes in teachers' deeply held beliefs. Also, teachers may need to try out the strategies they learned and see the impact on their students in order for their efficacy beliefs to change.

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[14] Enochs, L. G. & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy belief instrument: A preservice elementary scale. *School Science and Mathematics*, *90*(8), 694–706.

[15] Participants who do not teach science at the elementary level were not presented with the science teaching outcomes expectancy items. Therefore, this composite was computed only for those who indicated teaching science at the elementary level.

[16] The reliability for this 5-item composite on the pre-institute questionnaire was very low (Cronbach's Alpha = 0.362). Two items were dropped from the pre- and post-institute questionnaires, and a new 3-item composite was calculated. The reliabilities for this new composite were still low (Cronbach's Alpha = 0.584 for the pre-test and 0.571 for the post-test), indicating the composite may not be measuring the intended construct. Therefore, these results should be interpreted with caution.

STEBI Factors and Representative Items

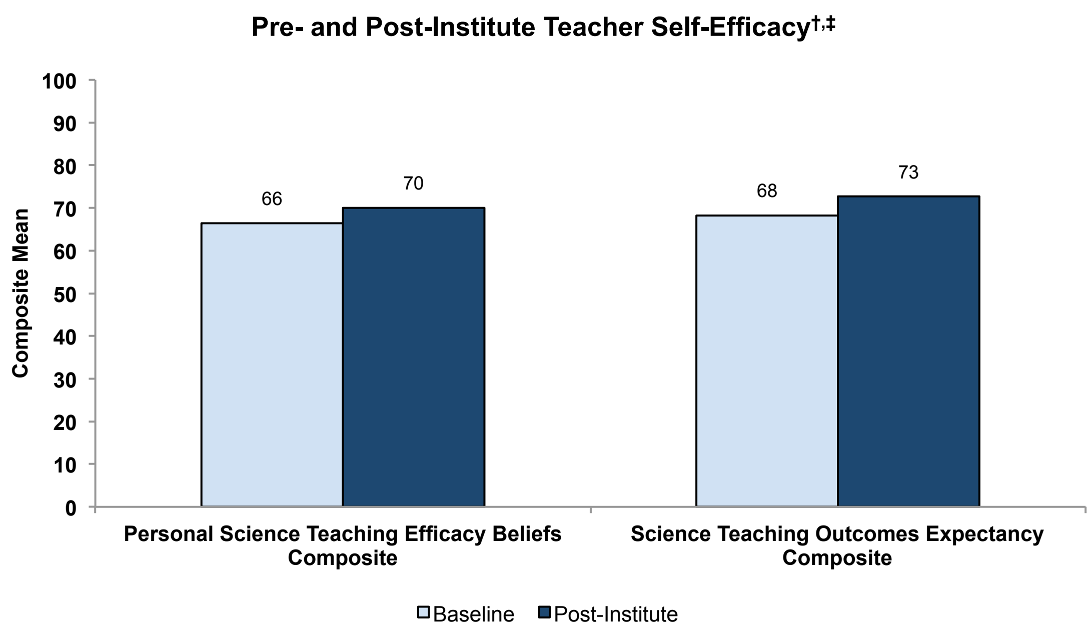
Personal Science Teaching Efficacy Beliefs

- I am not very effective in monitoring science experiments.
- I am typically able to answer students' science questions.

Science Teaching Outcomes Expectancy

- If students are underachieving in science, it is most likely due to ineffective science teaching.
- Even teachers with good science teaching abilities cannot help some kids learn science

Figure 8



† There was no statistically significant difference in self-efficacy scores from baseline to post-institute (two-tailed paired-samples t-tests; $p \geq 0.05$).

‡ Personal Science Teaching Efficacy Beliefs was computed only for those participants who indicated teaching science.

Figure 9

Taken together, these data indicate that the iEvolve summer institute had multiple impacts. Participation in the institute increased participants' content knowledge, as well as their perceptions of preparedness to teach the content standards at their designated grade level. These increases appear to be largely due to impacts in 3rd and 4th grade physical science and 5th grade life science. The institute also appears to have had an effect on teacher beliefs about science teaching, with desirable changes found in beliefs about learning-theory-aligned instruction and confirmatory instruction. The observed emphasis on the 6E learning cycle was likely a significant contributor to these changed beliefs.

COLLABORATION WITHIN AND ACROSS SCHOOLS

One major objective of the iEvolve project is establishing formal cross-school and cross-district networks of participants. The project envisions these networks (or PLTs) as a vehicle for achieving project goals and, as such, invested a substantial portion of the summer institute in creating them. The PLTs met throughout the 2013–14 school year to discuss what they learned in the institute and how it applies to implementing the FOSS kits. In subsequent years, the PLTs will be central to initiating and sustaining citizen science research projects.

Participant Collaboration – Baseline Data

As part of the external evaluation, HRI is tracking the development of participant networks using social network analysis (SNA). Baseline data were gathered via a question on the post-institute questionnaire that asked, "*During the 2012–2013 school year, excluding the past two weeks at the iEvolve Summer Institute, did you collaborate on teaching with any iEvolve participants from [school name]?*" If participants responded "no," they were asked the same question about the next school. If they responded "yes," they were presented with a list of participants from the school[17] and prompted, "*Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, excluding the past two weeks at the iEvolve Summer Institute. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results*."[18] The questionnaire required respondents to answer for each individual, using the following choices:

- Not at all in the last school year;
- Once or twice in the last school year;
- Quarterly;
- Monthly;
- Weekly; or
- Daily.

The data were analyzed using NodeXL, a plug-in for Microsoft Excel. Output from the analyses includes graphical representations of networks—known as sociograms—and metrics that represent various facets of the networks (e.g., graph density and reciprocity).

For the initial analysis, HRI allowed NodeXL to group participants, resulting in the sociogram shown in Figure 10. Each dot in the sociogram represents a participant, and arrows point from the questionnaire respondent to the individual with whom the respondent interacted. If the

[17] Using project records, HRI compiled a list of participants from each school.

[18] Note that the question asked about teaching in general, not science instruction specifically. This wording was chosen by the project, reflecting the emphasis on cross-disciplinary instruction.

interaction was reciprocated, the arrow is double-headed. The weight of the line indicates frequency of interaction; i.e., a wider line indicates more interaction. If the frequency of interaction was not the same in both directions of a reciprocated interaction, the difference is noticeable in the size of the arrowheads; i.e., a larger arrowhead indicates more interaction.

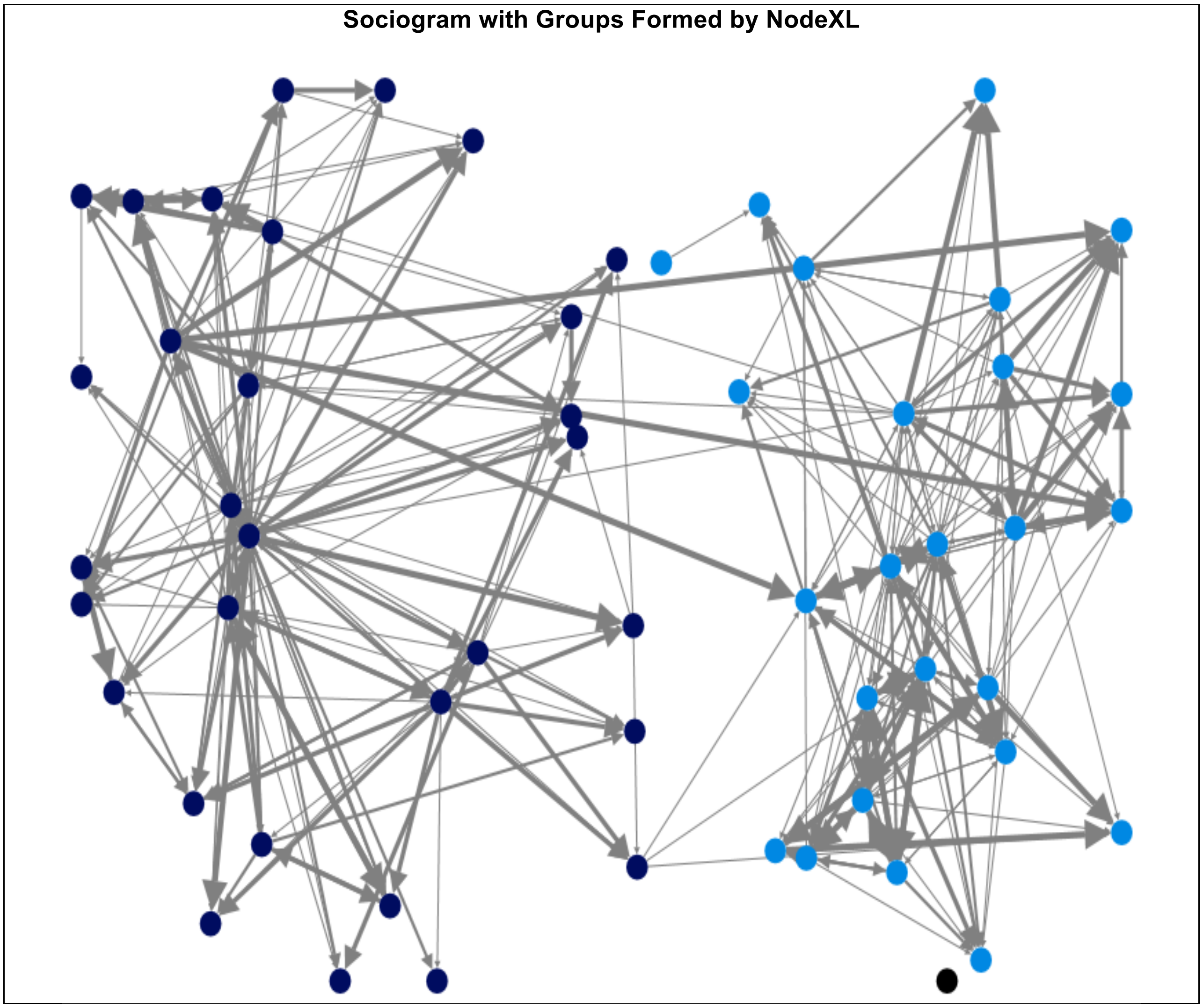


Figure 10

Two distinct groups emerged from the analysis, corresponding to the Perkins participants (on the right) and the Sandusky participants (on the left). Although Sandusky and Perkins are neighbors, the district grouping is to be expected given that opportunities for teacher interaction, regardless of location, tend to be school- and district-based. Note that relatively few interactions occur across districts.[19]

[19] In the lower right-hand section of Figure 10, there is a participant with no connections. This individual reported no interactions with other participants, and other participants reported no interactions with this participant.

A common metric used to describe a network is "graph density," a ratio that compares the number of "edges" in the graph (in SNA, an interaction is called an edge) with the number of edges the graph would have if all the participants were connected to each other.[20] The overall density of the sociogram in Figure 10 is 0.113. The density for the Sandusky network is 0.185, and the density for Perkins is 0.300, suggesting more interaction among Perkins teachers than among Sandusky teachers. This finding is not surprising given that Sandusky has five participating schools, and Perkins has only one.

In a second analysis, HRI forced NodeXL to group participants by their schools. The resulting sociogram is shown in Figure 11. Although there is quite a bit of cross-school interaction, it is largely within Sandusky. Interestingly, much of the cross-school interaction is accounted for by a relatively small number of individuals, as indicated by the large number of edges that involve these participants. Project records show that these participants are disproportionately coaches, interventionists, or other specialists. When these individuals are removed from the sociogram, the amount of cross-school interaction decreases sharply, suggesting that these participants may be functioning as pollinators, distributing ideas within and across schools. If so, the project should consider whether and how to capitalize on their existing relationships.

[20] Graph density has a minimum possible value of 0 and a maximum possible value of 1.

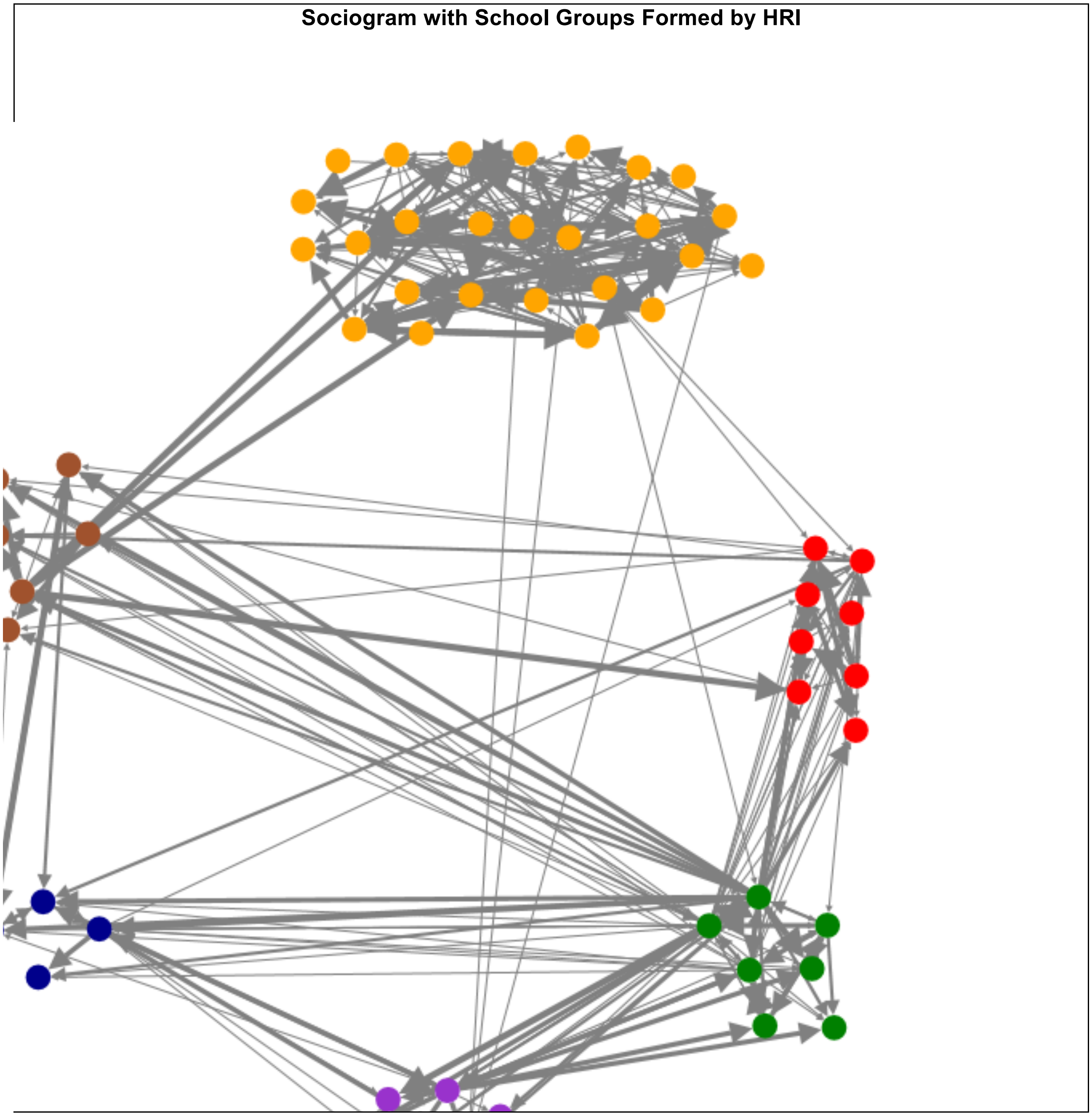


Figure 11

Although the amount of within-school interaction is difficult to discern in Figure 11, it varies considerably by school. School-level densities range from 0.300 to 0.667. Schools also vary in the extent to which interactions are bi-directional, indicated by the "reciprocated edge ratio," which ranges from 0.222 (less bi-directionality) to 0.800 (more bi-directionality).[21] These data are summarized in Table 10, with school identities masked.

[21] The reciprocated edge ratio is the number of edges that are reciprocated, divided by the total number of edges in the sociogram. The minimum possible value is 0 and the maximum is 1.

Table 10
School-level Sociogram Metrics

	Density	Reciprocated Edge Ratio
School 1	0.667	0.714
School 2	0.429	0.667
School 3	0.417	0.800
School 4	0.300	0.533
School 5	0.300	0.222
School 6	0.300	0.222

As noted above, these are baseline data; they do not reflect project impacts. Going forward, HRI will track the following aspects as indicators of project impact:

- Overall interactions;
- Cross-school interactions, particularly within Sandusky; and
- Frequency of interactions.

Professional Learning Teams (PLTs)

As described in the introduction, a major component of the iEvolve project is the organization of teachers into cross-school, cross-district, grade-level professional learning teams (PLTs). These PLTs generally meet three times each month, once at the monthly iEvolve academic year session and twice on their own, to discuss various topics related to science instruction. Each PLT is facilitated by an "ambassador"[22] whose major responsibilities include scheduling PLT meetings, keeping a record of PLT activities, and serving as a liaison between the PLT and iEvolve project leaders.

The following sections describe both the structure and function of the PLTs, highlighting teachers' and ambassadors' perspectives on their PLT experiences. These data come from interviews with ambassadors and the midyear feedback survey of all project participants, both of which were conducted in February and March 2014.

Attendance

When asked about attendance at their PLT meetings, 4 of the 6 ambassadors interviewed reported nearly perfect attendance at all meetings. However, five acknowledged difficulties scheduling face-to-face meetings due to such things as family schedules, staff/committee meetings, winter weather, and coaching. Said three:

[22] Two of the 6 PLTs have two ambassadors who co-facilitate the group. Only one ambassador was interviewed from each of these PLTs.

Some of the afterschool things get a little tricky just because it seems like a lot of people want to do things after school now, like committee meetings and everything else. So, it does get a little tricky when you're looking at all that.

We have a lot of people who have kids in winter sports and then with these snow days, it has just thrown everybody for a loop. It is amazing that we've had 12, 13 snow days; that's not just something we've ever had in this area. So, that being said, we had to reschedule a lot.

[Scheduling PLT meetings is] insane sometimes because we have a few people in our PLT that have children that are in sports…And we also have coaches in our PLT that need practices. And, when you coach, you practice every day. For a while we had to meet kind of late, then we had to move it up because somebody else's kid had practice. It's difficult, but we've gotten really good about knowing what two or three days a week we can work with.

The two ambassadors who described sporadic attendance at face-to-face meetings described more consistent participation in online meetings. In the words of one:

When we get together, we don't have as much participation due to family conflicts and schedules. It's really difficult. But when we have an online type of meeting, whether it's inputting information or blogging or something like that, we always have 100 percent participation.

Online Meetings

Ambassadors were also asked about the PLT's use of online meetings. All six said their PLT has held one or more meetings through MSPnet,[23] and four said their PLT has held one or more email meetings.[24] When asked to describe these online meetings, ambassadors explained that the meetings frequently involve collecting and sharing resources for teaching with the FOSS kits. For example:

We've also done email meetings where basically I sent them out a list of, "Hey, can you find or see if there's any of this stuff? This is what you guys said at the last meeting you are really in need of." I kind of grouped that list and sent it to everyone and said, "Hey, this is what we're looking for at the next meeting." Then we had hardcopies that we could give to the people that needed them.

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[23] MSPnet is an electronic community funded by the National Science Foundation for all MSP projects. The iEvolve project has a customized space on MSPnet in which project members can access resources and collaborate with one another.

[24] An email meeting is a means of facilitating virtual group discussion. The general format is for the ambassador to send out an initial email to all group members, posing a question or asking them to find specific resources. Group members then reply to this original email by a specified date, sharing their thoughts and resources with all members of the PLT.

We have been doing MSPnet. At one meeting, we had to all submit an activity that integrated with one of our FOSS kits. Another one was a technology link one that we had to do.

One of our email ones everyone had to do, their assignment was to find two websites that teachers could use for [kit name]. Another one was we made a literature connection. Everyone go out there and find any kind of literature you can connect to the units that you're using right now…It's really been a gathering of materials and resources and sharing, and I think that's why our PLT has worked, because every time someone comes they walk away with something.

Three ambassadors also said that their PLT often follows up on these online activities and discussions in subsequent face-to-face meetings.

Ambassadors' assessments of online meetings were mixed, highlighting both positive and negative aspects. The following two quotes illustrate the range of responses:

I've done [meetings] by email and we just had everybody do "reply all." This we did early on before we got comfortable with MSPnet. It was fantastic. It was literally like having a live forum that people could do on their own time. Their postings are very helpful. Nobody went in and just typed in something just to give themselves an attendance. They posted something valuable.

When they have to do it on their time, there is just more of the delayed response. You don't get the immediate response back and you have to put a timeline, and sometimes people don't respond until after the timeline.

PLT Focus Questions

The iEvolve PLTs have the flexibility to choose focus questions that best meet the needs of their group. When ambassadors were asked how the topics of discussion for their meetings are chosen, all six described a collaborative process, sometimes with ambassador guidance. Said four:

So, we typically meet as a group and kind of discuss. I throw a few ideas out. I try to come with a couple ideas of what I think they might need and they respond back to me.

What we usually do is we say, "Does anybody have anything, like concerns or do you need help with any certain topics?" And we try to make sure that it's something that we can include everyone in, and it doesn't really take us long to come up with things, but that drives our whole entire meeting.

At one point, we had a meeting where everybody on a post-it just wrote down some areas that they wanted to address in team meetings. Kind of trying to make them worthwhile for everybody, and it seemed like that was kind of a great turning point…so we took all their ideas and we clustered them according to topic. So, like one might be just concerns about inventory and packaging where another might be intervening and enriching *students, or literature. Different things like that. So, we had just topics that were kind of clustered together and then we were able to go ahead and have that be a focus at our PLT meeting.*

PLT discussions around these focus questions are summarized by ambassadors via online planning guides. Ambassadors complete these planning guides for every PLT session, whether it is held face-to-face or online. Looking at planning guide responses across groups,[25] it is clear that the majority of focus questions center on the mechanics of implementing the FOSS kits. For example:

- What are the best ways to inventory and pack up the kits effectively?
- How can we make the time needed to plan and implement the kits more manageable?
- What can we do to help the others on the team as they move into their new kits?
- How are student notebooks working?
- How can we establish a routine for teaching the new FOSS science curriculum on a daily basis?

However, PLTs are also tackling focus questions that move beyond mechanics, such as:

- What standards are actively addressed at each grade level with the FOSS kits?
- What are some technology links that enrich the FOSS kits?
- How can we set a measurable, attainable, challenging, and meaningful goal for student learning in both the short-term and long-term?
- How are we using science in other content areas?
- How well are students transferring information from the FOSS kits to the OAA testing format?

Four ambassadors described changes they are seeing over time in the types of focus questions their PLTs are discussing. Two explained that although their PLT discussions are usually about the kits, these discussions are becoming more focused on specific concerns:

[A]t the beginning it was all about the kits, all about the materials, all about…How should I say this in a nice way, but complaining about a lot of things. And we finally decided, we said, "Okay, we've used a month of stressing our concerns with the kits. I'll be happy to relate all of these messages, but let's do something useful with our time." You know? Because it was getting to the point where all it was griping, and who wants to spend extra time after school to hear someone complain? Now there's a purpose. Now there just seems to be, "Okay, what are we doing? How can I make this work?"

Yes, [the focus questions] seem to be less general. For example, I know in the beginning it was "How do we do this?" and I was like "How do we do what? What specifically are you trying to do?" But I think more recently it's been "Okay, I was doing this with [kit name], and I wanted to know how to get this over there" and "I really couldn't figure out

[25] The iEvolve leadership gave HRI access to the planning guides for each PLT.

any literature. Can we get a list of literature that goes with this?" or whatever. In their, I don't want to say demands, but in their requests, they've gotten more specific.

Two other ambassadors said that their PLTs have begun moving away from conversations about using the kits to discussing aspects such as cross-curricular connections and supplementing. In the words of one:

First, it was more of the concerns to get the kits going and be able to embrace it and do the best you can … The FOSS kit is very specific, teach this and do this, do this, but there are also outside areas that might help the kids get these concepts better too that we could do. So [now] part of our meeting is more of, "Do you have a cross-curricular idea that will go with that investigation that you were doing?" So we're trying to incorporate other subjects into the science too.

Although ambassadors see value in having PLTs choose their own focus questions, they also desire some level of guidance from project leaders. Half of the interviewed ambassadors expressed a need for confirmation that their PLT is discussing the types of things the project envisions. As two put it:

I guess my feelings are that I don't know the expectations and the depth that I'm supposed to be getting out of my group. Is this just a cursory, kind of introductory year where we lightly go over topics, or am I supposed to really be getting some meat out of them?

We come up with our ideas and our topics and our discussion. Just for my peace of mind, it would be nice to know, are there things that, are we covering everything that we are supposed to? And when we meet as ambassadors, that could happen every two months. Well, a lot can happen in two months. Am I missing something? Should I be doing something different? Here's a topic, here's a suggested list. And I don't want it to be scripted, but I just want to make sure I'm covering everything I'm supposed to. Because I'm doing what the members want, but I want to make sure I'm doing what iEvolve *wants me to.*

PLT Planning Guides

As previously mentioned, the iEvolve ambassadors complete planning guides for every PLT meeting. However, ambassadors' reactions to the usefulness of the guides are mixed. One of the 6 explained that the guide is very useful and described using it to structure each face-to-face PLT meeting:

Actually, I use [the planning guide] during the PLT meeting. We actually, as we're doing the meeting, I go through, you know, I start with the attendance, I write that down, and then we talk…And I use [the planning guide] as a guide for the meeting.

Conversely, three mentioned that although some helpful changes to the guide have been made, it is still not always clear how to fill it out:

Some of [the topics] are kind of cyclical so it's hard to fill [the planning guides] out completely, but I like how they are better now.

Sometimes it's hard to make sure you answer everything appropriately the way they…I'm sure [the project leaders] have some expectations of what they want, so making sure that I'm answering the questions the way that they need them to be answered.

If in a perfect world you were to run every meeting, and you went A B C D E F G and could put it in [the planning guide] perfectly, it would be great. But we all know that that's not how meetings happen.

One ambassador also commented on the repetitiveness of the guides:

[The planning guides] are repetitive. I know that we addressed that, and there were some slight changes, but I still think it is fairly repetitive as far as the information. Because what we are doing is saying the same thing a couple different times.

What Are Teachers Getting out of PLTs?

When iEvolve participants were asked to describe how opportunities to meet together in PLTs have been helpful, 33 of the 43 participants[26] who provided an answer mentioned the benefit of talking about science instruction with other teachers, particularly in relation to the FOSS kits. In the words of two:

The biggest benefit [of the PLT] is to share the information of what works and doesn't work with the students. That saves time figuring out the best way to present the material to the students.

The teaching frustrations don't seem so bad when we can gather and share them with each other. Otherwise, I presumed that I was the only one struggling with some of the elements of these kits.

Likewise, when interviewed, five ambassadors mentioned that the PLTs afford teachers a support system and provide the opportunity to share teaching resources, information, and ideas. Said two:

We are sharing ideas. We are able to support one another where we have concerns…So a lot of times the PLT just gives us an opportunity to kind of support each other and encourage each other. "Don't hang up on this and don't get so worried. You have had, you know, how many snow days? That's a rare occasion." You know what I mean? The frustration is sometimes brought to the table so we can just kind of talk through problem solving.

[26] The mid-year feedback survey was sent to all iEvolve participants, including ambassadors. Throughout this section of the report, ambassador responses are included in the counts and percentages. Ambassador responses to open-ended survey items are noted as such, given that they have a somewhat different perspective from other participants.

Support for one another, definitely. And secondly, secondary support as far as management would go. Kind of getting ideas in advance and know that others are in the same place.

Another helpful aspect of the PLTs, mentioned by 11 survey respondents, is the ability to interact with teachers across schools and districts that are using different kits at different times. In the words of two:

[The PLT has] allowed us to make professional connections between districts and schools, and compare kits that we have had and ones that we will have soon. (Ambassador)

The [district name] group was using kits that I got after them, and then they got ours, so we were able to give each other good feedback on what was great and what was not so great.

[The PLT] has allowed me to better prepare for kits already taught by [district name] teachers; what to do and what to avoid in order to have successful lessons.

Similarly, the benefits of these cross-school and cross-district discussions about the FOSS kits were noted by two ambassadors in interviews:

We've been fortunate, and some people don't think this is fortunate, but we think in our group it's very fortunate, we have not been on the same kits at all with the [district name] teachers. So, when they were on [kit name], they were able to tell us all the things that we needed to worry about…things that were very useful to us before we started.

It's awesome to have two school districts, I'm just going to throw that out there, because we don't usually get to work with other school districts, and a lot of times that missing piece that you need, they've had that piece, but they haven't had this other piece that we've had, and when you come together you have the whole cargo. It's fabulous. We've really kind of leaned on that a little bit…and that's really been our saving grace in our PLT is to lean on the different schools because both schools have a different positive thing that they kind of deal with…So, for example, like when we were going into the second kit. The people that had the first kit and some of the people that were getting the [kit name], they said, "Hey, make sure you do this, this was awesome. This one didn't work out for me. You know, you might want to try this." And then we shared with the other group. So, I know a lot of people are really upset that we're not on the same kit, but I don't think they realize that we're learning more faster by not being on the same kit.

Further, two ambassadors pointed to the developing culture of collegiality between Perkins and Sandusky teachers as a positive aspect of the PLTs:

I think truly it's always been Perkins versus Sandusky. And it seems like we're coming together more, you know?

I think [the PLT] has assisted us in meeting another school system that we felt was very different from us and that we had some probably poor feelings, for lack of a better word…I don't know that we necessarily view them as the enemy so much.

The iEvolve PLT meetings provide opportunities for teachers within grades to have cross-school and cross-district interactions, which has helped create a culture of collaboration and collegiality between the two school districts. PLT meetings are generally well attended, with opportunities for online meetings helping to alleviate some of the logistical concerns associated with scheduling face-to-face sessions. Although PLT discussions often center on the use of the FOSS kits, groups are also discussing topics such as alignment with state standards and opportunities for cross-curricular connections. In addition, PLT meetings provide teachers with opportunities to support one another and share teaching resources, information, and ideas.

FOSS Kit Implementation

As previously mentioned, the project has organized within-district, grade-level teams (GLTs) in response to requests from project participants. The project provides time for these teams to meet at the monthly project-wide meetings. The primary focus of the GLTs is facilitating implementation of the FOSS kits, including materials management and decisions about skipping/supplementing lessons. Whereas the PLTs have structured agendas and assigned leaders (i.e., ambassadors) who document all group discussions and activities, the GLTs are more informal.

The following sections describe participants' experiences in GLTs, as well as their experiences and perspectives on using the FOSS kits. These data come from the mid-year feedback survey, ambassador interviews, and observations of project-wide meetings.

Group Discussion of Kits

Although participants appreciate opportunities to collaborate in their PLTs with teachers using different FOSS kits at different times, they also place a high value on opportunities to discuss the kits with teachers using the same kits at the same time. When asked what changes they would make to the GLT meetings, nearly all suggested either no change or an increase in GLT meeting time, suggesting these meetings are serving an important purpose.

When asked about the most useful aspect of the GLTs, several teachers mentioned opportunities to plan for kit use together. In the words of two:

[Meeting as GLTs] gives us time to plan together. We do not get any time to plan and coordinate at school, so having this time through iEvolve is invaluable!

This is time well spent! As teachers, we have precious little time to plan and meet together in teams. We are all overwhelmed. This time has given us the opportunity to *dig into the kits together, share ideas and concerns, and plan together for the kits we are teaching.*

The value of collaborating with other teachers using the same kits was echoed by 3 of the 6 ambassadors interviewed. Two commented:

> *I do like the PLTs, but I also think that right now, more concentration should be done with the grade-level groups, because they are the ones that are teaching what needs to be taught, and right now, within the schools we don't have enough time to sit together and plan together.*

> *Right now, the only time we have provided through iEvolve for me to sit down with my team members who are in the same kit with me and plan and get ahead is during the monthly [academic year session] meetings. And that time, unfortunately is the one that seems to get nixed the fastest when they're behind schedule.*

When asked *how* the GLTs have been helpful, three-fourths of the teachers (33 of 44) indicated that kit-specific discussions allow them to share insights from their classroom experiences and ideas for how to implement kit investigations. In the words of two:

> *Grade-level group meetings are helpful because we are able to discuss the students' reactions to specific lessons and be able to use intervention and modification suggestions from other teachers who teach the same lessons.*

> *It helps to discuss specific details that we are experiencing with the same kit. Hearing the perception of others doing and learning the same things is encouraging. I like the insight it brings.*

Although many teachers described the utility of kit implementation discussions in general terms (e.g., "to help plan and discuss the use of the kits"), nine noted how these discussions can impact instruction more specifically. For example:

> *These [meetings] are more specific to challenges and modifications that make our efforts more workable.*

> *We have discussed ideas for cross-curricular lessons, pacing of investigations and how to best manage the time we are allotted for each kit.*

> *We have worked through many minor issues by being able to bounce ideas for solutions off of each other to see if they have been tried and whether they worked.*

Some of the specific issues with kit implementation discussed at monthly project-wide meetings that HRI researchers observed were:

- Time used in preparation/inventory of kit materials;

- Prioritizing kit investigations—determining which parts are essential and which can be skipped;
- Incorporating cross-curricular elements; and
- How to relate target concepts to daily life.

Discussions observed at the monthly project-wide meetings also included teachers sharing their approaches or solutions to some of the concerns that were raised. For example:

- Writing can be incorporated into lessons by comparing and contrasting the animals featured in kit investigations, and by building connections between writing in English/language arts and the note-booking in science;

- "Story problems" about functions of kit organisms can help make connections to mathematics; and

- Mathematics can be incorporated into science by emphasizing manipulations of quantities of supplies and ingredients.

Factors Affecting Kit Implementation

The mid-year feedback survey also asked classroom science teachers to describe both their science instruction and factors that impact their instruction. Teachers reported both challenges and successes.

Many teachers indicated that lack of time for instruction is a substantial challenge. More than half of science teachers (17 of 31) did not feel that they had adequate time to teach science. Most of these teachers pointed to prioritization of other subjects, particularly reading and mathematics, as the major factor that limits science instruction time. Said three:

> *Meeting all requirements for all subjects is impossible some days. Unfortunately, something has to be slighted. Reading and math come first at this grade level.*
>
> *Priority on reading and math instruction and intervention in those areas take up most of our day.*
>
> *Reading: 90 minutes; Reading intervention: 30 minutes; Math: 60 minutes; Grammar, spelling, writing, social studies, science: the other hour.*

Several teachers also mentioned the effect of unusually harsh winter weather on instructional time. In the words of two:

> *Besides the limited time in the day, we also have been out of school due to winter weather for 12 days. We have missed lots of days and have lots to catch up on throughout the school day.*

We had 12 snow days so I could only do what I could with the time given.

Nearly all classroom science teachers reported that they skipped lessons/activities included in the FOSS kits. Again, lack of time is by far the most commonly cited factor.

Just over half of respondents (17 of 31) indicated feeling fairly well or very well prepared to teach science using activity-based, inquiry-oriented instructional strategies with the FOSS kits, suggesting substantial room for growth. Some teachers pointed to the amount of work associated with the kits as a challenge they face in being prepared for instruction. In the words of two:

It is a lot of work to be prepared for the lessons.

I think the FOSS kits are a great idea, and we are supplied with everything we need. However, there is just too much and it's overwhelming.

Many teachers' descriptions of their science instruction included efforts made to facilitate interdisciplinary connections. Although teachers mentioned a diversity of connections, they cited ties to mathematics and language arts most frequently. Some teachers specifically referred to mathematics links forged through measurement and graphing. For example:

Math/Science connection made in the measurement section of matter.

Mathematics [has] been my main interdisciplinary focus. Coordinate graphs, tables, and averaging come to mind.

Other teachers referred to reading experiences and use of literature:

Several times during the [kit name], we drew on some wonderful fables and fiction to enhance the experience.

[Kit name] helped students to recognize how soil conditions, weathering, erosion, and deposition affected Ohio's early inhabitants and how they used soil to create landforms. We also had readings that correlated to this kit.

Teacher attention to introducing interdisciplinary connections is also reflected in records of their PLT activities. Three PLTs established goals centered on identifying materials that support cross-curricular activities. One PLT strategy is described as follows:

Everyone will find literature and writing connections to the unit they are currently teaching.

Kit Implementation Decisions

As mentioned above, nearly all science teachers (27 of 31) who responded to the mid-year feedback survey felt compelled to omit some elements of the kits. The vast majority of these (23) cited insufficient time as the reason. A much small number (five) indicated that they thought particular kit elements would add little to their instruction. One explained:

> *Felt [kit instruction] was too much of the same thing. Just condensed things a bit.*

Three teachers also found implementation of some kit activities impractical because of winter weather constraints. Said one:

> *Several of the investigations call for outside activities and the gathering of schoolyard samples. We haven't seen our schoolyard soil since the kit arrived!*

Science teachers who reported omitting kit elements were also asked to describe *how* they decided which elements to skip. The most frequently described factor, cited by 8 of 23 respondents, was the status of students' understandings. As explained by three:

> *I tried to make a decision based on what my students needed the most help to understand.*
>
> *[I] used the results of the pretest and got rid of lessons that they were achieving well on.*
>
> *I thought about what my students already know.*

Six teachers cited alignment with standards or learning goals as the key criterion. For example:

> *I chose the [elements] best aligned to the revised content standards.*

Teacher Preparedness to Use the Kits

As described above, many of the iEvolve classroom science teachers perceive that their preparation for instruction using the FOSS kits is incomplete. In fact, only 5 of 31 reported that they feel very well prepared to teach science using the instructional strategies in the FOSS kits. However, many teachers (18 of 28 who commented on what would help them feel better prepared) believe that using the kits will improve their preparation. As two wrote:

> *I will feel better when I have had a chance to teach each of [the kits] and become familiar with each lesson and the materials.*
>
> *It is just going to take some time to understand how it all works. I think with more experience, I will feel more prepared.*

Several teachers also indicated that more training or planning time with kit materials prior to the implementation of lessons would be helpful. In the words of one:

When a new kit is delivered, we should be given at least a half day professional development time with our grade-level teams to dig into the kits, familiarize ourselves with the materials, and plan for upcoming investigations.

Contributions to Instruction by Other Participants

Eleven iEvolve teachers indicated that they are not responsible for planning and delivering science instruction. These teachers have varied instructional roles (e.g., technology specialist, intervention specialist, curriculum coach, social studies teacher) and were therefore asked a distinct set of questions on the mid-year feedback survey. Their responses suggest that time spent planning for science instruction with classroom science teachers is quite limited. Nearly half reported spending 15 minutes or less per week collaborating with classroom science teachers to plan instruction using FOSS kits. In the words of one:

Time for collaboration with general education teachers is a real struggle. Usually collaboration is a comment passing in the hall.

However, these individuals also described a variety of ways they were able to support science instruction despite the time constraints. For example:

I have created and led technology projects with each grade level that I teach. [I] also helped teachers with their own technology ideas.

[I] help students to relate their learning to other experiences of math and or social studies to hopefully retain information or actually learn it, not memorize information.

When advance notice is provided, I am able to adjust my schedule so that I can provide support of students with special needs. I am able to read aloud with students and help with written tasks. I can modify test formats and provided study guides.

We have discussed ways to address the standards and information needed in other content areas. Our group has created a differentiated journal for those students needing extra support. I meet with the teachers and asked how and to what degree the lessons are being implemented.

iEvolve teachers identified successes and struggles in implementing instruction centered on the use of FOSS kits. Nearly all believe that their teaching practice benefits from discussions with other teachers using the same kits. However, constraints of teaching contexts make it difficult for teachers to devote the time they consider sufficient for planning and implementing kit-based lessons. Nearly all teachers omitted some elements of the kits. Many based their selection of which elements to omit on learning standards and knowledge of their students' understandings. Teachers anticipate improved kit-based instruction as the project proceeds because their initial experiences using the kits are providing useful insights.

Summary and Recommendations

An overarching goal of the iEvolve project is to impact teaching and learning in two collaborating school districts, such that student engagement and motivation increase. iEvolve anticipates improvement in student outcomes as a result of enhanced teacher capabilities with regard to content knowledge, assessment of student learning, and hands-on, inquiry-based instruction. To this end, the first cohort of project participants attended an eight-day summer institute, participated in monthly project-wide meetings, and met in PLTs and GLTs between June 2013 and March 2014.

Survey data indicate that participants' perceptions of the summer institute were largely positive across a variety of factors. For example, participants reported that the science content addressed in the institute was accessible, as nearly all agreed that they understood the content and found it interesting. The vast majority also reported that the instructors supported them and helped improve their understanding of science concepts. Participants' impressions of their interactions with other participants and of the institute culture were also quite positive. Almost 9 in 10 felt that their contributions to discussions were valued and that they were supported by other participants as they developed conceptual understanding of the contents. In addition, participants' perceptions of the clarity of institute requirements were generally favorable, with over 80 percent indicating that the goals and work requirements were clear and that the work requirements were realistic.

Survey and observation data indicate that the summer institute had multiple positive impacts. Participants' content knowledge increased following the institute, as did their perceptions of preparedness to teach the content standards at their grade level. The institute also appears to have had a positive effect on teachers' beliefs about science teaching, with desirable changes seen in beliefs aligned with what is known from cognitive science about effective instruction. Although impacts on teacher self-efficacy were not detected, it is possible that additional professional development and sufficient opportunities to implement new teaching strategies will impact efficacy beliefs in the future.

Survey and interview data point to participants' positive opinions towards PLT and GLT meetings. Although group meetings required a substantial amount of time, with the PLTs in particular presenting scheduling challenges, participants were generally complimentary of these experiences. Perhaps the biggest benefit of the PLTs and GLTs was the opportunity to discuss kit implementation. In GLTs, teachers working on the same kit could problem solve together. In PLTs, participants could share their knowledge about a kit they had already implemented, giving other group members valuable advice. An additional benefit of the PLTs was the opportunity to collaborate across district lines, fostering new relationships.

Reflecting on their use of the FOSS kits, teachers identified both successes and struggles. They are keenly aware of constraints on their time for teaching science, which were magnified by canceled school days due to a particularly severe winter. Most teachers reported skipping parts of kits largely because of time constraints. Teachers also acknowledge that they have substantial room for growth in their skill with use of the kits, but at the same time anticipate that their skills will improve with experience. Further, nearly all believe that their teaching practice benefits from discussions with other teachers using the same kits. Those not directly responsible for science instruction report few opportunities to plan with teachers using the kits, but they still found ways to support these teachers.

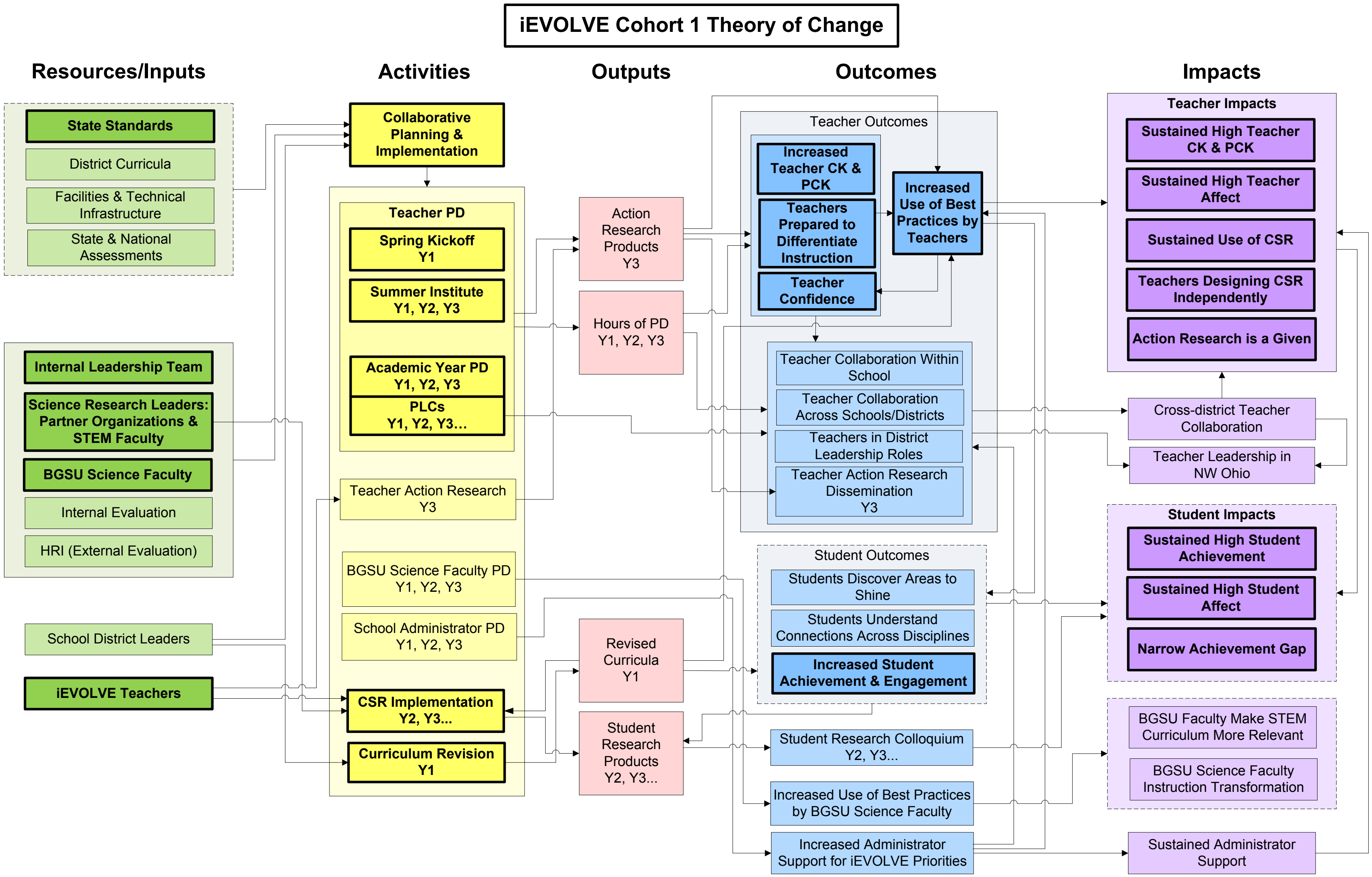
As planned, the iEvolve project has laid a foundation of kit-based instruction in all partnering schools. However, literature on curriculum implementation suggests that teachers need two or three iterations before they can begin to implement materials purposefully. Therefore, although a foundation has been laid, it remains to be seen how firm it is. In the coming year, project efforts will shift to implementing citizen science research projects in conjunction with the kits. This shift will likely not be easy, and it will be important that the project continue to support teachers' use of the kits during this transition. To its credit, the project has multiple mechanisms in place to monitor the experience teachers are having, including monthly project-wide meetings and the recent deployment of teacher liaisons. These mechanisms should provide an early warning if teachers' efforts related to citizen science research detract from their efforts to continue developing expertise with kits.

The project should also be alert to "reform fatigue" among teachers. The transition to kit-based instruction likely entailed a major shift in teaching strategies for many teachers. Such fundamental changes are difficult and take time. Given that many teachers are not yet comfortable with these new strategies, they may also struggle to implement citizen science research, which will undoubtedly precipitate more changes in their instruction. Again, the monitoring mechanisms the project has put in place will be critical for identifying struggles and providing appropriate support.

iEvolve has much to celebrate—a successful summer institute, a robust series of monthly support meetings, successful implementation of PLTs and GLTs, and project-wide rollout of kits. Other achievements not mentioned in this report include ongoing efforts of the curriculum design team, organization of citizen science research projects for the coming year, and a spate of positive media attention. With all of these accomplishments, the project is well positioned for the year ahead.

APPENDIX A

iEvolve Logic Model



iEVOLVE Cohort 1 Theory of Change
Resources/Inputs
Activities
Outputs
Outcomes
Impacts
State Standards
District Curricula
Facilities & Technical Infrastructure
State & National Assessments
Internal Leadership Team
Science Research Leaders: Partner Organizations & STEM Faculty
BGSU Science Faculty
Internal Evaluation
HRI (External Evaluation)
School District Leaders
iEVOLVE Teachers
Collaborative Planning & Implementation
Teacher PD
Spring Kickoff Y1
Summer Institute Y1, Y2, Y3
Academic Year PD Y1, Y2, Y3
PLCs Y1, Y2, Y3...
Teacher Action Research Y3
BGSU Science Faculty PD Y1, Y2, Y3
School Administrator PD Y1, Y2, Y3
CSR Implementation Y2, Y3...
Curriculum Revision Y1
Action Research Products Y3
Hours of PD Y1, Y2, Y3
Revised Curricula Y1
Student Research Products Y2, Y3...
Teacher Outcomes
Increased Teacher CK & PCK
Teachers Prepared to Differentiate Instruction
Teacher Confidence
Increased Use of Best Practices by Teachers
Teacher Collaboration Within School
Teacher Collaboration Across Schools/Districts
Teachers in District Leadership Roles
Teacher Action Research Dissemination Y3
Student Outcomes
Students Discover Areas to Shine
Students Understand Connections Across Disciplines
Increased Student Achievement & Engagement
Student Research Colloquium Y2, Y3...
Increased Use of Best Practices by BGSU Science Faculty
Increased Administrator Support for iEVOLVE Priorities
Teacher Impacts
Sustained High Teacher CK & PCK
Sustained High Teacher Affect
Sustained Use of CSR
Teachers Designing CSR Independently
Action Research is a Given
Cross-district Teacher Collaboration
Teacher Leadership in NW Ohio
Student Impacts
Sustained High Student Achievement
Sustained High Student Affect
Narrow Achievement Gap
BGSU Faculty Make STEM Curriculum More Relevant
BGSU Science Faculty Instruction Transformation
Sustained Administrator Support

APPENDIX B

Evaluation Instruments

iEvolve Baseline Questionnaire, Summer 2013

iEvolve Mid-Year Participant Feedback Survey

iEvolve Teacher Interview Protocol

iEvolve Ambassador Interview Protocol

iEvolve Baseline Questionnaire
Summer 2013

1. Do you teach science at the elementary level?

○	Yes

○	No

2. How often do you do each of the following in your science instruction?

	Never	Rarely	Often	All or almost all science lessons
Q2A: Have students work in small groups	1	2	3	4
Q2B: Do hands-on/laboratory activities	1	2	3	4
Q2C: Engage the class in project-based learning (PBL) activities	1	2	3	4
Q2D: Have students represent and/or analyze data using tables, charts or graphs	1	2	3	4
Q2E: Require students to supply evidence in support of their claims	1	2	3	4
Q2F: Have students write their reflections (e.g., in their journals) in class or for homework	1	2	3	4

3. In a typical school year, how much emphasis will each of the following student science objectives receive?

	None	Minimal Emphasis	Moderate Emphasis	Heavy Emphasis
Q3A: Understanding science concepts	1	2	3	4
Q3B: Learning science process skills (e.g., observing, measuring)	1	2	3	4
Q3C: Learning about real-life applications of science	1	2	3	4
Q3D: Increasing students' interest in science	1	2	3	4
Q3E: Preparing for further study in science	1	2	3	4

4. How well prepared do you feel to do each of the following in your science instruction?

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Q4A: Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	1	2	3	4
Q4B: Teach science to students who have learning disabilities	1	2	3	4
Q4C: Teach science to students who have physical disabilities	1	2	3	4
Q4D: Teach science to English-language learners	1	2	3	4
Q4E: Provide enrichment experiences for gifted students	1	2	3	4
Q4F: Encourage students' interest in science and/or engineering	1	2	3	4
Q4G: Encourage participation of females in science and/or engineering	1	2	3	4
Q4H: Encourage participation of racial or ethnic minorities in science and/or engineering	1	2	3	4
Q4I: Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	1	2	3	4

5a. Please indicate the degree to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q5A.A: Even when I try very hard, I don't teach science as well as I do most subjects.	1	2	3	4	5	6
Q5A.B: I am not very effective in monitoring science experiments.	1	2	3	4	5	6
Q5A.C: If students are underachieving in science, it is most likely due to ineffective science teaching.	1	2	3	4	5	6
Q5A.D: I understand science concepts well enough to be effective in teaching elementary science.	1	2	3	4	5	6
Q5A.E: The teacher is generally responsible for the achievement of students in science.	1	2	3	4	5	6
Q5A.F: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	1	2	3	4	5	6
Q5A.G: I am typically able to answer students' science questions.	1	2	3	4	5	6
Q5A.H: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	1	2	3	4	5	6

Q5A.I: When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.	1	2	3	4	5	6
Q5A.J: Even teachers with good science teaching abilities cannot help some kids learn science.	1	2	3	4	5	6

5b. Please indicate the degree to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q5B.A: If students are underachieving in science, it is most likely due to ineffective science teaching.	1	2	3	4	5	6
Q5B.B: The teacher is generally responsible for the achievement of students in science.	1	2	3	4	5	6
Q5B.C: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	1	2	3	4	5	6
Q5B.D: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	1	2	3	4	5	6
Q5B.E: Even teachers with good science teaching abilities cannot help some kids learn science.	1	2	3	4	5	6

6. This series of statements helps us understand what you believe about effective science instruction; that is, what does science instruction that helps students learn science concepts well look like?

   We recognize that teachers have to make many trade-offs when they are responsible for teaching many standards in one year. Teachers may not be able to emphasize the instructional strategies they believe are effective and still cover the entire curriculum. When you respond to the statements below, we ask that you put those trade-offs aside. Imagine that you are not constrained by state/district standards, or available time/resources, or feasibility issues. We want to know what you think effective instruction looks like, without all the constraints that limit what you can do in the classroom.

   When responding to the statements, please try to think about students in general, not one student or a particular group of students. We know that's hard to do, but please try.

   Finally, these statements make frequent use of two terms that teachers may interpret differently depending on the context. For the purpose of this questionnaire, we ask that you use the following definitions of "data" and "evidence."

Data—information that has not yet been analyzed or processed; typically gathered through observation or measurement

Evidence—analyzed or processed data that are used to support a scientific claim or conclusion

Practical constraints aside, do you agree that doing what is described in each statement would help most students learn science?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q6A: Teachers should provide students with opportunities to connect the science they learn in the classroom to what they experience outside of the classroom.	1	2	3	4	5	6
Q6B: At the beginning of instruction on a science concept, students should be provided with definitions for new scientific vocabulary that will be used.	1	2	3	4	5	6
Q6C: Hands-on activities and/or laboratory activities should be used primarily to reinforce a science concept that the students have already learned.	1	2	3	4	5	6
Q6D: Teachers should have students do hands-on activities, even if the data they collect are not closely related to the concept they are studying.	1	2	3	4	5	6
Q6E: Teachers should explain a concept to students before having them consider evidence that relates to the concept.	1	2	3	4	5	6
Q6F: Teachers should ask students to support their conclusions about a science concept with evidence.	1	2	3	4	5	6
Q6G: Students should do hands-on or laboratory activities, even if they do not have opportunities to reflect on what they learned by doing the activities.	1	2	3	4	5	6
Q6H: At the beginning of instruction on a science concept, students should have the opportunity to consider what they already know about the concept.	1	2	3	4	5	6
Q6I: Students should do hands-on activities after they have learned the related science concepts.	1	2	3	4	5	6

Q6J: Teachers should provide students with opportunities to apply the concepts they have learned in new or different contexts.	1	2	3	4	5	6
Q6K: Teachers should have students do interesting hands-on activities, even if the activities do not relate closely to the concept being studied.	1	2	3	4	5	6
Q6L: Students should have opportunities to connect the concept they are studying to other concepts.	1	2	3	4	5	6
Q6M: Students should consider evidence that relates to the science concept they are studying.	1	2	3	4	5	6
Q6N: Teachers should provide students with the outcome of an activity in advance so students know they are on the right track as they do the activity.	1	2	3	4	5	6
Q6O: When students do a hands-on activity and the data don't come out right, teachers should tell students what they should have found.	1	2	3	4	5	6
Q6P: Students should know what the results of an experiment are supposed to be before they carry it out.	1	2	3	4	5	6

7. Which of the following activities have you engaged in during the last 5 years?

	Yes	**No**
Q7A: Serving as a grade-level/team leader	○	○
Q7B: Serving as an informal resource in science to other teachers in your school or district	○	○
Q7C: Providing workshops on science teaching to other teachers in your school or district	○	○
Q7D: Serving on a school or district science curriculum committee	○	○
Q7E: Serving as the science lead teacher or science department chair	○	○
Q7F: Worked on science curriculum development outside of your district	○	○
Q7G: Consulted on science education for other districts	○	○
Q7H: Taught in-service workshops or courses in science/science teaching outside of your district	○	○

23. What do you anticipate as the greatest challenge(s) related to your participation in iEVOLVE this summer and in the coming years?

24. What do you anticipate as the greatest benefit(s) of participating in evolve this summer and in the coming years?

Post-Institute Questionnaire
Summer 2013

1. Please indicate the extent to which you agree or disagree with each statement below.

	Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
Q1A: The goals of the Institute were made clear.	1	2	3	4	5	6
Q1B: The Institute work requirements were made clear.	1	2	3	4	5	6
Q1C: The Institute work requirements were realistic.	1	2	3	4	5	6
Q1D: Interactions with the *instructors* helped me understand the concepts addressed in the Institute better.	1	2	3	4	5	6
Q1E: Interactions with the *participants* helped me understand the concepts addressed in the Institute better.	1	2	3	4	5	6
Q1F: Interactions with the *instructors* helped me understand how to apply the Institute concepts in my teaching.	1	2	3	4	5	6
Q1G: Interactions with the *participants* helped me understand how to apply the Institute concepts in my teaching.	1	2	3	4	5	6
Q1H: I felt supported by the *instructors* as I developed my understanding of the concepts addressed in the Institute material.	1	2	3	4	5	6
Q1I: I felt supported by other *participants* as I developed my understanding of the concepts addressed in the Institute material.	1	2	3	4	5	6
Q1J: The content of the Institute was interesting to me.	1	2	3	4	5	6
Q1K: I usually understood the content being addressed in the Institute.	1	2	3	4	5	6
Q1L: I found the discussions during the Institute interesting.	1	2	3	4	5	6
Q1M: The Institute atmosphere encouraged me to make contributions to the discussions.	1	2	3	4	5	6
Q1N: I felt my contributions to the Institute discussions were valued.	1	2	3	4	5	6
Q1O: I would recommend the Institute to my colleagues.	1	2	3	4	5	6

2. Do you teach science at the elementary level?

○	Yes
○	No

3a. Please indicate the extent to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q3A.A: Even when I try very hard, I don't teach science as well as I do most subjects.	1	2	3	4	5	6
Q3A.B: I am not very effective in monitoring science experiments.	1	2	3	4	5	6
Q3A.C: If students are underachieving in science, it is most likely due to ineffective science teaching.	1	2	3	4	5	6
Q3A.D: I understand science concepts well enough to be effective in teaching elementary science.	1	2	3	4	5	6
Q3A.E: The teacher is generally responsible for the achievement of students in science.	1	2	3	4	5	6
Q3A.F: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	1	2	3	4	5	6
Q3A.G: I am typically able to answer students' science questions.	1	2	3	4	5	6
Q3A.H: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	1	2	3	4	5	6
Q3A.I: When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.	1	2	3	4	5	6
Q3A.J: Even teachers with good science teaching abilities cannot help some kids learn science.	1	2	3	4	5	6

3b. Please indicate the extent to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q3B.A: If students are underachieving in science, it is most likely due to ineffective science teaching.	1	2	3	4	5	6
Q3B.B: The teacher is generally responsible for the achievement of students in science.	1	2	3	4	5	6

Q3B.C: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	1	2	3	4	5	6
Q3B.D: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	1	2	3	4	5	6
Q3B.E: Even teachers with good science teaching abilities cannot help some kids learn science.	1	2	3	4	5	6

4. This series of statements helps us understand what you believe about effective science instruction; that is, what does science instruction that helps students learn science concepts well look like?

   We recognize that teachers have to make many trade-offs when they are responsible for teaching many standards in one year. Teachers may not be able to emphasize the instructional strategies they believe are effective and still cover the entire curriculum. When you respond to the statements below, we ask that you put those trade-offs aside. Imagine that you are not constrained by state/district standards, or available time/resources, or feasibility issues. We want to know what you think effective instruction looks like, without all the constraints that limit what you can do in the classroom.

   When responding to the statements, please try to think about students in general, not one student or a particular group of students. We know that's hard to do, but please try.

   Finally, these statements make frequent use of two terms that teachers may interpret differently depending on the context. For the purpose of this questionnaire, we ask that you use the following definitions of "data" and "evidence."

   > **Data**—information that has not yet been analyzed or processed; typically gathered through observation or measurement.
   >
   > **Evidence**—analyzed or processed data that are used to support a scientific claim or conclusion.

   Practical constraints aside, do you agree that doing what is described in each statement would help most students learn science?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q4A: Teachers should provide students with opportunities to connect the science they learn in the classroom to what they experience outside of the classroom.	1	2	3	4	5	6

Q4B: At the beginning of instruction on a science concept, students should be provided with definitions for new scientific vocabulary that will be used.	1	2	3	4	5	6
Q4C: Hands-on activities and/or laboratory activities should be used primarily to reinforce a science concept that the students have already learned.	1	2	3	4	5	6
Q4D: Teachers should have students do hands-on activities, even if the data they collect are not closely related to the concept they are studying.	1	2	3	4	5	6
Q4E: Teachers should explain a concept to students before having them consider evidence that relates to the concept.	1	2	3	4	5	6
Q4F: Teachers should ask students to support their conclusions about a science concept with evidence.	1	2	3	4	5	6
Q4G: Students should do hands-on or laboratory activities, even if they do not have opportunities to reflect on what they learned by doing the activities.	1	2	3	4	5	6
Q4H: At the beginning of instruction on a science concept, students should have the opportunity to consider what they already know about the concept.	1	2	3	4	5	6
Q4I: Students should do hands-on activities after they have learned the related science concepts.	1	2	3	4	5	6
Q4J: Teachers should provide students with opportunities to apply the concepts they have learned in new or different contexts.	1	2	3	4	5	6
Q4K: Teachers should have students do interesting hands-on activities, even if the activities do not relate closely to the concept being studied.	1	2	3	4	5	6
Q4L: Students should have opportunities to connect the concept they are studying to other concepts.	1	2	3	4	5	6
Q4M: Students should consider evidence that relates to the science concept they are studying.	1	2	3	4	5	6
Q4N: Teachers should provide students with the outcome of an activity in advance so students know they are on the right track as they do the activity.	1	2	3	4	5	6
Q4O: When students do a hands-on activity and the data don't come out right, teachers should tell students what they should have found.	1	2	3	4	5	6

Q4P: Students should know what the results of an experiment are supposed to be before they carry it out.	1	2	3	4	5	6

The next few questions gather information about the individuals in the iEvolve program with whom you have collaborated on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. We do not expect that you will have collaborated with everyone on these lists. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

5a. During the 2012-2013 school year **excluding the past two weeks at the iEvolve Summer Institute**, did you collaborate on teaching with any iEvolve participants at Meadowlawn School?

○	Yes
○	No

5b. Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

	Not at all in the last school year	**Once or twice in the last school year**	**Quarterly**	**Monthly**	**Weekly**	**Daily**
Teacher A	1	2	3	4	5	6
Teacher B	1	2	3	4	5	6
Teacher C	1	2	3	4	5	6

6a. During the 2012-2013 school year **excluding the past two weeks at the iEvolve Summer Institute**, did you collaborate on teaching with any iEvolve participants at Hancock School?

○	Yes
○	No

6b. Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

	Not at all in the last school year	Once or twice in the last school year	Quarterly	Monthly	Weekly	Daily
Teacher A	1	2	3	4	5	6
Teacher B	1	2	3	4	5	6
Teacher C	1	2	3	4	5	6

7a. During the 2012-2013 school year **excluding the past two weeks at the iEvolve Summer Institute**, did you collaborate on teaching with any iEvolve participants at Mills Elementary School?

○	Yes
○	No

7b. Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

	Not at all in the last school year	Once or twice in the last school year	Quarterly	Monthly	Weekly	Daily
Teacher A	1	2	3	4	5	6
Teacher B	1	2	3	4	5	6
Teacher C	1	2	3	4	5	6

8a. During the 2012-2013 school year **excluding the past two weeks at the iEvolve Summer Institute**, did you collaborate on teaching with any iEvolve participants at Ontario Elementary School?

○	Yes
○	No

8b. Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

	Not at all in the last school year	**Once or twice in the last school year**	**Quarterly**	**Monthly**	**Weekly**	**Daily**
Teacher A	1	2	3	4	5	6
Teacher B	1	2	3	4	5	6
Teacher C	1	2	3	4	5	6

9a. During the 2012-2013 school year **excluding the past two weeks at the iEvolve Summer Institute**, did you collaborate on teaching with any iEvolve participants at Osborne School?

○	Yes
○	No

9b. Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

	Not at all in the last school year	**Once or twice in the last school year**	**Quarterly**	**Monthly**	**Weekly**	**Daily**
Teacher A	1	2	3	4	5	6
Teacher B	1	2	3	4	5	6
Teacher C	1	2	3	4	5	6

10a. During the 2012-2013 school year **excluding the past two weeks at the iEvolve Summer Institute**, did you collaborate on teaching with any iEvolve participants at Venice Heights School?

○	Yes
○	No

10b. Please indicate how often you have collaborated with each of the following individuals on teaching in the last year, **excluding the past two weeks at the iEvolve Summer Institute**. When considering collaboration, please include such activities as planning a lesson together, searching for or sharing resources, co-teaching, coaching/mentoring, and analyzing assessment results.

	Not at all in the last school year	Once or twice in the last school year	Quarterly	Monthly	Weekly	Daily
Teacher A	1	2	3	4	5	6
Teacher B	1	2	3	4	5	6
Teacher C	1	2	3	4	5	6

11. Please respond to each of the following items in terms of <u>your present concerns</u> about your involvement with Citizen Science Research.

	Irrele-vant	Not true of me now			Some-what true of me now			Very true of me now
Q11A: I don't even know what citizen science research is.	0	1	2	3	4	5	6	7
Q11B: I have very limited knowledge about citizen science research.	0	1	2	3	4	5	6	7
Q11C: I would like to know the effect of implementing citizen science research on my professional status.	0	1	2	3	4	5	6	7
Q11D: I would like to know how my teaching or administration is supposed to change with citizen science research.	0	1	2	3	4	5	6	7
Q11E: I am completely occupied with other things.	0	1	2	3	4	5	6	7
Q11F: I would like to know what the use of citizen science research will require in the immediate future.	0	1	2	3	4	5	6	7
Q11G: I would like to have more information on time and energy commitments required by citizen science research.	0	1	2	3	4	5	6	7
Q11H: I would like to know how my role will change when I am using citizen science research.	0	1	2	3	4	5	6	7

12. During the 2012-13 school year, did you participate in a professional learning community (PLC) or team?

○	Yes
○	No

13. Please indicate the extent to which you agree or disagree with each statement below.

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q13A: Members of our PLC/team have a shared understanding of the purpose of the PLC/team.	1	2	3	4	5	6
Q13B: Members of our PLC/team have a shared understanding of the structure and function of the PLC/team (e.g., Who participates in the PLC/team? Who leads/organizes the PLC/team? What are the various roles for members of the PLC/team?).	1	2	3	4	5	6
Q13C: Members of our PLC/team have a shared vision for increasing student achievement.	1	2	3	4	5	6
Q13D: Our PLC/team has a set of norms that are consistently followed at our meetings (i.e., expectations and processes to which members hold themselves and each other accountable).	1	2	3	4	5	6
Q13E: Members of our PLC/team work together to seek knowledge, skills, and/or strategies to increase student achievement.	1	2	3	4	5	6
Q13F: Members of our PLC/team participate in peer observations and offer feedback as a way to improve our teaching.	1	2	3	4	5	6
Q13G: Members of our PLC/team collaboratively analyze student work to improve teaching and learning.	1	2	3	4	5	6
Q13H: As an individual teacher, our PLC/team prompts me to regularly think about how my instructional practices affect student achievement.	1	2	3	4	5	6
Q13I: I have made changes to my classroom teaching as a result of the work we have done in our PLC/team.	1	2	3	4	5	6
Q13J: Our PLC/team is provided with sufficient time during the school day/school year to meet as a team.	1	2	3	4	5	6
Q13K: Members of our PLC/team regularly attend PLC/team meetings.	1	2	3	4	5	6
Q13L: Our principal understands the purpose of the PLC/team.	1	2	3	4	5	6

Q13M: Our principal understands the structure and function of the PLC/team (e.g., Who participates in the PLC/team? Who leads/organizes the PLC/team? What are the various roles for members of the PLC/team?).	1	2	3	4	5	6
Q13N: Our principal is supportive of the work of our PLC/team.	1	2	3	4	5	6

14 (3rd grade). Many teachers feel better prepared to teach some topics than others. Please indicate your level of preparedness to teach each of the following topics *at the third grade level* 1) **prior to the *iEvolve Summer Institute***, and 2) **now** (i.e., after the Institute).

	Prior to Institute				Now			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**	**Not Adequately Prepared**	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A: Inheritance of traits from one generation to the next	1	2	3	4	1	2	3	4
Q14B: The difference between inherited traits and learned behavioral traits	1	2	3	4	1	2	3	4
Q14C: Relationships between physical features of plants and animals and the environments where they live	1	2	3	4	1	2	3	4
Q14D: The effects of organisms' characteristics on survival and reproduction in particular environments	1	2	3	4	1	2	3	4
Q14E: Relationships between plant and animal life cycles and survival in particular environments	1	2	3	4	1	2	3	4
Q14F: Properties of Earth's nonliving resources	1	2	3	4	1	2	3	4
Q14G: Rock formation and classification	1	2	3	4	1	2	3	4
Q14H: Soil composition	1	2	3	4	1	2	3	4
Q14I: Renewable and nonrenewable energy resources	1	2	3	4	1	2	3	4

Q14J: How natural resources become limited and can be conserved	1	2	3	4	1	2	3	4
Q14K: The definition and fundamental characteristics of matter	1	2	3	4	1	2	3	4
Q14L: States of matter and their associated properties	1	2	3	4	1	2	3	4
Q14M: The change of matter from one state to another	1	2	3	4	1	2	3	4
Q14N: The definition and fundamental forms of energy	1	2	3	4	1	2	3	4

14 (4th grade). Many teachers feel better prepared to teach some topics than others. Please indicate your level of preparedness to teach each of the following topics *at the fourth grade level* 1) **prior to the *iEvolve Summer Institute***, and 2) **now** (i.e., after the Institute).

	Prior to Institute				Now			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**	**Not Adequately Prepared**	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A. The effects of the environment and environmental change on organism behavior and survival	1	2	3	4	1	2	3	4
Q14B. How similarities and differences among organisms are used in different ways for classification	1	2	3	4	1	2	3	4
Q14C. Extinct organisms and comparisons with organisms existing today	1	2	3	4	1	2	3	4
Q14D. Earth's surface and landforms	1	2	3	4	1	2	3	4
Q14E. The distribution of Earth's water	1	2	3	4	1	2	3	4
Q14F. The effects of weathering, erosion, and deposition on earth materials and Earth's surfaces	1	2	3	4	1	2	3	4

Q14G. Processes that change the size and shape of rocks	1	2	3	4	1	2	3	4
Q14H. Creation of landforms by catastrophic events	1	2	3	4	1	2	3	4
Q14I. Conservation of matter during physical changes	1	2	3	4	1	2	3	4
Q14J. Transfers and transformations of energy	1	2	3	4	1	2	3	4
Q14K. How energy transfer relates to temperature change	1	2	3	4	1	2	3	4
Q14L. Electric circuits	1	2	3	4	1	2	3	4
Q14M. Uses of energy in electric circuits	1	2	3	4	1	2	3	4

14 (5th grade). Many teachers feel better prepared to teach some topics than others. Please indicate your level of preparedness to teach each of the following topics *at the fifth grade level* 1) **prior to** the ***iEvolve Summer Institute***, and 2) **now** (i.e., after the Institute).

	Prior to Institute				Now			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**	**Not Adequately Prepared**	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A. The relationships among producers, consumers, and decomposers in an ecosystem.	1	2	3	4	1	2	3	4
Q14B. The flow of energy through ecosystems	1	2	3	4	1	2	3	4
Q14C. The solar system and properties of planets	1	2	3	4	1	2	3	4
Q14D. The fundamental characteristics of the sun as a star	1	2	3	4	1	2	3	4
Q14E. How Earth's motion causes day and night.	1	2	3	4	1	2	3	4
Q14F. The relationship of seasons to the tilt of Earth's axis and its orbit around the sun	1	2	3	4	1	2	3	4
Q14G. The definition and measurement of speed	1	2	3	4	1	2	3	4
Q14H. The relationships among force, gravity, and weight	1	2	3	4	1	2	3	4
Q14I. How force strength and an object's mass	1	2	3	4	1	2	3	4

affect it's change in motion								
Q14J. How light travels and interacts with objects	1	2	3	4	1	2	3	4
Q14K. Sound production, travel, and pitch	1	2	3	4	1	2	3	4

iEvolve Mid-Year Participant Feedback Survey

1. iEvolve provides opportunities for teachers to spend some time meeting together in small groups.
   a. In what ways have the opportunities to meet together in **PLTs** been helpful to you?
   b. In what ways have the opportunities to meet together in **grade-level groups** been helpful to you?

2. What changes, if any, would you recommend for future **PLT** meetings?

3. What changes, if any, would you recommend for future **grade-level group** meetings?

4. Are you responsible for planning and delivering science instruction to one or more classes of students?

○	Yes
○	No

5. *Which of the following best describes your teaching role?

○	Computer or Technology Specialist
○	Intervention Specialist
○	Curriculum Coach
○	Other (specify) __________________

6. As one who is not responsible for planning and delivering science instruction to one or more classes of students, how do you see your role within your PLT?

7. Please describe the ways in which you collaborate with classroom teachers to enhance instruction using the FOSS materials.

8. In a typical week, approximately how many minutes do you spend collaborating with classroom teachers to plan instruction using the FOSS materials?

○	0 minutes
○	1-15 minutes
○	16-30 minutes
○	31-60 minutes
○	Greater than 60 minutes

9. Please describe the major interdisciplinary connections you helped make that directly relate to the FOSS materials.

10. What are the most important aspects of your role in supporting science instruction?

11. What additional comments would you like to make about iEvolve in general?

12. Which of the following best describes your teaching role?

○	3rd grade teacher
○	4th grade teacher
○	5th grade teacher
○	Multi-grade teacher
○	Other (specify) ___________

13. This year (2013–14), in a typical week, how many days do you teach science lessons?

○	1
○	2
○	3
○	4
○	5

14. This year (2013–14), approximately how many minutes per week do you spend teaching science?

15. How many minutes is a typical day's science lesson?

16. Do you feel like you have adequate time for teaching science?

○	Yes
○	No

17. Please briefly explain what factors keep you from having adequate time to teach science.

18. How well prepared do you feel to teach science using the instructional strategies in the FOSS kits (i.e., activity-based, inquiry-oriented instruction)?

○	Not adequately prepared
○	Somewhat prepared
○	Fairly well prepared
○	Very well prepared

19. What would help you feel better prepared to teach science using the FOSS kits?

20. Did you skip any lessons/activities in the FOSS kits you have used?

○	Yes
○	No

21. a. Why did you skip lessons/activities in the FOSS kits?
    b. How did you decide which lessons/activities to skip?

22. Please describe the major interdisciplinary connections you made in your teaching that directly relate to the FOSS materials.

23. What additional comments do you have about teaching with the FOSS kits?

24. What additional comments would you like to make about iEvolve in general?

iEvolve Teacher Interview Protocol

Overall

1. What were your expectations for the summer institute? What were you hoping to get out of it?
   Probes:
   a. content knowledge
   b. preparing you to teach the FOSS kits
   c. in terms of interactions with others

2. In what ways did the institute meet your expectations?
   Probes:
   a. content knowledge
   b. preparing you to teach the FOSS kits
   c. in terms of interactions with others

3. In what ways did it not meet your expectations?
   Probes:
   a. content knowledge
   b. preparing you to teach the FOSS kits
   c. in terms of interactions with others

Content

4. How did you feel about the level of the science content?
   Probes:
   a. Was it just right? Too easy? Too hard?
   b. How well did it match with the content you have to teach?

5. In what ways would you say the institute affected your content knowledge?
   Probes:
   a. deepening your content knowledge?
   b. helping you see connections between science content and other content (other science or other subjects; e.g., social studies)?
   c. how could the institute have done a better job of improving your content knowledge?

6. *[Ask only* if *interviewee indicated impacts on content knowledge in Q5.]* What role did the lead teachers play in deepening your content knowledge? How about the content experts/scientists? The other participants?

Perceptions of preparedness/Self-efficacy

7. Aside from content knowledge, what aspects of the Summer Institute had the biggest impact on preparing you to teach science?
   Probes:
   a. What aspects of the institute were helpful?
   b. What roles did interaction with leaders play?
   c. What roles did other participants play?

8. What aspects of the Summer Institute had the biggest impact on preparing you to teach the FOSS kits?
   Probes:
   a. What aspects of the institute were helpful?
   b. What roles did interaction with leaders play?
   c. What roles did other participants play?

9. Are there any aspects of teaching with the FOSS kits that you feel the institute did not prepare you for? If yes, what?
   Probes:
   a. *[If yes]* How could the institute have prepared you better?

10. Overall, how well prepared do you feel to teach the FOSS kits?
    a. Are there specific science topics or kit investigations you feel most ready to teach?
    b. Are there any areas of the kits you're concerned about?

11. Do you feel the institute prepared you to use note booking in your science teaching?
    Probes:
    a. What aspects of the institute were especially helpful for preparing you to use note booking?
    b. What aspects of the institute could have been better in preparing you to use note booking?

12. Do you feel the institute prepared you to use the 6E model in your science teaching?
    Probes:
    a. What aspects of the institute were especially helpful for preparing you to use the 6E model?
    b. What aspects of the institute could have been better for preparing you to use the 6E model?

13. Do you feel the institute prepared you to differentiate your science instruction?
    Probes:
    a. What aspects of the institute were especially helpful for preparing you to differentiate science instruction?
    b. What aspects of the institute could have been better for preparing you to differentiate science instruction?

Beliefs about science teaching

14. What are your thoughts about how hands-on activities should be used in science instruction? In what ways, if any, did the institute change your views?

15. What are your thoughts about how science vocabulary (defining terms) is best incorporated into instruction? In what ways, if any, did the institute change your views?

Your science teaching

16. Aside from the kits themselves, do you think that the way you teach science next year will be different compared to previous years? Why or why not?
    Probes:
    a. Do you think you will use the 6E model, or parts of it? Why or why not?
    b. [*Ask only if interviewee indicated impacts on content knowledge in Q5*] How do you think the new science content you learned will affect your science teaching?

17. What are your thoughts about using note booking along with the FOSS kits in your teaching next year?

AY PD and PLTs

18. What are your expectations for iEvolve PD during the upcoming school year?
    Probes:
    a. What do you see as the roles/purposes of the iEvolve PD during the upcoming school year?
    b. How do you think the continued PD might be helpful to you as a science teacher?

19. What additional support/resources from iEvolve would be most helpful to your teaching this coming year? Why?

20. What recommendations would you make for the PLCs/PLTs that will happen this year?

CSR

21. I realize that at this early stage you might not have thought too much about this aspect of the project, but what initial thoughts/concerns come to mind when you consider incorporating citizen science research into your instruction?

iEvolve Ambassador Interview Protocol

1. How would you describe participation in the PLT? Do all members of your PLT actively participate in PLT meetings?
    a. Please explain/give an example of how they participate (or not).
    b. Over time, have you noticed any changes in participation at your PLT meetings? If so, what kinds of changes?

2. Are all members of your PLT usually able to attend PLT meetings?
    a. How difficult is it to schedule group meetings around everyone's schedules?
    b. Are there other things that make it difficult for teachers to attend PLT meetings? Please explain.
    c. Over time, have you noticed any changes in attendance at your PLT meetings?
    d. Has your PLT held any meetings that are not face-to-face? Maybe a team conference call or a virtual meeting through MSPnet?
        i. **[If yes]** Please describe this meeting/these meetings.
        ii. **[If yes]** How did it/they go?
    e. If the iEvolve project provided video conferencing equipment and training, do you think some members of your PLT would like to meet using video conferencing?
        i. **[If yes]** How often do you think PLT meetings would be conducted using video conferencing?
        ii. **[If yes]** Approximately how many members of your PLT do you think would use video conferencing?

3. How much do members of your PLT actively participate in tasks/work that occurs outside of the PLT meetings (e.g., finding and sharing resources)?
    a. Please explain/give an example.

4. How are the focus questions for your PLT meetings determined?
    a. Has it been difficult to choose focus questions? Why or why not?
    b. Over time, have you seen any changes in the types of focus questions your PLT is discussing? Please explain.

5. What are your thoughts about the PLT planning guides that you complete after each PLT meeting?
    a. Are they useful? Why or why not?
    b. Do you have suggestions for how the planning guides might be more useful to you and your PLT team?

6. What are you and others getting out of the PLT? What is it accomplishing?

7. Going forward, what else could the project do to support the work of your PLT?

8. Do you have anything else you want to share about your PLT?
    a. Are there aspects of your PLT that are going especially well?
    b. Are there aspects of your PLT that are not going as well?

9. As an ambassador, how would you describe your major responsibilities?
    a. Are your responsibilities as an ambassador more than, less than, or about what you expected when you volunteered for this position? Please explain.
    b. Do you feel like your responsibilities as an ambassador are realistic? Why or why not?
    c. Do you feel that the iEvolve project adequately supports your work as an ambassador? What else could the project do to support you?

10. How has your role as an ambassador changed over time, if at all?
    a. Do you anticipate that it will change in the future?

11. In your opinion, would it be good to keep the same ambassadors for the second year of the iEvolve program, or would it be good to rotate the leadership responsibilities? Please explain.
    a. Given the opportunity, would you want to continue as an ambassador for the 2014-15 school year? Why or why not?

12. Do you have anything else you want to share about your role as an ambassador?

APPENDIX C

Composite Reliabilities

Composite Reliabilities

Beliefs about Science Teaching: Learning Theory Aligned Beliefs

a. Teachers should provide students with opportunities to connect the science they learn in the classroom to what they experience outside of the classroom.
b. Teachers should ask students to support their conclusions about a science concept with evidence.
c. At the beginning of instruction on a science concept, students should have the opportunity to consider what they already know about the concept.
d. Teachers should provide students with opportunities to apply the concepts they have learned in new or different contexts.
e. Students should have opportunities to connect the concept they are studying to other concepts.
f. Students should consider evidence that relates to the science concept they are studying.

<u>Cronbach's Alpha</u>

Pre-Institute: 0.856
Post-Institute: 0.799

Beliefs about Science Teaching: Confirmatory Instruction Beliefs

a. At the beginning of instruction on a science concept, students should be provided with definitions for new scientific vocabulary that will be used.
b. Hands-on activities and/or laboratory activities should be used primarily to reinforce a science concept that the students have already learned.
c. Teachers should explain a concept to students before having them consider evidence that relates to the concept.
d. Students should do hands-on activities after they have learned the related science concepts.
e. Teachers should provide students with the outcome of an activity in advance so students know they are on the right track as they do the activity.
f. When students do a hands-on activity and the data don't come out right, teachers should tell students what they should have found.
g. Students should know what the results of an experiment are supposed to be before they carry it out.

<u>Cronbach's Alpha</u>

Pre-Institute: 0.779
Post-Institute: 0.803

Beliefs about Science Teaching: Hands-on Instruction Beliefs

a. Teachers should have students do hands-on activities, even if the data they collect are not closely related to the concept they are studying.
b. Students should do hands-on or laboratory activities, even if they do not have opportunities to reflect on what they learned by doing the activities.
c. Teachers should have students do interesting hands-on activities, even if the activities do not relate closely to the concept being studied.

<u>Cronbach's Alpha</u>
Pre-Institute: 0.724
Post-Institute: 0.686

Self-efficacy: Personal Science Teaching Efficacy Beliefs

a. Even when I try very hard, I don't teach science as well as I do most subjects.
b. I am not very effective in monitoring science experiments. I understand science concepts well enough to be effective in teaching elementary science.
c. I am typically able to answer students' science questions.
d. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.

<u>Cronbach's Alpha</u>
Pre-Institute: 0.813
Post-Institute: 0.749

Self-efficacy: Science Teaching Outcomes Expectancy

a. The teacher is generally responsible for the achievement of students in science.
b. Students' achievement in science is directly related to their teacher's effectiveness in science teaching.
c. Effectiveness in science teaching has little influence on the achievement of students with low motivation.

<u>Cronbach's Alpha</u>
Pre-Institute: 0.584
Post-Institute: 0.571

Use of Reform-oriented Teaching Practices

a. Have students work in small groups
b. Do hands-on/laboratory activities
c. Engage the class in project-based learning (PBL) activities
d. Have students represent and/or analyze data using tables, charts or graphs
e. Require students to supply evidence in support of their claims
f. Have students write their reflections (e.g., in their journals) in class or for homework

Cronbach's Alpha: 0.890

Emphasis on Reform-oriented Instructional Objectives

a. Understanding science concepts
b. Learning science process skills (e.g., observing, measuring)
c. Learning about real-life applications of science
d. Increasing students' interest in science
e. Preparing for further study in science

Cronbach's Alpha: 0.871

Perceptions of Preparedness to Teach Diverse Learners

a. Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity
b. Teach science to students who have learning disabilities
c. Teach science to students who have physical disabilities
d. Teach science to English-language learners
e. Provide enrichment experiences for gifted students

Cronbach's Alpha: 0.833

Perceptions of Preparedness to Encourage Students

a. Encourage students' interest in science and/or engineering
b. Encourage participation of females in science and/or engineering
c. Encourage participation of racial or ethnic minorities in science and/or engineering
d. Encourage participation of students from low socioeconomic backgrounds in science and/or engineering

Cronbach's Alpha: 0.940

Content Accessibility

a. Interactions with the instructors helped me understand the concepts addressed in the Institute better.
b. I felt supported by the instructors as I developed my understanding of the concepts addressed in the Institute material.
c. The content of the Institute was interesting to me.
d. I usually understood the content being addressed in the Institute.

Cronbach's Alpha: 0.931

Participant Interactions/Culture

a. Interactions with the participants helped me understand the concepts addressed in the Institute better.
b. Interactions with the participants helped me understand how to apply the Institute concepts in my teaching.
c. I felt supported by other participants as I developed my understanding of the concepts addressed in the Institute material.
d. I found the discussions during the Institute interesting.
e. The Institute atmosphere encouraged me to make contributions to the discussions.
f. I felt my contributions to the Institute discussions were valued.

Cronbach's Alpha: 0.956

Logistics/Clarity

a. The goals of the Institute were made clear.
b. The Institute work requirements were made clear.
c. The Institute work requirements were realistic.

Cronbach's Alpha: 0.956

Alignment of PLCs/PTLs with Principles of Effectiveness

a. Members of our PLC/T have a shared understanding of the purpose of the PLC/T.
b. Members of our PLC/T have a shared understanding of the structure and function of the PLC/T.
c. Members of our PLC/T have a shared vision for increasing student achievement.
d. Our PLC/T has a set of norms that are consistently followed at our meetings (i.e., expectations and processes to which members hold themselves and each other accountable).
e. Members of our PLC/T work together to seek knowledge, skills, and/or strategies to increase student achievement.
f. Members of our PLC/T participate in peer observations and offer feedback as a way to improve our teaching.
g. Members of our PLC/T collaboratively analyze student work to improve teaching and learning.
h. As an individual teacher, our PLC/T prompts me to regularly think about how my instructional practices affect student achievement.
i. I have made changes to my classroom teaching as a result of the work we have done in our PLC/T.
j. Our PLC/T is provided with sufficient time during the school day/school year to meet as a team.
k. Members of our PLC/T regularly attend PLC/T meetings.
l. Our principal understands the purpose of the PLC/T.
m. Our principal understands the structure and function of the PLC/T (e.g., Who participates in the PLC/T? Who leads/organizes the PLC/T? What are the various roles for members of the PLC/T?).
n. Our principal is supportive of the work of our PLC/T.

<u>Cronbach's Alpha</u>: 0.897

Concerns about CSR: Awareness Concerns

a. I don't even know what citizen science research is.
b. I have very limited knowledge about citizen science research.
c. I am completely occupied with other things.

<u>Cronbach's Alpha</u>: 0.677

Concerns about CSR: Personal Concerns

a. I would like to know the effect of implementing citizen science research on my professional status.
b. I would like to know how my teaching or administration is supposed to change with citizen science research.
c. I would like to know what the use of citizen science research will require in the immediate future.
d. I would like to have more information on time and energy commitments required by citizen science research.
e. I would like to know how my role will change when I am using citizen science research.

Cronbach's Alpha: 0.887

Preparedness to Teach Grade-Specific Content: 3rd Grade

a. Inheritance of traits from one generation to the next
b. The difference between inherited traits and learned behavioral traits
c. Relationships between physical features of plants and animals and the environments where they live
d. The effects of organisms' characteristics on survival and reproduction in particular environments
e. Relationships between plant and animal life cycles and survival in particular environments
f. Properties of Earth's nonliving resources
g. Rock formation and classification
h. Soil composition
i. Renewable and nonrenewable energy resources
j. How natural resources become limited and can be conserved
k. The definition and fundamental characteristics of matter
l. States of matter and their associated properties
m. The change of matter from one state to another
n. The definition and fundamental forms of energy

Cronbach's Alpha

Retrospective Pre: 0.961
Post-Institute: 0.910

Preparedness to Teach Grade-Specific Content: 4th Grade

a. The effects of the environment and environmental change on organism behavior and survival
b. How similarities and differences among organisms are used in different ways for classification
c. Extinct organisms and comparisons with organisms existing today
d. Earth's surface and landforms
e. The distribution of Earth's water
f. The effects of weathering, erosion, and deposition on earth materials and Earth's surfaces
g. Processes that change the size and shape of rocks
h. Creation of landforms by catastrophic events
i. Conservation of matter during physical changes
j. Transfers and transformations of energy
k. How energy transfer relates to temperature change
l. Electric circuits
m. Uses of energy in electric circuits

<u>Cronbach's Alpha</u>
Retrospective Pre: 0.980
Post-Institute: 0.931

Preparedness to Teach Grade-Specific Content: 5th Grade

a. The relationships among producers, consumers, and decomposers in an ecosystem
b. The flow of energy through ecosystems
c. The solar system and properties of planets
d. The fundamental characteristics of the sun as a star
e. How Earth's motion causes day and night
f. The relationship of seasons to the tilt of Earth's axis and its orbit around the sun
g. The definition and measurement of speed
h. The relationships among force, gravity, and weight
i. How force strength and an object's mass affect it's change in motion
j. How light travels and interacts with objects
k. Sound production, travel, and pitch

<u>Cronbach's Alpha</u>
Retrospective Pre: 0.969
Post-Institute: 0.934

APPENDIX D

Questionnaire Results

Baseline Questionnaire

Post-Institute Questionnaire

Mid-Year Feedback Questionnaire

Baseline Questionnaire

Table D-1
Respondents Indicating that They Teach Science at the Elementary Level†

	Percent of Respondents (N = 52)	
	No	**Yes**
Q1: Do you teach science at the elementary level?	27	73

† Includes those with pre and post data on this item.

Table D-2
Distribution of Responses for Statements about Use of Reform-Oriented Teaching Practices†

		Percent of Respondents			
	N	**Never**	**Rarely**	**Often**	**All or almost all science lessons**
Q2A: Have students work in small groups	39	3	18	62	18
Q2B: Do hands-on/laboratory activities	39	13	26	51	10
Q2C: Engage the class in project-based learning (PBL) activities	39	13	46	36	5
Q2D: Have students represent and/or analyze data using tables, charts or graphs	38	13	34	50	3
Q2E: Require students to supply evidence in support of their claims	39	10	36	41	13
Q2F: Have students write their reflections (e.g., in their journals) in class or for homework	39	13	46	36	5

† Includes those participants who indicated teaching science at the elementary level in *Q1*.

Table D-3
Distribution of Responses for Statements about Emphasis on Reform-Oriented Instructional Objectives†

	Percent of Respondents (N = 39)			
	None	**Minimal Emphasis**	**Moderate Emphasis**	**Heavy Emphasis**
Q3A: Understanding science concepts	0	10	51	38
Q3B: Learning science process skills (e.g., observing, measuring)	3	21	38	38
Q3C: Learning about real-life applications of science	3	18	46	33
Q3D: Increasing students' interest in science	0	15	49	36
Q3E: Preparing for further study in science	3	36	44	18

† Includes those participants who indicated teaching science at the elementary level in *Q1*.

Table D-4
Distribution of Responses for Statements about
Perceptions of Preparedness to Teach Diverse Learners and Encourage Students[†]

		Percent of Respondents			
	N	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Q4A: Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	38	11	50	32	8
Q4B: Teach science to students who have learning disabilities	38	16	37	37	11
Q4C: Teach science to students who have physical disabilities	39	33	38	23	5
Q4D: Teach science to English-language learners	39	38	41	13	8
Q4E: Provide enrichment experiences for gifted students	39	15	49	31	5
Q4F: Encourage students' interest in science and/or engineering	39	21	38	31	10
Q4G: Encourage participation of females in science and/or engineering	39	21	36	31	13
Q4H: Encourage participation of racial or ethnic minorities in science and/or engineering	39	15	33	38	13
Q4I: Encourage participation of students from low socioeconomic backgrounds in science and/or engineering	39	23	28	33	15

[†] Includes those participants who indicated teaching science at the elementary level in *Q1*.

Table D-5.1
Distribution of Responses for Statements about
Personal Science Teaching Efficacy Beliefs and Science Teaching Outcomes Expectancy†‡

		Percent of Respondents					
	N	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q5A.A: Even when I try very hard, I don't teach science as well as I do most subjects.	35	23	11	20	20	11	14
Q5A.B: I am not very effective in monitoring science experiments.	35	20	26	14	31	0	9
Q5A.C: If students are underachieving in science, it is most likely due to ineffective science teaching.	35	9	9	14	43	20	6
Q5A.D: I understand science concepts well enough to be effective in teaching elementary science.	34	3	0	3	44	26	24
Q5A.E: The teacher is generally responsible for the achievement of students in science.	34	0	3	6	35	47	9
Q5A.F: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	35	0	0	14	40	43	3
Q5A.G: I am typically able to answer students' science questions.	35	0	3	0	29	49	20
Q5A.H: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	34	21	32	12	24	12	0
Q5A.I: When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.	34	18	26	35	18	3	0
Q5A.J: Even teachers with good science teaching abilities cannot help some kids learn science.	34	18	24	35	21	3	0

† Includes those participants who indicated teaching science at the elementary level in *Q1*.
‡ Includes those with pre and post data on this item.

Table D-5.2
Distribution of Responses for Statements about Science Teaching Outcomes Expectancy†‡

	Percent of Respondents (N = 11)					
	Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
Q5B.A: If students are underachieving in science, it is most likely due to ineffective science teaching.	9	9	18	27	36	0
Q5B.B: The teacher is generally responsible for the achievement of students in science.	0	0	9	27	45	18
Q5B.C: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	0	0	9	45	36	9
Q5B.D: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	27	27	18	18	9	0
Q5B.E: Even teachers with good science teaching abilities cannot help some kids learn science.	18	0	27	27	27	0

† Includes those participants who indicated not teaching science at the elementary level in *Q1*.
‡ Includes those with pre and post data on this item.

Table D-6
Distribution of Responses for Statements about Beliefs about Science Teaching†

	N	Percent of Respondents					
		Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
Q6A: Teachers should provide students with opportunities to connect the science they learn in the classroom to what they experience outside of the classroom	51	2	0	2	8	18	71
Q6B: At the beginning of instruction on a science concept, students should be provided with definitions for new scientific vocabulary that will be used.	51	2	8	8	29	31	22
Q6C: Hands-on activities and/or laboratory activities should be used primarily to reinforce a science concept that the students have already learned.	50	8	28	26	10	8	20
Q6D: Teachers should have students do hands-on activities, even if the data they collect are not closely related to the concept they are studying.	50	2	20	22	26	16	14
Q6E: Teachers should explain a concept to students before having them consider evidence that relates to the concept.	50	10	24	36	18	8	4
Q6F: Teachers should ask students to support their conclusions about a science concept with evidence.	50	2	2	2	10	30	54
Q6G: Students should do hands-on or laboratory activities, even if they do not have opportunities to reflect on what they learned by doing the activities.	49	6	24	29	14	20	6
Q6H: At the beginning of instruction on a science concept, students should have the opportunity to consider what they already know about the concept.	50	0	0	2	16	26	56
Q6I: Students should do hands-on activities after they have learned the related science concepts.	51	2	18	24	25	18	14

† Includes those with pre and post data on this item.

Table D-6 (Continued)
Distribution of Responses for
Statements about Beliefs about Science Teaching†

	N	Percent of Respondents					
		Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
Q6J: Teachers should provide students with opportunities to apply the concepts they have learned in new or different contexts.	51	0	0	0	14	25	61
Q6K: Teachers should have students do interesting hands-on activities, even if the activities do not relate closely to the concept being studied.	51	2	22	18	31	20	8
Q6L: Students should have opportunities to connect the concept they are studying to other concepts.	51	0	0	2	10	25	63
Q6M: Students should consider evidence that relates to the science concept they are studying.	50	0	2	0	18	32	48
Q6N: Teachers should provide students with the outcome of an activity in advance so students know they are on the right track as they do the activity.	50	36	32	18	8	4	2
Q6O: When students do a hands-on activity and the data don't come out right, teachers should tell students what they should have found.	49	18	22	22	27	8	2
Q6P: Students should know what the results of an experiment are supposed to be before they carry it out.	50	36	32	18	8	4	2

† Includes those with pre and post data on this item.

Table D-7
Distribution of Responses for Statements
about Collaboration During the Last Five Years

	N	Percent of Respondents	
		No	**Yes**
Q7A: Serving as a grade-level/team leader	54	65	35
Q7B: Serving as an informal resource in science to other teachers in your school or district	54	78	22
Q7C: Providing workshops on science teaching to other teachers in your school or district	54	98	2
Q7D: Serving on a school or district science curriculum committee	54	78	22
Q7E: Serving as the science lead teacher or science department chair	53	92	8
Q7F: Worked on science curriculum development outside of your district	54	87	13
Q7G: Consulted on science education for other districts	54	96	4
Q7H: Taught in-service workshops or courses in science/science teaching outside of your district	52	98	2

Post-Institute Questionnaire

Table D-8
Distribution of Responses for Statements about Perceptions of Various Aspects of the Summer Institute

		Percent of Respondents					
	N	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q1A: The goals of the Institute were made clear.	54	9	0	4	4	24	59
Q1B: The Institute work requirements were made clear.	54	7	6	2	4	30	52
Q1C: The Institute work requirements were realistic.	54	6	4	4	6	17	65
Q1D: Interactions with the instructors helped me understand the concepts addressed in the Institute better.	54	6	0	0	7	41	46
Q1E: Interactions with the participants helped me understand the concepts addressed in the Institute better.	54	6	0	0	7	44	43
Q1F: Interactions with the instructors helped me understand how to apply the Institute concepts in my teaching.	54	4	2	4	4	39	48
Q1G: Interactions with the participants helped me understand how to apply the Institute concepts in my teaching.	54	4	2	0	11	52	31
Q1H: I felt supported by the instructors as I developed my understanding of the concepts addressed in the Institute material.	54	4	4	2	6	37	48
Q1I: I felt supported by other participants as I developed my understanding of the concepts addressed in the Institute material.	54	6	0	0	7	41	46
Q1J: The content of the Institute was interesting to me.	54	4	4	0	4	41	48
Q1K: I usually understood the content being addressed in the Institute.	54	4	2	0	6	43	46
Q1L: I found the discussions during the Institute interesting.	54	4	0	2	7	46	41

Table D-8 (Continued)
Distribution of Responses for Statements about Perceptions of Various Aspects of the Summer Institute

	N	Percent of Respondents					
		Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q1M: The Institute atmosphere encouraged me to make contributions to the discussions.	54	4	4	4	7	20	61
Q1N: I felt my contributions to the Institute discussions were valued.	54	4	4	2	4	24	63
Q1O: I would recommend the Institute to my colleagues.	53	4	2	0	4	30	60

† Includes those with pre and post data on this item.

Table D-9
Respondents Indicating that They Teach Science at the Elementary Level†

	Percent of Respondents (N = 52)	
	No	Yes
Q2: Do you teach science at the elementary level?	27	73

† Includes those with pre and post data on this item.

Table D-10.1
Distribution of Responses for Statements about Personal Science Teaching Efficacy Beliefs and Science Teaching Outcomes Expectancy†‡

		Percent of Respondents					
	N	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q3A.A: Even when I try very hard, I don't teach science as well as I do most subjects.	35	20	17	6	23	26	9
Q3A.B: I am not very effective in monitoring science experiments.	35	29	14	23	20	14	0
Q3A.C: If students are underachieving in science, it is most likely due to ineffective science teaching.	34	9	6	12	44	24	6
Q3A.D: I understand science concepts well enough to be effective in teaching elementary science.	35	3	0	9	20	49	20
Q3A.E: The teacher is generally responsible for the achievement of students in science.	34	0	0	12	29	41	18
Q3A.F: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	35	0	3	3	34	43	17
Q3A.G: I am typically able to answer students' science questions.	35	0	0	3	9	63	26
Q3A.H: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	35	14	46	20	17	3	0
Q3A.I: When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.	35	17	51	23	9	0	0
Q3A.J: Even teachers with good science teaching abilities cannot help some kids learn science.	35	23	23	20	20	11	3

† Includes those participants who indicated teaching science at the elementary level in *Q2*.
‡ Includes those with pre and post data on this item.

Table D-10.2
Distribution of Responses for Statements about Science Teaching Outcomes Expectancy†‡

	Percent of Respondents (N = 11)					
	Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
Q3B.A: If students are underachieving in science, it is most likely due to ineffective science teaching.	0	0	9	27	64	0
Q3B.B: The teacher is generally responsible for the achievement of students in science.	0	0	0	18	82	0
Q3B.C: Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	0	0	0	45	55	0
Q3B.D: Effectiveness in science teaching has little influence on the achievement of students with low motivation.	27	27	18	0	18	9
Q3B.E: Even teachers with good science teaching abilities cannot help some kids learn science.	18	18	27	18	18	0

† Includes those participants who indicated not teaching science at the elementary level in *Q2*.
‡ Includes those with pre and post data on this item.

Table D-11
Distribution of Responses for Statements about Beliefs about Science Teaching[†]

	N	Percent of Respondents					
		Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q4A: Teachers should provide students with opportunities to connect the science they learn in the classroom to what they experience outside of the classroom	51	0	0	0	4	12	84
Q4B: At the beginning of instruction on a science concept, students should be provided with definitions for new scientific vocabulary that will be used.	51	12	18	16	31	16	8
Q4C: Hands-on activities and/or laboratory activities should be used primarily to reinforce a science concept that the students have already learned.	51	24	24	20	10	8	16
Q4D: Teachers should have students do hands-on activities, even if the data they collect are not closely related to the concept they are studying.	51	4	12	29	24	20	12
Q4E: Teachers should explain a concept to students before having them consider evidence that relates to the concept.	50	26	42	22	0	4	6
Q4F: Teachers should ask students to support their conclusions about a science concept with evidence.	50	0	0	0	4	28	68
Q4G: Students should do hands-on or laboratory activities, even if they do not have opportunities to reflect on what they learned by doing the activities.	50	10	28	12	16	20	14
Q4H: At the beginning of instruction on a science concept, students should have the opportunity to consider what they already know about the concept.	50	0	0	0	2	24	74

[†] Includes those with pre and post data on this item.

Table D-11 (Continued)
Distribution of Responses for Statements about Beliefs about Science Teaching†

	N	Percent of Respondents					
		Strongly Disagree	**Moderately Disagree**	**Slightly Disagree**	**Slightly Agree**	**Moderately Agree**	**Strongly Agree**
Q4I: Students should do hands-on activities after they have learned the related science concepts.	51	18	22	20	18	14	10
Q4J: Teachers should provide students with opportunities to apply the concepts they have learned in new or different contexts.	51	0	0	0	8	16	76
Q4K: Teachers should have students do interesting hands-on activities, even if the activities do not relate closely to the concept being studied.	51	12	14	27	22	16	10
Q4L: Students should have opportunities to connect the concept they are studying to other concepts.	51	0	0	0	4	14	82
Q4M: Students should consider evidence that relates to the science concept they are studying.	51	0	0	0	2	35	63
Q4N: Teachers should provide students with the outcome of an activity in advance so students know they are on the right track as they do the activity.	51	67	20	8	2	4	0
Q4O: When students do a hands-on activity and the data don't come out right, teachers should tell students what they should have found.	51	18	20	25	20	12	6
Q4P: Students should know what the results of an experiment are supposed to be before they carry it out.	51	65	20	12	0	2	2

† Includes those with pre and post data on this item.

Table D-12
Distribution of Responses for Statements about Citizen Science Research†

	N	Percent of Respondents							
		Irrelevant	Not true of me now			Somewhat true of me now			Very true of me now
Q11A: I don't even know what citizen science research is.	53	4	32	8	13	26	0	2	15
Q11B: I have very limited knowledge about citizen science research.	53	0	11	11	11	28	9	11	17
Q11C: I would like to know the effect of implementing citizen science research on my professional status.	52	6	6	8	4	25	17	13	21
Q11D: I would like to know how my teaching or administration is supposed to change with citizen science research.	53	4	4	4	6	28	23	15	17
Q11E: I am completely occupied with other things.	53	15	23	11	6	25	9	4	8
Q11F: I would like to know what the use of citizen science research will require in the immediate future.	53	0	4	2	2	23	26	11	32
Q11G: I would like to have more information on time and energy commitments required by citizen science research.	52	2	4	4	4	27	15	12	33
Q11H: I would like to know how my role will change when I am using citizen science research.	53	0	2	4	2	26	19	19	28

Table D-13.1
Respondents Indicating that They Participated in a Professional Learning Community during the 2012-13 School Year

	Percent of Respondents (N = 53)	
	No	Yes
Q12: During the 2012-13 school year, did you participate in a professional learning community (PLC) or team?	51	49

Table D-13.2
Distribution of Responses for Statements about Beliefs about Professional Learning Communities[†]

		Percent of Respondents					
	N	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q13A: Members of our PLC/T have a shared understanding of the purpose of the PLC/T.	24	0	0	0	21	38	42
Q13B: Members of our PLC/T have a shared understanding of the structure and function of the PLC/T.	24	0	4	0	17	54	25
Q13C: Members of our PLC/T have a shared vision for increasing student achievement.	24	0	0	0	21	29	50
Q13D: Our PLC/T has a set of norms that are consistently followed at our meetings (i.e., expectations and processes to which members hold themselves and each other accountable).	24	0	4	13	13	38	33
Q13E: Members of our PLC/T work together to seek knowledge, skills, and/or strategies to increase student achievement.	24	0	0	4	21	29	46
Q13F: Members of our PLC/T participate in peer observations and offer feedback as a way to improve our teaching.	23	17	9	9	30	13	22
Q13G: Members of our PLC/T collaboratively analyze student work to improve teaching and learning.	24	4	8	8	29	21	29

[†] Includes those participants who indicated participating in a professional learning community/team during the 2012-13 school year in *Q12*.

Table D-13.2 (Continued)
Distribution of Responses for Statements about Beliefs about Professional Learning Communities†

		Percent of Respondents					
	N	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Q13H: As an individual teacher, our PLC/T prompts me to regularly think about how my instructional practices affect student achievement.	24	4	0	4	13	46	33
Q13I: I have made changes to my classroom teaching as a result of the work we have done in our PLC/T.	24	4	4	4	21	38	29
Q13J: Our PLC/T is provided with sufficient time during the school day/school year to meet as a team.	23	13	9	13	9	35	22
Q13K: Members of our PLC/T regularly attend PLC/T meetings.	24	4	0	8	13	29	46
Q13L: Our principal understands the purpose of the PLC/T.	24	4	4	8	21	25	38
Q13M: Our principal understands the structure and function of the PLC/T (e.g., Who participates in the PLC/T? Who leads/organizes the PLC/T? What are the various roles for members of the PLC/T?).	24	4	4	17	17	33	25
Q13N: Our principal is supportive of the work of our PLC/T.	24	4	4	4	21	17	50

† Includes those participants who indicated participating in a professional learning community/team during the 2012-13 school year in *Q12*.

Table D-14.1
Distribution of Responses for Statements about Grade-Specific Content Preparedness – Third Grade Teachers Prior to Institute

	Percent of Respondents (N = 18)			
	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Q14A Prior: Inheritance of traits from one generation to the next	28	56	11	6
Q14B Prior: The difference between inherited traits and learned behavioral traits	22	50	17	11
Q14C Prior: Relationships between physical features of plants and animals and the environments where they live	17	28	39	17
Q14D Prior: The effects of organisms' characteristics on survival and reproduction in particular environments	17	44	28	11
Q14E Prior: Relationships between plant and animal life cycles and survival in particular environments	11	33	33	22
Q14F Prior: Properties of Earth's nonliving resources	22	28	33	17
Q14G Prior: Rock formation and classification	22	33	22	22
Q14H Prior: Soil composition	22	39	28	11
Q14I Prior: Renewable and nonrenewable energy resources	17	39	39	6
Q14J Prior: How natural resources become limited and can be conserved	17	39	33	11
Q14K Prior: The definition and fundamental characteristics of matter	22	33	39	6
Q14L Prior: States of matter and their associated properties	6	17	56	22
Q14M Prior: The change of matter from one state to another	6	17	50	28
Q14N Prior: The definition and fundamental forms of energy	17	50	28	6

Table D-14.2
Distribution of Responses for Statements about
Grade-Specific Content Preparedness – Third Grade Teachers Now

	Percent of Respondents (N = 18)			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A Now: Inheritance of traits from one generation to the next	17	28	44	11
Q14B Now: The difference between inherited traits and learned behavioral traits	11	39	39	11
Q14C Now: Relationships between physical features of plants and animals and the environments where they live	6	11	50	33
Q14D Now: The effects of organisms' characteristics on survival and reproduction in particular environments	0	17	56	28
Q14E Now: Relationships between plant and animal life cycles and survival in particular environments	0	6	39	56
Q14F Now: Properties of Earth's nonliving resources	11	11	39	39
Q14G Now: Rock formation and classification	22	28	28	22
Q14H Now: Soil composition	22	28	33	17
Q14I Now: Renewable and nonrenewable energy resources	11	39	39	11
Q14J Now: How natural resources become limited and can be conserved	11	17	56	17
Q14K Now: The definition and fundamental characteristics of matter	0	11	44	44
Q14L Now: States of matter and their associated properties	6	0	28	67
Q14M Now: The change of matter from one state to another	6	0	22	72
Q14N Now: The definition and fundamental forms of energy	11	17	56	17

Table D-15.1
Distribution of Responses for Statements about
Grade-Specific Content Preparedness – Fourth Grade Teachers Prior to Institute

	Percent of Respondents (N = 14)			
	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Q14A Prior: The effects of the environment and environmental change on organism behavior and survival	36	21	29	14
Q14B Prior: How similarities and differences among organisms are used in different ways for classification	36	29	29	7
Q14C Prior: Extinct organisms and comparisons with organisms existing today	43	36	14	7
Q14D Prior: Earth's surface and landforms	29	7	36	29
Q14E Prior: The distribution of Earth's water	36	29	14	21
Q14F Prior: The effects of weathering, erosion, and deposition on earth materials and Earth's surfaces	36	7	29	29
Q14G Prior: Processes that change the size and shape of rocks	29	36	7	29
Q14H Prior: Creation of landforms by catastrophic events	29	36	7	29
Q14I Prior: Conservation of matter during physical changes	36	29	14	21
Q14J Prior: Transfers and transformations of energy	50	21	7	21
Q14K Prior: How energy transfer relates to temperature change	36	36	0	29
Q14L Prior: Electric circuits	29	43	14	14
Q14M Prior: Uses of energy in electric circuits	36	50	0	14

Table D-15.2
Distribution of Responses for Statements about
Grade-Specific Content Preparedness – Fourth Grade Teachers Now

	Percent of Respondents (N = 14)			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A Now: The effects of the environment and environmental change on organism behavior and survival	14	14	43	29
Q14B Now: How similarities and differences among organisms are used in different ways for classification	7	14	64	14
Q14C Now: Extinct organisms and comparisons with organisms existing today	0	36	57	7
Q14D Now: Earth's surface and landforms	0	7	43	50
Q14E Now: The distribution of Earth's water	14	14	50	21
Q14F Now: The effects of weathering, erosion, and deposition on earth materials and Earth's surfaces	0	7	50	43
Q14G Now: Processes that change the size and shape of rocks	0	14	50	36
Q14H Now: Creation of landforms by catastrophic events	7	21	43	29
Q14I Now: Conservation of matter during physical changes	7	0	50	43
Q14J Now: Transfers and transformations of energy	21	7	50	21
Q14K Now: How energy transfer relates to temperature change	7	29	36	29
Q14L Now: Electric circuits	0	14	50	36
Q14M Now: Uses of energy in electric circuits	0	14	57	29

Table D-16.1
Distribution of Responses for Statements about
Grade-Specific Content Preparedness – Fifth Grade Teachers Prior to Institute

	Percent of Respondents (N = 14)			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A Prior: The relationships among producers, consumers, and decomposers in an ecosystem	29	43	7	21
Q14B Prior: The flow of energy through ecosystems	21	43	14	21
Q14C Prior: The solar system and properties of planets	29	36	21	14
Q14D Prior: The fundamental characteristics of the sun as a star	29	36	21	14
Q14E Prior: How Earth's motion causes day and night	14	36	29	21
Q14F Prior: The relationship of seasons to the tilt of Earth's axis and its orbit around the sun	14	29	43	14
Q14G Prior: The definition and measurement of speed	43	36	14	7
Q14H Prior: The relationships among force, gravity, and weight	21	57	0	21
Q14I Prior: How force strength and an object's mass affect it's change in motion	29	43	14	14
Q14J Prior: How light travels and interacts with objects	36	36	14	14
Q14K Prior: Sound production, travel, and pitch	36	29	21	14

Table D-16.2
Distribution of Responses for Statements about Grade-Specific Content Preparedness – Fifth Grade Teachers Now

	Percent of Respondents (N = 14)			
	Not Adequately Prepared	**Somewhat Prepared**	**Fairly Well Prepared**	**Very Well Prepared**
Q14A Now: The relationships among producers, consumers, and decomposers in an ecosystem	0	7	50	43
Q14B Now: The flow of energy through ecosystems	0	14	43	43
Q14C Now: The solar system and properties of planets	0	14	71	14
Q14D Now: The fundamental characteristics of the sun as a star	0	29	50	21
Q14E Now: How Earth's motion causes day and night	0	7	50	43
Q14F Now: The relationship of seasons to the tilt of Earth's axis and its orbit around the sun	0	7	50	43
Q14G Now: The definition and measurement of speed	21	29	36	14
Q14H Now: The relationships among force, gravity, and weight	0	36	36	29
Q14I Now: How force strength and an object's mass affect it's change in motion	0	43	43	14
Q14J Now: How light travels and interacts with objects	7	29	43	21
Q14K Now: Sound production, travel, and pitch	0	21	57	21

Mid-Year Feedback Questionnaire

Table D-17
Respondents Indicating that They are Responsible for Planning and Delivering Science Instruction to One or More Classes (N = 42)

	Percent of Participants	
	Yes	No
Q5. Are you responsible for planning and delivering science instruction to one or more classes?	74	26

Table D-18
Participants'[†] Teaching Roles (N = 11)

	Percent of Participants
Computer or Technology Specialist	9
Intervention Specialist	27
Curriculum Coach	9
Other	55

[†] Only participants that are not responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-19
Time Spent by Participants'[†] Collaborating with Classroom Teachers to Plan Instruction using the FOSS Materials (N = 10)

	Percent of Participants
0 minutes	0
1–15 minutes	40
16–30 minutes	30
31–60 minutes	30
Greater than 60 minutes	0

[†] Only participants that are not responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-20
Participants'[†] Teaching Roles (N = 31)

	Percent of Participants
3rd grade teacher	32
4th grade teacher	29
5th grade teacher	13
Multi-grade teacher	23
Other	3

[†] Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-21
Number of Days Participants† Teach Science in a Typical Week (N = 31)

	Percent of Participants
1 day	0
2 days	0
3 days	16
4 days	35
5 days	48

† Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-22
Average Number of Minutes per Week Participants'† Spend Teaching Science (N = 28)

	Mean	Standard Deviation
Minutes per week teaching science	190.54	61.83

† Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-23
Average Number of Minutes Participants'†
Spend Teaching a Typical Science Lesson (N = 31)

	Mean	Standard Deviation
Minutes in a typical day's science lesson	43.87	13.40

† Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-24
Participants'† Indicating they Have Adequate Time to Teach Science (N = 31)

	Percent of Participants	
	Yes	No
Do you feel like you have adequate time to teach science?	45	55

† Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-25
Participants'† Perceptions of Preparedness to Teach
Science Using the Instructional Strategies in the FOSS Kits (N = 31)

	Percent of Participants
Not Adequately Prepared	0
Somewhat Prepared	45
Fairly Well Prepared	39
Very Well Prepared	16

† Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

Table D-26
Participants'[†] Indicating they have Skipped Lessons/Activities in their FOSS Kits (N = 31)

	Percent of Participants	
	Yes	**No**
Did you skip any lessons/activities in the FOSS kits you have used?	87	13

[†] Only participants that are responsible for planning and delivering science instruction to one or more classes are represented in this table.

APPENDIX E

Grade-Specific Content Assessment Items

Third Grade Content Assessment Items

Fourth Grade Content Assessment Items

Fifth Grade Content Assessment Items

Third Grade Content Assessment Items

1. A teacher asks her students to define “behavioral trait” on a quiz.

Which of the following answer choices is correct?

A. A trait an organism inherits from its parents (12%) (6%)

B. A trait an organism learns over time (82%) (76%)

C. A trait that an organism gets from its genetic material (6%) (6%)

D. A trait an organism has at birth (0%) (12%)

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2. A teacher points out to his students that flower petals have begun falling off the flowers of a plant. He then asks what will happen next in this plant’s life cycle?

Which of the following student responses is correct?

A. The plant will die. (35%) (53%)

B. Flower buds will form. (6%) (0%)

C. New flowers will grow. (6%) (0%)

D. The plant’s seeds will form. (53%) (47%)

---

3. A teacher asks her students about life cycles of plants and animals. Which of the following student responses is correct?

A. Only plants that make seeds have life cycles. (0%) (0%)

B. Only animals that produce eggs have life cycles. (0%) (0%)

C. Both plants and animals have life cycles. (59%) (24%)

D. All plants and animals complete a life cycle. (41%) (76%)

---

4. During a class discussion, a student says: **"plants and animals inherit all their traits from their parents."** Many other students agree.

What should the teacher do next to increase student understanding of traits?

A. Point out that only animals inherit traits from parents. (12%) (0%)

B. Describe experiments showing that seeds from tall plants tend to produce tall plants. (12%) (12%)

C. Explain that behavioral traits can be learned through interactions with the environment. (76%) (76%)

D. Affirm that the students are correct and move on to the next topic. (0%) (12%)

---

5. Students plant bean seeds and then construct a poster showing the order of different events of plant growth. Some students disagree about what event should come first after the planting of a seed.

Which of the following happens first as a plant grows from a seed?

A. The plant produces buds. (0%) (0%)

B. The plant grows true leaves. (0%) (6%)

C. A central stem begins to branch. (6%) (12%)

D. A root begins to grow. (94%) (82%)

6. A teacher shows students a cup of water at room temperature (20 degrees Celsius). She asks students what would happen to the volume of the water in the cup if it was heated to 80 degrees Celsius.

Which of the following is a correct student response?

- **A. The volume of the water in the cup would *go up* because water *expands* when heated. (24%) (41%)**
- **B.** The volume of the water in the cup would *go down* because water *contracts* when heated. (35%) (24%)
- **C.** The volume of the water in the cup would go up because water rapidly evaporates when heated. (12%) (6%)
- **D.** The volume of the water in the cup would stay the same. (29%) (29%)

---

7. During a discussion of how humans use saltwater and freshwater, a student makes the following statement:

"Freshwater is important to people only because we need to drink it, saltwater can be used for other purposes"

Many other students agree.

What should the teacher do next to advance the students' thinking about how humans use water?

- **A.** Have students research the most important types of saltwater fish that humans eat. (18%) (6%)
- **B.** Show students how availability of healthy drinking water has changed in different regions of the world. (65%) (71%)
- **C. Explain that freshwater is important to people because flowing water can be used to do work. (6%) (24%)**
- **D.** Affirm that the students understand how humans use water and move on to the next topic. (12%) (0%)

8. A teacher drops a small cube of ice into a small glass of water at room temperature. Students observe that the ice floats in the water. Next, the teacher asks her students to write a short explanation for why the piece of ice floats. One student writes:

   "The ice floats because it weighs less than the water in the glass."

   Which of the following ideas, if any, does this student appear to be missing?

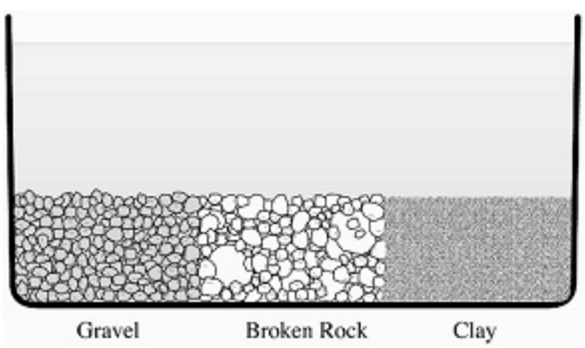
   A. The density of the ice is *less* than that of liquid water. (71%) (94%)

   B. The density of the ice is *greater* than that of liquid water. (6%) (0%)

   C. The shape of the ice piece determines whether it floats or sinks. (0%) (0%)

   D. None. The student appears to have an accurate understanding of why ice floats in liquid water. (24%) (6%)

9. During a lesson on water and Earth materials, a teacher shows students an aquarium with gravel, broken rock, and clay.



The teacher tells the students that he is going to pour water into the aquarium and asks, ***"which material will the water eventually seep into?"*** Which of the following student predictions is correct?

A. Water will seep into gravel *only*. (0%) (0%)

B. Water will seep into broken rock *only*. (0%) (0%)

C. Water will seep into gravel and broken rock *only*. (24%) (41%)

D. Water will seep into all three of these materials. (76%) (59%)

10. A teacher shows students two beakers:

Beaker 1: Red water at 10 degrees Celsius

Beaker 2: Blue water at 75 degrees Celsius

Next, the teacher gently pours the red and blue water into a single container and asks students to explain what they see. Which student explanation fits what is known about the properties of water?

- **A.** The red water moves to the bottom of the container because it *is heavier* than the warmer blue water. (18%) (12%)
- **B. The red water moves to the bottom of the container because it is *more dense* than the warmer blue water. (47%) (88%)**
- **C.** The red water moves to the bottom of the container because the warmer blue water evaporates at the surface. (0%) (0%)
- **D.** The red and blue water samples will mix to make purple water because temperature does not affect water density. (35%) (0%)

11. A teacher asks her students to name one measurement that, by itself, would determine the amount of matter in a rock? Which of the following student responses is correct?

- **A.** Measuring the height of the rock. (0%) (0%)
- **B.** Measuring the circumference of the rock. (0%) (0%)
- **C. Measuring the mass of the rock. (94%) (94%)**
- **D.** Measuring how much space the rock takes up. (6%) (6%)

12. A teacher asks her students, ***"which of the states of matter have a definite shape?"*** Which of the following student responses is correct?

- **A. Solids *only* (94%) (94%)**
- **B.** Solids and liquids *only* (6%) (6%)
- **C.** Liquids and gases *only* (0%) (0%)
- **D.** Solids, liquids, and gases (0%) (0%)

13. A student has two different containers: a small box and a large cup. On Day 1, she puts a 30 ml sample of a particular material in the box and observes that it fills the box and is box-shaped. The student then puts all of that material in the cup and observes that it is box-shaped, but does not fill the cup. She leaves the cup on her desk overnight.

The next day, the student notices that the material still does not fill the cup, but it has the same shape as the cup.

Which of the following could explain the change in the material's shape?

A. The material melted. (88%) (82%)

B. The material froze. (0%) (6%)

C. The material vaporized. (6%) (6%)

D. Nothing happened to the material. (6%) (6%)

---

14. During a discussion of matter, three students make the following statements about air:

Student 1: **Air is matter because it has a definite volume.**

Student 2: **Air is matter because it has mass.**

Student 3: **Air is *not* matter because it is mostly empty space.**

Which student statements are correct?

A. Student 1 *only* (12%) (0%)

B. Student 2 *only* (18%) (18%)

C. Student 3 *only* (12%) (6%)

D. Student 1 and 2 *only* (59%) (76%)

15. A teacher asks his students to describe the volume of liquids. Which of the following student responses is correct?

A. Liquids always fill up the entire volume of their container. (0%) (6%)

B. The volume of liquids depends on the shape of their container. (47%) (24%)

C. Liquids have a definite volume as long as the temperature does not change. (41%) (65%)

D. The volume of liquids is measured with a scale. (12%) (6%)

Fourth Grade Content Assessment Items

1. A teacher asks her students, ***"What can affect animals in a forest ecosystem?"*** One student responds,

"The animals are affected only by the other plants and animals that live there."

Based on this statement, what idea, if any, about interactions in ecosystems is the student missing?

A. Animals are affected by plants in an ecosystem, but not by other animals. (7%) (0%)

B. Animals are affected by other animals in an ecosystem, but not by plants. (7%) (0%)

C. Animals are also affected by nonliving things in an ecosystem. (86%) (100%)

D. None. The student appears to have a correct understanding of interactions in ecosystems. (0%) (0%)

2. A teacher has her students read the following passage:

Passage Turtles have hard shells for protection. When they sense danger, they can pull their arms, legs, and head into their shell.

She then asks students what this passage describes. Which of the following student responses is correct?

A. An animal's space (0%) (0%)

B. An animal's habitat (0%) (0%)

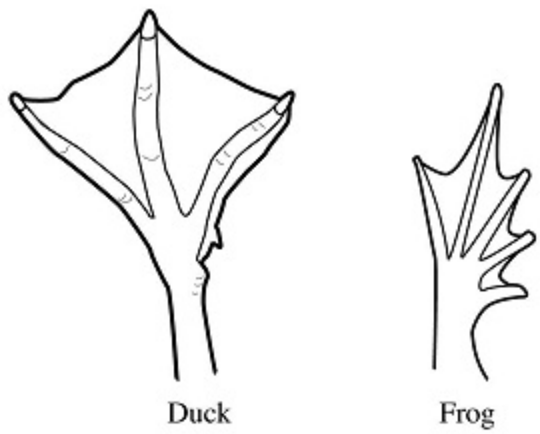
C. An animal changing habitats (0%) (0%)

D. An animal behavior (100%) (100%)

3. A teacher tells her students that crayfish live in water and like cool, dark places. What is the teacher describing?

- **A. The habitat of crayfish (86%) (93%)**
- **B.** The behavior of crayfish (7%) (7%)
- **C.** The functions of crayfish (7%) (0%)
- **D.** The structures of crayfish (0%) (0%)

4. A teacher shows his students the drawing below and explains that frogs and ducks both swim in water and have similar feet:



He then asks students to explain why these two types of animals have similar feet. Which of the following student responses is correct?

- **A.** The two animals must live in the same habitat. (14%) (14%)
- **B. The two animals use their webbed feet for a similar purpose. (86%) (86%)**
- **C.** All animals that swim in water have similar feet. (0%) (0%)
- **D.** There is no reason why. It just happened by chance. (0%) (0%)

5. On an exam, a teacher asks his students what plant part seeds form in.

Which of the following answer choices is correct?

- **A. The fruit (86%) (86%)**
- **B.** The stem (7%) (0%)
- **C.** The seedling (7%) (14%)
- **D.** The root (0%) (0%)

6. During a debate about how landforms change, one student claims that landforms change, but they only wear away and get smaller over time. Many other students agree with this claim.

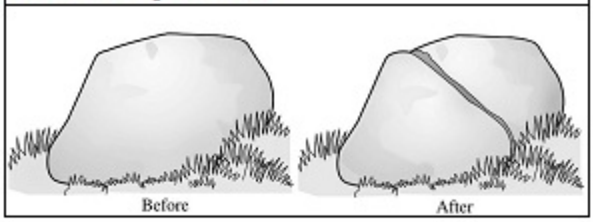
What should the teacher do to advance the students' understanding of landform changes?

- **A.** Show students a globe and explain that landforms do not change much and that the way they are today is the way they have always been. (7%) (7%)
- **B. Have students read a text book passage that describes deposition of eroded river bank material downstream. (36%) (36%)**
- **C.** Have students examine evidence that indicates the reduction of sand dunes by a series of storms. (43%) (57%)
- **E.** Move on to the next section of the lesson because the students indicate a correct understanding of landform change. (14%) (0%)

7. A teacher included the following question on a quiz about rocks:

Quiz Question

Look at the diagram below.



What processes most likely caused the change in the rock?

Which of the following answers is correct?

A. Erosion (0%) (0%)

B. Sedimentation (7%) (0%)

C. Weathering (93%) (100%)

D. Deposition (0%) (0%)

8. A teacher asks his students to define the term "erosion." Which of the following student responses is accurate?

A. Water moving over land (0%) (7%)

B. The slow flow of a glacier over land (7%) (0%)

C. Water seeping through Earth materials like sand and gravel (14%) (7%)

D. The movement of rocks and soil by natural forces like wind and water flow (79%) (86%)

9. During a discussion of Earth's surface, a student makes the following claim:

"Some changes to Earth's surface happen slowly, and other changes happen quickly."

What idea about changes to Earth's surface does this student seem to be missing?

A. Earth's surface does *not* change. (0%) (0%)

B. Changes to Earth's surface only happen *slowly*. (21%) (0%)

C. Changes to Earth's surface only happen *quickly*. (0%) (0%)

D. None, the student's claim is correct. (79%) (100%)

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10. A teacher plays a video for her students that shows large amounts of sand and soil settling in the bottom of a roadside ditch after a rainstorm. The teacher then pauses the video and asks her students to name the process by which materials settle in a new place.

Which of the following student responses is correct?

A. Weathering (0%) (0%)

B. Erosion (7%) (14%)

C. Deposition (86%) (86%)

D. Saturation (7%) (0%)

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11. A teacher asks his students to define "conductor." Which of the following student responses is correct?

A. Something that makes electric current (0%) (0%)

B. Something that provides the voltage that causes electric current to flow (0%) (0%)

C. Something that electric current can flow through easily (93%) (93%)

D. Something that electric current can flow through easily, but only in one direction (7%) (7%)

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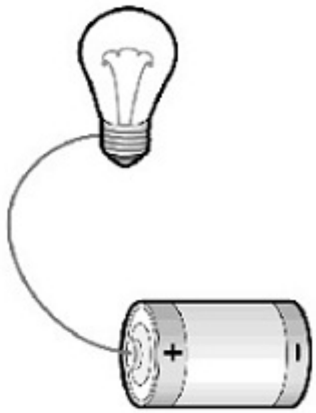
12. In a lesson on electricity, a student sets up the arrangement pictured below:



The student asks,

"Why isn't the bulb lighting up?"

Which of the following ideas would best address the student's question?

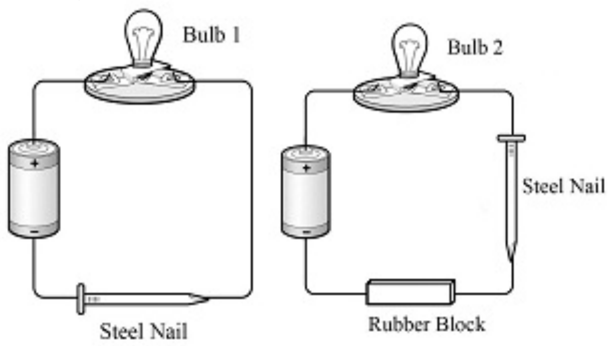
A. All electric circuits must have at least two wires for electric current to flow. (14%) (7%)

B. Electric components in an electric circuit need to be connected in a complete loop. (79%) (93%)

C. Materials that do not allow electric current to flow through them easily are called insulators. (0%) (0%)

D. A short circuit does not include any resistive components from one end of an electric energy source to the other. (7%) (0%)

13. A teacher tells her students that a steel nail is a conductor and a rubber block is an insulator. She then shows her students the two drawings below and asks them to predict which of the bulbs will light.



Which student response is correct?

A. Bulb 1 only (79%) (93%)

B. Bulb 2 only (7%) (0%)

C. Bulbs 1 and 2 (14%) (7%)

D. Neither bulb will light. (0%) (0%)

14. A teacher asks her students to compare electric current flow through insulators and conductors. Which of the following student responses is correct?

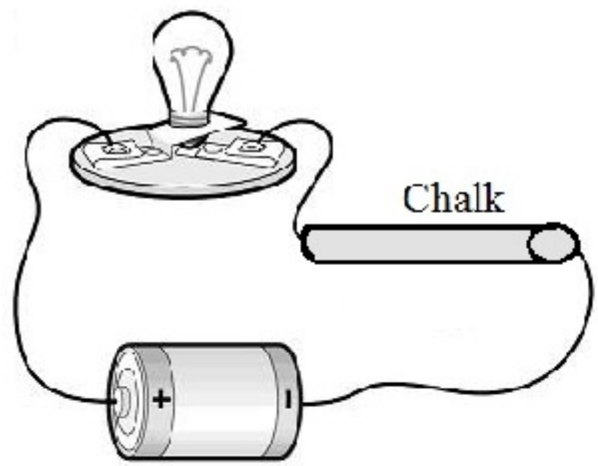
A. Electric current flows more easily through insulators. (7%) (0%)

B. Electric current flows more easily through conductors. (86%) (100%)

C. Electric current flows easily through both insulators and conductors. (7%) (0%)

D. Electric current does not flow easily through either insulators or conductors. (0%) (0%)

15. A teacher constructs the arrangement shown below, and her students see that the bulb does not light.



The teacher asks her students why the bulb does not light. Which of the following responses is correct?

A. **The piece of chalk does *not* allow electric current to flow and is an *insulator*. (86%) (93%)**

B. The piece of chalk does allow electric current to flow and is an *insulator*. (14%) (7%)

C. The piece of chalk does *not* allow electric current to flow and is a *conductor*. (0%) (0%)

D. The piece of chalk does allow electric current to flow and is a *conductor*. (0%) (0%)

Fifth Grade Content Assessment Items

1. A teacher reads the following passage from a textbook aloud to her class:

Passage
Fungi, including molds and yeast, break down dead organisms and make necessary materials available to plants.

She then asks her students to use this information to decide what type of organisms fungi are. Which of the following student responses is correct?

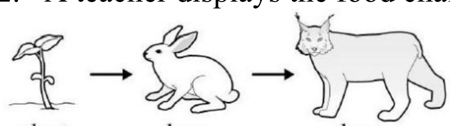
A. Producers *only* (0%) (7%)

B. Decomposers *only* (29%) (64%)

C. Producers and decomposers (57%) (21%)

D. There is not enough information to determine what type of organisms fungi are. (14%) (7%)

2. A teacher displays the food chain below for her students:



The teacher states:

"A type of lynx lives in Canada and preys on hares, which eat plants. What is most likely to happen if a predator that eats only lynxes enters the ecosystem?"

Which student response is correct?

A. The number of plants will increase. (7%) (14%)

B. The number of hares will increase. (57%) (71%)

C. The number of lynxes will increase. (7%) (0%)

D. The numbers of lynxes and hares will both decrease. (29%) (14%)

3. A teacher shows her students an empty, 10-gallon tank and asks, ***"What would you need to create a miniature ecosystem in this tank."*** One student makes the following list:

Frogs
Gravel
Insects
Soil
Snake

Sunlamp
Worms

What should the teacher do to advance this student's thinking about complete ecosystems?

- **A. Lead a class discussion about the role of producers in an ecosystem. (36%) (43%)**
- **B.** Have the student categorize each item on the list as either living or nonliving. (7%) (14%)
- **C.** Show the student an online video that highlights the impact of pollutants on ecosystems. (0%) (0%)
- **D.** Have the student give examples of how each organism on this list interacts with nonliving things. (57%) (43%)

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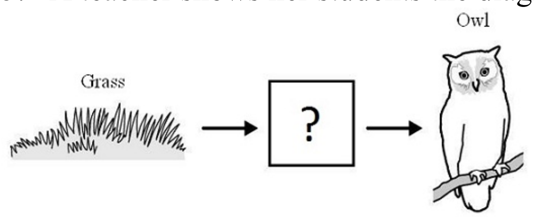
4. A teacher shows her students several pictures of crickets eating the leaves of living plants. She asks her students to identify what type of organism a cricket is. One student says,

"I think crickets are consumers."

Is the student correct?

- **A. Yes, crickets are consumers. (79%) (93%)**
- **B.** No, crickets are producers. (7%) (0%)
- **C.** No, crickets are scavengers. (14%) (7%)
- **D.** No, crickets are decomposers. (0%) (0%)

5. A teacher shows her students the diagram of a food chain below:



The teacher asks what kind of organism belongs in the square labeled "?" in the diagram. Which of the following student responses is correct?

A. An organism that is bigger than grass (0%) (0%)

B. An organism that eats owls (14%) (0%)

C. An organism that eats grass and is eaten by owls (86%) (100%)

D. An organism that decomposes both grass and owls (0%) (0%)

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6. During a discussion about our solar system, students described the planets. Which of the following student descriptions is accurate?

A. All the planets are different in size, but they all have one moon. (0%) (0%)

B. All the planets are the same size, but they have different compositions and surface features. (0%) (0%)

C. All the planets have the same composition, but are different in size and may have more than one moon. (0%) (0%)

D. All the planets differ in size, composition, and surface features. (100%) (100%)

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7. A teacher asks his students what objects are included in our solar system. Which student response is correct?

A. Planets *only* (0%) (0%)

B. Planets and their moons *only* (0%) (0%)

C. Planets, their moons, and comets that orbit the sun *only* (7%) (0%)

D. Planets, their moons, and comets and asteroids that orbit the sun (93%) (100%)

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8. During a discussion of the solar system, a teacher states that a day on Mars is about 25 hours. A student then asks:

"What determines how long a day is on Earth?"

Which of the following responses from other students is correct?

- **A. The time it takes Earth to rotate on its axis once. (71%) (93%)**
- **B.** The time it takes Earth to revolve around the Sun once. (21%) (7%)
- **C.** The time it takes the moon to travel around Earth once. (7%) (0%)
- **D.** The time it takes the Sun to travel across the sky from the eastern horizon to the western horizon. (0%) (0%)

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9. A student creates a poster about our solar system that includes the following statements:

planets are made of different materials

some planets orbit the sun and some do not

planets are all different distances from the sun

What idea does this student apparently not understand?

- **A.** Some planets have moons that orbit their planet (0%) (7%)
- **B.** Planets are different sizes, but they are composed of the same materials (0%) (0%)
- **C. All planets in the solar system orbit the sun (100%) (93%)**
- **D.** None. The student appears to have a correct understanding of planets (0%) (0%)

10. During a class discussion, a student states that only planets orbit the sun. Many other students agree. What should the teacher do next to advance the students' thinking about our solar system?

- **A.** Show students models that demonstrate that the planets' orbits are elliptical (21%) (36%)
- **B.** Challenge students to represent the relative distances the planets are from the sun (29%) (7%)
- **C. Point out a section of the textbook explaining that many moons, comets and asteroids also orbit the sun (36%) (43%)**
- **D.** Move on to the next topic. The students appear to have a correct understanding of objects that orbit the sun. (14%) (14%)

11. During a unit that includes scientific modeling, students construct models of a local ecosystem. Then, during a discussion of their ecosystem models, a student makes the following statement:

"A good model of an ecosystem is used to show the different things in the ecosystem and how they interact."

Many other students agree.

What should the teacher do next to advance the students' understanding of scientific models?

- **A.** Have students describe different interactions they observe in their classmates' models (57%) (64%)
- **B. Explain that good ecosystem models can also be used to make predictions (21%) (21%)**
- **C.** Take the students on a field trip to the local ecosystem to check if it has each component included in their models (21%) (14%)
- **D.** Affirm that the students are correct and move on to the next topic (0%) (0%)

12. A teacher asks students about the relationship of scientific models to what they represent. Students make the following statements:

Student 1: **A good scientific model must be identical to the thing it represents in every way.**

Student 2: **A good scientific model must be identical to the thing it represents in every way except that it can be made out of different materials.**

Student 3: **A good scientific model must be identical to the thing it represents in every way except that it can be a different size.**

Student 4: **A good scientific model can be different from the thing it represents in either its size or the materials it is made of.**

Which student is correct?

- **A.** Student 1 (7%) (0%)
- **B.** Student 2 (21%) (7%)
- **C.** Student 3 (7%) (7%)
- **D. Student 4 (64%) (86%)**

13. During a discussion of scientific models, three students make the following statements:

Student 1: **Models can be used to explain how systems work**

Student 2: **Models can include both drawings and words**

Student 3: **Models can be drawings or objects, but do not include words**

Which student statements are correct?

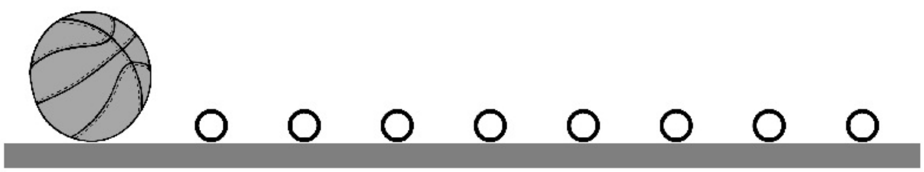
A. Student 1 *only* (7%) (7%)

B. Student 3 *only* (0%) (0%)

C. Students 1 and 2 (71%) (64%)

D. Students 1 and 3 (21%) (29%)

14. A student makes a simple model of the solar system by using a basketball to represent the sun. He then puts a series of ping pong balls in a line to represent each of the planets. The ping pong balls are spaced evenly about one foot apart from each other.



The student wants to use the model to compare how long it would take for a spaceship to travel between different planets. How should he change the model to help him make these comparisons?

A. He should paint the balls so that each ball looks more like the particular planet it represents. (0%) (0%)

B. He should add a scale-sized spaceship to the model to represent the spaceship traveling between the planets. (0%) (0%)

C. He should use different sized balls to represent the planets so that the relative sizes of the planets are represented. (21%) (14%)

D. He should spread the balls out differently so that the relative distances between the planets are represented. (79%) (86%)

15. In a class discussion, students make different statements about whether models of objects can be used to predict how the actual objects will behave in certain situations.

Which of the following student statements shows the best understanding of model use?

A. Models will behave like the objects behave because models are just like the objects they represent. (14%) (7%)

B. Predictions made with models can be useful, but models might not behave exactly like the objects because models are not just like the objects they represent. (79%) (86%)

C. Predictions made with models are not useful because models are not just like the actual objects. (7%) (0%)

D. Models are only useful for showing what objects are like, not for making predictions about how objects will behave. (0%) (7%)