MONTGOMERY COUNTY PUBLIC SCHOOLS

Evaluation of the Howard Hughes Science Grant Initiative, Year Two

Office of Shared Accountability

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Executive Summary for Howard Hughes Science Grant Initiative
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Background and Evaluation Questions

The Office of Shared Accountability in Montgomery County Public Schools (MCPS) is conducting a multiyear evaluation of the implementation and outcomes of a science professional development (PD) initiative at the elementary school level. The implementation and evaluation of this three-year program (2013–2014 through 2015–2016) are supported by a grant from the Howard Hughes Medical Institute (HHMI). The evaluation was requested by the Office of Curriculum and Instructional Programs. This report will document the status of implementation of HHMI grant components during the second year (2014–2015) of the program and provide feedback to relevant stakeholders for the program's improvement as well as its ongoing development.

The goal of the HHMI supported science initiative is to train one staff member within each of the elementary schools in the district to become a science lead teacher. The specific objectives of the second year of the HHMI grant project were to: a) deliver on-site coaching as follow-up to Cohort 1 participants who received a 5-day professional development opportunity during summer 2014; and b) to deliver professional development during summer 2015 to Cohort 2—approximately 120 elementary Grade K – 5 classroom teachers. For the second cohort, the professional development, called Science Institute Cohort (SIC), was held for two days during the summer of 2015 and will continue with three additional days of PD during the 2015−16 school year.

An additional goal of the HHMI grant initiative is to impact school science culture through these cohorts of trained elementary classroom teachers who can support science instruction in their schools. Further, it is expected that these trained teachers will bring ideas back to their schools to support science, technology, and engineering related school activities.

This is the second of three reports for the HHMI Grant. This report describes the outcomes of the training and support for Cohort 1 during year two (2014−2015 school year) obtained through a follow-up survey. Additionally, this report addresses the implementation of the summer PD (SIC) for Cohort 2 through feedback from pre- and post-training surveys. The summary of findings are arranged by each evaluation question.

Summary of Methodology

<u>Cohort 1 Sample</u>

Teacher PD Participants: Grade 2–5 classroom teachers (*N* = 68) attended the professional development held in summer 2014 in the first year of the grant.

Teacher Leaders: Teacher leaders (*N* = 21) participated in professional development during spring 2014 and then created and delivered the summer 2014 PD to other classroom teachers.

Cohort 2 Sample

SIC Participants: Grade K−5 classroom teachers (*N* = 91) attended the Cohort 2 (SIC) professional development during summer 2015.

Data Collection and Analysis

A nonexperimental design utilizing pre- and post-PD surveys, follow-up surveys, and review of program documents and records was applied. Specifically, an online follow-up survey was collected from 41 of the 68 Cohort 1 participants (60% response rate) and from 20 of the 21 Cohort 1 teacher leaders who developed and led the PD sessions. Additionally, a pre-training survey (n = 89) and post-training survey (n = 91) were collected from the 91 Cohort 2 professional development participants before and after their two-day PD in the summer of 2015. Descriptive statistics are provided for survey results; and comparisons, using paired t-tests and effect sizes (Cohen's *d*), between pre-, post- and follow-up surveys, are made where appropriate. In order for program staff to receive feedback and adjust accordingly, interim data summaries were provided after the summer training and follow-up surveys.

Summary of Key Findings

The findings are presented in two sections: Findings for the Cohort 1 PD participants and findings for the Cohort 2 PD participants.

Cohort 1: PD Participants and Teacher Leaders

Question 1. How were the PD activities (on-site coaching) supported by the HHMI grant implemented during the 2014−2015 school year?

Cohort 1 participants received 5 days of professional development (SSI) during the summer of Year 1 of the grant. Participants could volunteer to receive onsite coaching during the subsequent school year. Only 12 of the 68 Cohort 1 teacher participants requested an onsite coach visit. The five who provided survey feedback gave positive ratings about the coach and the help they received.

Question 2: What were the outcomes of the training and support provided by the HHMI grant for elementary classroom teachers and teacher leaders?

About three fourths of the Cohort 1 teacher and teacher leader respondents reported in the follow-up survey that the summer 2014 PD changed their science instruction a lot or a moderate amount and they shared their new knowledge with their grade level teams. There was also a statistical and practical difference in their comfort level rating for teaching science. Almost three fourths of teacher respondents reported that the science kits promoted effective instruction, which was a statistically significantly higher percentage than in the pre-survey. There was also a statistically significant increase in teacher leaders' reported time available for their own professional development between the pre-survey and follow-up survey. Finally, respondents reported teaching an average of two hours of science a week (slightly more among teacher leaders). Grade 4 teachers had a statistically significant increase in their amount of reported science instructional time compared to the prior year, and the effect size indicated the increase was of practical significance.

Cohort 2: Summer Institute Cohort Participants

Question 3: How were the PD activities for the Cohort 2 Science Institute Cohort (SIC) implemented?

A cadre of teacher leaders developed and administered the two-day SIC to teachers in kindergarten through Grade 5. Each grade level focused on a different NGSS practice (or two practices). Three additional PD sessions will be delivered during the 2015−2016 school year just prior to marking periods 2, 3, and 4.

Question 4: What were the characteristics of the Cohort 2 SIC participants and their perceptions of science instruction and culture in their classroom and at their school?

There were 91 participants in SIC which included kindergarten through Grade 5 teachers and a few other elementary level staff such as a Staff Development Teacher, a Special Education Teacher and a Consulting Teacher. More than one third of the participants had more than 10 years teaching experience, including teaching science. In the pre-SIC survey, about one half reported that time available for science PD, time available to plan, and availability of science resources were hindrances to effective science instruction. Many respondents elaborated that reading and math take precedence over science in their instructional day.

Question 5: What were the immediate outcomes of the Cohort 2 SIC?

At the end of the two-day SIC training, almost all participants reported they were very or somewhat knowledgeable about the three dimensions of NGSS and the NGSS practices; whereas the vast majority reported that they were not at all knowledgeable at the start of the training. Similarly, there was an increase in reported comfort level for implementing the learned practices. Participants reported positive experiences with the SIC, such as it was a comfortable environment, the trainers were knowledgeable and well-prepared, and learning about literacy connections in science was very helpful. More than one half reported that SIC had a major effect on their ability to use the science kits more effectively. Additionally, the most reported important aspects of the SIC were receiving ideas and resources related to the curriculum, learning about NGSS, and the connection between the two. Finally, most participants anticipated they would need online resources and materials over the next school year.

Future Plans and Recommendations

The second cohort of this Howard Hughes Grant will receive continued professional development on NGSS practices prior to marking periods 2, 3 and 4 during school year 2015−16. A follow-up survey of Cohort 2 participants is planned for the end of the 2015−16 school year to elicit participants' experiences of implementing the science practices in their classrooms.

The following recommendations are to provide feedback for the program's improvement and ongoing development and are based on findings from year two of the evaluation.

- Explore ways to increase participation in summer professional development such as SIC. In year two (2015−16), initial enrollment for SIC was at its maximum for most all grade levels; however, not everyone who signed up actually attended.
- Encourage more participants to share their new skills and knowledge with other teachers beyond their grade levels at their schools.
- Continue to explore ways to further expand the knowledge of practices and the skills for implementing lesson seeds using the practices. Especially focus on practices with lower knowledge and comfort ratings from the PD surveys (i.e., Practice 2 from the Cohort 1 follow-up and Practices 2, 3 and 6 in the Cohort 2 SIC).
- Continue to support participants in their skill development by offering online resources and specific examples and suggestions for implementing practices.

Evaluation of the Howard Hughes Science Grant Initiative, Year Two

Natalie L. Wolanin and Julie H. Wade, M.S.

The Office of Shared Accountability (OSA) in Montgomery County Public Schools (MCPS) is conducting a multiyear evaluation of the implementation and outcomes of a science professional development (PD) initiative at the elementary school level. The implementation and evaluation of this three-year initiative (2013–2014 through 2015–2016) are supported by a grant from the Howard Hughes Medical Institute (HHMI). The evaluation was requested by the Office of Curriculum and Instructional Programs (OCIP). This report will document the status of implementation of HHMI grant components during the second year of the initiative and provide feedback to relevant stakeholders for the program's improvement as well as its ongoing development.

Background

The long-standing partnership of MCPS with HHMI has supported the district's vision for science instruction—that all students achieve full STEM literacy through standards referenced, problem/project based instruction that develops critical thinkers who apply scientific and engineering practices to non-routine problems in a globally competitive society (MCPS, 2015). Grants from HHMI have allowed teachers to have access to PD and experiences that otherwise would not be possible or would be greatly restricted due to fiscal limitations of the school district.

The objective for the portion of the three-year HHMI grant addressed by this evaluation is to build the science content knowledge of elementary teachers and provide support for implementation of the updated elementary curriculum—Curriculum 2.0. Although Curriculum 2.0 maintains many of the scientific concepts and ideas present in the previous curriculum materials, the integration of science with other subject areas presents new challenges for elementary teachers. Furthermore, the Science, Technology, and Engineering (STE) office collected various forms of feedback from elementary teachers who expressed a need for resources and training to support the new curriculum, specifically related to science.

Concurrent with the implementation of Curriculum 2.0, Maryland adopted the *Next Generation Science Standards* (NGSS), which specifically focuses on scientific literacy for all students. To ensure the successful introduction of both Curriculum 2.0 and the NGSS, the science program recognizes that MCPS must align PD for teachers to Curriculum 2.0 and the NGSS. The PD will have an emphasis on students engaging with content, and teachers will be coached in the design and facilitation of opportunities for students to apply their content knowledge within the context of real world problems. HHMI grant efforts center on research-based, well-designed PD and instructional support to carry this vision forward. Learning components for the project include training teacher leaders, development and delivery of a summer training institute, and ongoing support and coaching to ensure sustainable transfer of content and pedagogy.

The goal of the HHMI supported science PD initiative is to train one staff member within each of the elementary schools in the district to become a science lead. An additional goal of the HHMI grant project is to impact school science culture through these cohorts of trained elementary classroom teachers who can support science instruction in their schools as well as bring ideas to support STE related school activities.

First Year of Grant

The specific objectives of the first year (2013−2014) of the HHMI grant project were to: a) provide approximately 20 teacher leaders with an increased understanding of targeted NGSS practices and the skills needed for them to create a training plan; and b) to deliver this knowledge to 100 elementary Grades 2−5 classroom teachers during a week-long professional development opportunity in summer 2014. Findings from these first year activities can be found in a previous report (Wolanin and Wade, 2015).

Second Year of Grant

The specific objectives of the second year (2014−2015) of the HHMI grant project were to: a) deliver on-site coaching as follow-up to Cohort 1 participants of the summer 2014 PD, b) provide opportunities for approximately 20 teacher leaders to create a training plan for Cohort 2; and c) to deliver this knowledge to approximately 120 elementary Grades K−5 classroom teachers during the summer 2015 Science Institute Cohort (SIC). This report focuses on the second year of the grant, which includes outcomes of the training and support for Cohort 1 obtained through a follow-up survey and addresses the implementation of the summer PD (SIC) for Cohort 2 through feedback from pre- and post-training surveys.

Design and Scope of the Study

Guskey's (2000) model for evaluating PD is used as a framework for measuring the impact of the PD components of the HHMI grant. Guskey describes five sequential levels to be addressed in an evaluation of PD.

- **Level 1: Participants' reactions**. Did they like it? Was it useful? Was the leader knowledgeable and helpful?
- **Level 2: Participants' learning**. Did participants acquire the intended knowledge and skills?
- **Level 3: Organization support and change**. Was implementation advocated, accommodated, facilitated, and supported?
- **Level 4: Participants' use of new knowledge and skills**. Did participants effectively apply the new knowledge and skills?
- **Level 5: Student learning outcomes**. What was the impact on students?

This year two evaluation addresses levels 1–4 of Guskey's model. The evaluation describes the implementation and impact on: a) Cohort 1: elementary classroom teachers who attended the week-long 2014 PD, whether or not they received onsite coaching during the school year, and b) Cohort 2: elementary classroom teachers who attended the two day summer 2015 SIC PD. A table displaying the four Guskey's levels and corresponding evaluation questions and activities can be seen in Appendix A. The evaluation for year two addresses the following questions:

Cohort 1: PD participants and teacher leaders

1. How were the PD activities supported by the HHMI grant implemented during the 2014−2015 school year? (on-site coaching delivered to Cohort 1)

2. What were the outcomes of the training and support provided by the HHMI grant for elementary classroom teachers? (i.e., perception, knowledge, and comfort level)

Cohort 2: Summer Institute Cohort (SIC) participants

3. How were the PD activities for the Year 2 Science Institute Cohort (SIC) implemented? (development and delivery of 2015 Science Institute)

4. What were the characteristics of the Year 2 SIC participants and their perceptions of science instruction and culture in their classroom and at their school?

5. What were the immediate outcomes of the Year 2 SIC? (i.e., perception, knowledge and comfort level)

Methodology

Since participation in the HHMI grant project is limited to a group of elementary teachers voluntarily signing up for professional development, a nonexperimental design utilizing multiple methods of data collection was applied. These data collection methods for the second year of the study included pre- and post-PD surveys, follow-up surveys, and review of program documents and records.

Study Samples

Three groups of teachers constitute the samples for this evaluation.

<u>Cohort 1</u>

- *PD Participants:* All 68 elementary classroom teachers for Grades 2–5 who attended the summer 2014 PD in the first year of the grant (2014−2015).

- *Teacher Leaders*: All 21 teacher leaders who participated in professional development during spring 2014 and then created and delivered the summer 2014 PD to other classroom teachers.

Cohort 2

- *SIC Participants*: All 91 SIC elementary classroom teachers for Grades K−5 who attended SIC during summer 2015 of the second year of the grant (2015−2016).

Data Collection Activities

Review of Program Documents, Training Records, and Materials

Program documents, training records, and materials were reviewed including session agendas, session handouts, and session attendance records to determine the content of the program and the extent to which it was implemented as planned.

Surveys

Based on program goals and objectives and PD materials and curricula, survey instruments were developed by OSA evaluators in collaboration with staff from OCIP. The following instruments were used during the second year of the evaluation.

Follow-up surveys of Cohort 1: PD teacher participants. Online follow-up surveys were sent in February 2015 to all 68 Cohort 1 PD participants; 41 completed a follow-up survey for a 60% response rate. Twelve of these participants who requested follow-up coach support during the school year were given additional questions in their survey about their experience with an STE coach; six of them completed a survey. Table 1 shows a breakdown of teacher roles among the follow-up survey respondents.

Table 1
Number and Percent of Follow-up Survey Respondents by Role in the School

	Cohort 1 Follow-up Respondents (N = 41)	
Current position	*n*	%
2nd grade teacher	8	19.5
3rd grade teacher	9	22.0
3rd/4th grade teacher	1	2.4
4th grade teacher	11	26.8
5th grade teacher	10	24.4
ESOL teacher	2	4.9

Data source. Cohort 1: Follow-up survey

Follow-up surveys of teacher leaders. Online follow-up surveys were sent to all 21 of the Cohort 1 teacher leaders in February 2015. Teacher leaders developed and delivered the summer 2014 PD to teacher participants after a series of workshops with staff in the STE office to expand their knowledge of NGSS. A total of 20 teacher leaders completed the follow-up teacher leader survey for a 95% response rate. Table 2 shows a breakdown of role/responsibility of the teacher leaders at the time of the follow-up survey and their grade/position assignment at the time of the 2014 PD.

Table 2
Role of Teacher Leader Survey Respondents

Teacher Leader Role	Current Position (N = 20)		Original Grade Level at 2014 PD (N = 20)	
	n	%	n	%
Kindergarten	1	5.0	0	0.0
2nd grade teacher	5	25.0	4	20.0
3rd grade teacher	6	30.0	6	30.0
4th grade teacher	2	10.0	5	25.0
5th grade teacher	3	15.0	5	25.0
Math Focus K–5	1	5.0	0	0.0
Assistant School Admin	1	5.0	0	0.0

Data source. Cohort 1: Teacher Leader Follow-up survey

Pre-training surveys of Cohort 2; SIC teacher participants: A pre-SIC survey was given to participants at the start of the Science Institute Cohort (SIC). A total of 89 of the 91 elementary staff completed pre-surveys (a 98% response rate).

Post-training surveys of Cohort 2: SIC teacher participants: A post-SIC survey was given to participants in their grade level breakout sessions at the end of the two-day SIC training. A total of 91 participants (a 100% response rate) completed post-surveys.

Note that surveys were not collected from teacher leaders during the second year of the grant since many of them were the same teachers from the first year.

Summary of Data Analysis

A nonexperimental design utilizing pre- and post-PD surveys, follow-up surveys, and review of professional development program documents and records was applied. Descriptive analyses and, where appropriate, paired t-tests and effect sizes were used to estimate the effect of the professional development on classroom teachers. Effect sizes using Cohen's d (Cohen, 1988) were calculated by taking the mean difference between pre- and post-survey (or pre- and follow-up surveys) divided by the pooled standard deviation. Cohen proposed the following guidelines for d: .20, .50, and .80 correspond to small, medium, and large effect sizes, respectively. Statistical significance measures the probability that results occurred by chance and effect size measures the magnitude of the differences. In order for program staff to receive feedback and adjust accordingly, interim data summaries were provided after the summer training and follow-up surveys.

Strengths and Limitations

A strength of this study is that almost all (95%) of the 21 Cohort 1 teacher leaders responded to the follow-up survey and almost all elementary teachers who participated in SIC (Cohort 2) completed a pre- and post-PD survey. Therefore, a comprehensive and representative picture of the experiences among these participants was obtained. Additionally, evaluators worked collaboratively with program staff on development of all surveys to ensure appropriate questions were asked. Furthermore, Cohort 1 survey data were collected at three time points—pre-PD, post-PD, and a follow-up in February, strengthening the findings of the evaluation.

A limitation of the study is that the response rate for the follow-up survey among Cohort 1 PD participants was 60%; therefore, non-respondents' experiences were not included. This low response rate also limited the extent to which comparisons about change could be made between responses from pre-surveys and follow-up surveys. Additionally, only 6 of the 12 participants receiving coaching services completed a follow-up survey. Finally, it should be noted that the implementation of the NGSS standards and science instructional time were not observed and are self-reported by the teacher participants.

Findings

The findings are presented in two sections. Findings related to each evaluation question for the Cohort 1 participants are organized under the first section, and findings related to each evaluation question for the Cohort 2 SIC participants are organized under the second section.

Findings Related to Follow-up Survey Among Cohort 1: PD Participants and Teacher Leaders

Cohort 1 teachers participated in a five-day PD held during summer 2014. The findings from that PD can be found in the Year One grant report (Wolanin and Wade, 2015). The HHMI Grant also supported these teachers during the subsequent school year by offering them voluntary onsite coaching, which several participants elected to receive. Note that this occurred after the first report. The Cohort 1 elementary teachers, as well as the trainers (i.e., teacher leaders), were administered a follow-up survey in February 2015 to measure the impact of their new skills and knowledge.

Question 1: How were the PD activities (on-site coaching) supported by the HHMI grant implemented during the 2014−2015 school year?

Teachers from Cohort 1, who participated in the 2014 summer PD, could volunteer to receive an on-site visit by an STE coach to provide support in any area of need pertaining to implementing the NGSS practices into the classroom. Out of the 68 Cohort 1 teachers, 12 requested an on-site coach visit. The twelve participants who requested on-site coaching were from 11 schools and were 2nd, 4th and 5th grade teachers.

Five of 12 teachers who were visited by an on-site coach (two of each for Grades 2, 4, and 5) responded to the survey. The teachers reported that they received on-site coaching in the following formats:

- Coach observed teacher during instruction plus a debriefing (n = 3).
- Coach met with teacher with no observation (n = 1).
- Teacher never met with coach, but reported exchanging emails with coach (n = 1).

Four of the five respondents reported that the coach helped them with NGSS practice-based instruction, and one also said the coach helped with the science kit implementation and other materials to extend learning.

Question 2: What were the outcomes of the training and support provided by the HHMI grant for elementary classroom teachers and teacher leaders?

Cohort 1 Follow-up Survey Respondents Who Received On-site Coaching

Perceptions of coaching session. The five respondents who received coaching gave positive ratings that the coach was knowledgeable and well-prepared, created a comfortable environment, answered questions adequately, improved skills that were addressed, and helped implement science instruction in the classroom (see Appendix B, Table B1).

All Cohort 1 Follow-up Survey Respondents

The follow-up online survey was completed by 41 of the 68 Cohort 1 teachers who attended the 2014 PD. The following findings are from the follow-up survey and comparisons to the pre- and post-summer PD surveys were made where appropriate.

Change in implementing science instruction. Respondents were asked to rate their change in implementing science instruction this school year since attending the 2014 PD (and receiving coaching, if applicable). One third reported they changed their instruction *a lot,* and another 45% reported a *moderate amount* (Table 3). No one reported *no change at all*.

Table 3
Change in Implementation of Science Instruction
Reported by Cohort 1 Follow-up Survey Respondents

Change in Science Instruction from 2014 to 2015	Follow-up Survey Respondents (N = 40)	
	n	%
Changed a lot	13	32.5
Changed a moderate amount	18	45.0
Changed a little	9	22.5
No change at all	0	0.0

Data source. Cohort 1: Follow-up survey

Ways instruction changed. Participants were asked in what ways they had changed their science instruction. Almost three fourths (73%) reported that they modified a lesson seed using the practice “planning and carrying out investigations” (Table 4). This practice was a focus for the Grades 2−4 teachers during PD, and a slightly higher proportion of Grades 2–4 teachers (76%) reported this change in their classrooms versus Grade 5 teachers (70%). Only 39% of follow-up survey respondents reported that they modified a lesson seed using the practice “developing and using models,” which was a focus for the Grade 5 teachers during PD and, understandably, a slighter higher proportion of Grade 5 teachers (50% vs 38%) reported using the practice.

More than one half of the Cohort 1 follow-up survey respondents reported that they spent more time on science instruction (59%) and used more technology (56%) compared with before the PD. When disaggregated by grade level, a much higher percentage of Grade 5 teachers (80%) than Grades 2−4 teachers (52%) reported that they use more technology in science instruction. It should be noted that the district implemented the use of Chromebooks in Grades 3 and 5 during 2014−2015, and the Grade 5 team specifically integrated more technology into their summer training plans, which could explain their higher usage of technology in science instruction.

Table 4
Science Instruction Changes Reported by Cohort 1 Follow-Up Survey Respondents

	Total Respondents (N = 41)		Grades 2–4 (N = 29)		Grade 5 (N = 10)	
Specific changes reported from 2014 to 2015	*n*	%	n	%	n	%
Modified a lesson seed using the practice "Planning and Carrying Out Investigations"	30	73.2	22	75.9	7	70.0
More time spent on science instruction	24	58.5	18	62.1	4	40.0
More technology used in science instruction	23	56.1	15	51.7	8	80.0
Modified a lesson seed using the practice "Developing and Using Models"	16	39.0	11	37.9	5	50.0
Utilized formative assessment probes	17	41.5	10	34.5	6	60.0
Increased use of MCPS science kits	16	39.0	14	48.3	2	20.0

Note. Findings from ESOL teachers' follow-up surveys were not disaggregated due to the low sample (N = 2).
Data source. Cohort 1: Follow-up survey

Sharing new skills and knowledge. When asked how they shared their new skills and knowledge, more than two thirds of respondents (68%) reported that they shared at a grade level meeting. Some also shared with a science or STEM committee (20%), at a staff meeting (5%), and other ways (7%). Fifteen percent reported they did not share with anyone (Table 5).

Table 5
Sharing New Skills and Knowledge
Reported by Cohort 1 Follow-Up Survey Respondents

	Total Follow-up Survey Respondents (N = 41)	
Sharing New Skills and Knowledge	n	%
Shared at a grade level meeting	28	68.3
Shared with the Science or STEM committee	8	19.5
Have not shared with anyone (yet)	6	14.6
Shared at a schoolwide staff meeting	2	4.9
Other: shared with admin, other teachers, my team was there	3	7.3

Data source. Cohort 1: Follow-up survey

Time spent on science instruction. The mean number of minutes for science instruction reported by respondents in spring 2015 was 137 minutes per week. Table 6 shows that this was higher than the mean reported before the 2014 PD (120 minutes) with a small effect size (d = .28); however, a paired-sample t-test revealed no statistically significant difference in the average time before and after PD for all participants, t (37) = 1.522, p>.05. Analysis by grade level showed a large effect size (d = 0.87) and a statistically significant difference in Grade 4 science instructional time with an average of 123 minutes reported in the pre-survey compared to 173 minutes in the follow-up survey, t (10) = 2.269, p<.05.

Table 6
Average Weekly Minutes of Science Instruction Reported
by Cohort 1 Respondents: Pre-PD and Follow-up

	Pre Survey (N = 38)		Follow-up Survey (N = 38)			
Science Instructional Time from 2014 to 2015	Mean	SD	Mean	SD	Mean Diff.	ES
Average weekly minutes taught science	119.87	61.09	136.84	59.95	16.97	0.28

Note. ES = Effect Size
Note. Statistical comparison of means revealed the difference as not significant (p > .05).
Data source. Cohort 1: Pre-PD and Follow-up surveys

Comfort level with subject areas. Cohort 1 teachers were asked in the follow-up survey to rate their comfort level teaching science and three other subject areas for comparison. Eighty percent of respondents reported they were extremely or very comfortable teaching science (Table 7). This compares to 80% extremely or very comfortable teaching reading, 90% teaching math, and 76% teaching social studies.

Table 7
Subject Area Comfort Level Reported by Cohort 1 Follow-up Survey Respondents

	Extremely/Very Comfortable		Somewhat Comfortable		Not at All/Slightly Comfortable	
	n	%	*n*	%	*n*	%
Mathematics (*N* = 40)	36	90.0	4	10.0	0	0.0
Science (*N* = 40)	32	80.0	8	20.0	0	0.0
Reading/Language Arts (*N* = 39)	31	79.5	8	20.5	0	0.0
Social Studies (*N* = 38)	29	76.3	7	18.4	2	5.3

Data source. Cohort 1: Follow-up survey

Comfort level with subject areas comparing follow-up to pre-PD survey. When the follow-up responses of teacher participants' ratings of their comfort level teaching science and three other subject areas were compared with their ratings before the 2014 PD, a statistically significant increase in the mean rating for comfort level of teaching science was found; teachers were statistically significantly more comfortable teaching science one year after the 2014 PD (Table 8). The mean difference was .64, $t(38) = 5.665$, $p < .01$. A medium effect size ($d = .78$) indicated that the difference was of practical significance. Additionally, a statistically significant increase was found in the comfort level of teaching social studies since the summer PD, with a mean difference of .37, $t(35) = 2.499$, $p < .05$; a small effect size was found ($d = .42$).

Table 8
Subject Area Comfort Level Reported by Cohort 1 Respondents: Pre- and Follow-up

	Pre-Survey			Follow-up Survey				
Subject area	N	Mean	SD	N	Mean	SD	Mean Diff.	ES
Mathematics	39	4.10	.882	39	4.33	.662	.23	.29
Science	39	3.54	.884	39	4.18^{**}	.756	.64	.78
Reading/Language Arts	36	4.06	.893	36	4.25	.732	.19	.23
Social Studies	36	3.69	.786	36	4.06^{*}	.960	.37	.42

*p< .05, **p<.01

Note: A scale of 1 to 5 was used where 1 = Not at all comfortable and 5 = Extremely comfortable.
Note. ES = Effect Size
Data source. Cohort 1: Pre-and Follow-up surveys

School culture among Cohort 1 follow-up respondents. Teacher respondents were asked questions regarding science culture at their school, such as factors that hindered or promoted effective instruction. Responses varied greatly; however, 70% reported that the science kits promoted their effective instruction (Table 9). Time (for both PD and planning) was reported as a hindrance by a similar number of participants as those who reported it as promoting effective instruction.

Table 9
School Science Culture Reported by Cohort 1 Follow-up Survey Respondents

	Total Cohort 1 Follow-up Survey Respondents (N = 40)							
	Hindered Effective Instruction = 1/2[a]		Neutral = 3		Promoted Effective Instruction = 4/5[b]		Don't Know	
Aspects of School Culture	*n*	%	*n*	%	*n*	%	*n*	%
Contents of materials in the science kits	4	10.0	8	20.0	28	70.0	0	0.0
Availability of other science resources such as books or materials to support curriculum instruction.	9	22.5	14	35.0	17	42.5	0	0.0
Time available for your own science Professional Development (outside of planning).	14	35.0	10	25.0	16	40.0	0	0.0
Time that was available for you to plan, individually and/or with colleagues.	14	35.0	10	25.0	16	40.0	0	0.0
Importance that your school places on science.	8	20.5	16	41.0	14	35.9	1	2.6
Administrative support that was provided.	5	12.5	22	53.7	11	26.8	2	4.9
Parent expectation and involvement.	2	5.0	27	67.5	6	15.0	5	12.0

[a]Ratings 1 and 2 on a 5-point scale were combined, where 1 = hindered effective instruction.
[b]Ratings 4 and 5 on a 5-point scale were combined, where 5 = promoted effective instruction.
Data source. Cohort 1: Follow-up survey

Teachers were asked if there was anything else that hindered their science instruction this school year. Similar comments were reported regarding time and materials. Comments can be seen in Appendix B.

School culture comparing follow-up to pre-survey. Using a 5-point scale, where 1 = Hindered Effective Instruction and 5 = Promoted Effective Instruction, the mean ratings in the follow-up survey were compared to ratings prior to the 2014 PD. Statistically significantly higher ratings were found for time available for professional development (a mean difference of .62, $t(39) = 2.502$, $p < .05$) and the science kits (with a mean difference of .80, $t(39) = 3.937$, $p < .05$). Furthermore, the mean difference in time available for PD and science kits both showed practical significance with small and medium effect sizes of $d = .49$ and $d = .64$ respectively (Table 10).

Table 10
School Science Culture Reported by Cohort 1 Respondents: Pre- and Follow-up

	Pre-Survey			Follow-up Survey				
Aspect of School Culture	N	Mean	SD	N	Mean	SD	Mean Diff	ES
Parent expectation and involvement	32	3.25	0.803	32	3.22	0.706	-.03	.04
Administration support that was provided	36	3.17	0.697	36	3.25	0.906	.08	.10
Time available to plan individually or with colleagues	40	2.75	1.373	40	3.05	1.518	.30	.21
Time available for your own PD	40	2.58	1.059	40	3.20*	1.454	.62	.49
Importance that your school places on science	35	3.20	1.158	35	3.37	1.190	.17	.14
Contents of materials in science kits	40	3.10	1.429	40	3.90*	1.033	.80	.64
Availability of other science resources	39	2.95	1.337	39	3.36	1.158	.41	.33

*p < .05
Note. Scale 1 to 5 was used where 1 = Hindered Effective Instruction and 5 = Promoted Effective Instruction.
Note. ES = Effect Size
Data source. Cohort 1: Pre-PD and Follow-up surveys

STEM activities among follow-up respondents. Respondents were asked in the follow-up survey to indicate what school activities they had done or were planning to do during the school year. Only one response per school is shown in Table 11a. If one respondent indicated he or she had offered or was planning to offer an activity, it is reported. Just under two thirds (63%) of the respondents reported their school offered, or is planning to offer, an after school program for science or engineering during the school year. More than one half (56%) reported holding a family science night or event, or are planning to, and just under one half (47%) reported they visited, or are planning a visit, to a science or engineering site. Examples of other reported activities are shown in Table 11b.

Table 11a
School Participation in STEM Activities Reported by Cohort 1 Follow-up Survey Respondents

		Total Cohort 1 Responses (*N* = 32)					
		Yes		Plan to		Not this Year	
STEM School Activities	*N*	*n*	%	*n*	%	*n*	%
Offer after school programs for science and/or engineering enrichment.	30	17	56.7	2	6.7	11	36.7
Offer one or more science and/or engineering clubs.	30	13	43.3	1	3.3	16	53.3
Hold family science and/or engineering nights/events.	30	10	33.3	7	23.3	13	43.3
Visit to science/engineering sites.	30	9	30.0	5	16.7	16	53.3
Sponsors meeting with science or engineering professionals.	30	7	23.3	4	13.3	19	63.3
Host AAAS volunteers in your science classrooms.	30	5	16.7	1	3.3	24	80.0
Other science or engineering activities outside of classroom instruction.	24	5	20.8	1	4.2	18	75.0
Participant in local or regional science or engineering fair/event.	31	3	9.7	6	19.4	22	71.0

Note. Only 1 response is reported per school. If one respondent indicated he or she offered or were planning to offer an activity, it is reported.
Data source. Cohort 1: Follow-up survey

Table 11b
Examples of Other STEM Activities Reported by Cohort 1 Follow-up Survey Respondents

Examples of Other Activities Mentioned (*N* = 10)

- Students attend a STEM special each week.
- Sponsored a Caine's Arcade at our school.
- Implemented a weekly STEM activity for students not participating in chorus.
- The STEM Committee is planning "Rocky's Rockin' Arcade," which is modeled after Caine's Arcade.
- Students created a mural using thousands of bottle tops.
- The 4th grade has participated in the NOAA sponsored grant, Our Neighborhood, Our Watershed (ONOW). Also Salad Science.
- Croydon Creek for Soil Sleuth, portable planetarium came to the school and PTA is having a science assembly.

Elaborations on list of choices

- Hoping to do a career day with some scientists.
- Our school has a Hands on Science club, an Environmental Club, and has participated in numerous science-based assemblies and field trips throughout the year. (Such as Mad Science, Robotics, etc.)
- We have PTA-sponsored science classes offered all year.

Data source. Cohort 1: Follow-up survey

STEM activities comparing follow-up and pre-survey. To examine whether additional STEM activities were implemented in the schools after PD participation, responses to the pre-PD survey and follow-up survey were compared. Thirty percent of school level responses from the follow-up survey reported they visited (or plan to visit) a science or engineering site this year when they didn't last year. Most all the other activities shown in Table 12 had 20−23% of the school level respondents indicating they offered, or were planning to offer, the activity this school year but didn't last year.

Table 12
STEM School Activities Added in Current Year by
Cohort 1 Pre- and Follow-up Survey Respondents

	Held Activity This Year and Not Last Year		
STEM School Activities	*N*	*n*	%
Visit to science/engineering sites.	30	9	30.0
Sponsors meeting with science or engineering professionals	30	7	23.3
Offer after school programs for science and/or engineering enrichment	31	7	22.6
Host AAAS volunteers in your science classrooms	29	6	20.7
Hold family science and/or engineering nights/events	30	6	20.0
Offer one or more science and/or engineering clubs	30	6	20.0
Participant in local or regional science or engineering fair/event	29	4	13.8

Note. Only 1 response is reported per school. If one respondent indicated he or she offered or were planning to offer an activity, it is reported.
Data source. Cohort 1: Pre-PD and Follow-up surveys

Follow-up Survey of Cohort 1 Teacher Leaders

The online follow-up survey was completed by 20 cohort 1 Teacher Leaders who are also elementary classroom teachers. This cadre of teacher leaders had their own professional development on NGSS prior to developing and delivering the 2014 summer PD. The following findings are from the follow-up survey of the teacher leaders, and comparisons to pre- and post-surveys were made where appropriate.

Change in implementing science instruction. Teacher leaders were asked to rate their change in implementing science instruction this school year since before receiving any PD on the HHMI Grant. More than half (53%) of those teaching the same grade level reported they changed their instruction *a lot,* and another 27% reported a *moderate amount (*Appendix C, Table C1*).*

Ways instruction changed. All the teacher leaders were asked in what ways they had changed their science instruction. More than two thirds (67%) reported an increased use of science kits. More than half reported they modified a lesson seed using the practice "planning and carrying out investigations" (61%); spent more time on science instruction (56%); and utilized formative assessment probes (56%). Half reported they used more technology in the classroom (50%). This can be seen in Appendix C Table C2.

Sharing new skills and knowledge. When asked if they shared their new skills and knowledge with others at their school, 85% of the teacher leaders reported that they have shared at a grade level meeting; two fifths shared at a schoolwide staff meeting, and just over one third shared with the science or STEM committee (Appendix C, Table C3).

Science instruction time. The mean average weekly time spent on science instruction this year (135 minutes) was higher than the mean reported at the end of their professional development last year (114 minutes). A paired-sample t-test revealed no statistically significant difference in the average time before and after the PD, t (14) = 1.079, p>.05; however, there was a small effect size of d = .37 (Appendix C, Table C4).

Comfort level with course subjects among follow-up respondents. Teacher leaders were asked to rate their comfort level teaching various subjects using a 5 point scale where 1 = Not at all comfortable and 5 = Extremely comfortable. When compared to the mean rating in the pre-survey, before their professional development, a statistically significant increase was found for the comfort level of teaching science (Appendix C, Table C5). The mean difference was .59, t(16) = 3.405, p < .05 with a large effect size of d = 1.17, indicating the difference was of practical significance.

School culture among follow-up respondents. Teacher leader respondents rated various aspects of school science culture in terms of whether they hindered or promoted effective instruction using a 5-point scale. When mean ratings in the follow-up teacher leader survey were compared to mean ratings prior to their professional development, time available for their own professional development had a statistically significantly higher mean rating, with a large effect size (d = 2.47), in the follow-up survey, t(13) = 2.879, p < .05 (Appendix C, Table C6).

STEM activities comparing follow-up and pre-survey. When results were compared to the same teacher leaders' answers on the pre-survey (referring to last school year), 40% offered (or plan to offer) science or engineering clubs this year when they didn't last year; 35% offered (or plan to visit) a science or engineering event this year when they didn't last year; and 25% sponsored a meeting with a science or engineering professional when they didn't last year.

Professional growth among teacher leaders. Teacher leaders were asked in an open ended question if they had grown professionally as a result of their science lead teacher role, and if so, to elaborate. A summary of these responses is below. The most frequent responses had to do with a better understanding of NGSS standards in general and implementing the specific standards they learned about into their instruction.

- Better understanding of standards and implementing in classroom (n = 7)
    - (e.g., more hands-on explorations, better at carrying out investigations, deeper understanding of the standards, creating meaningful tasks for students, better teacher)
- Learned a lot about training adults and professional development (n = 4)

- Share with other teachers more effectively and enthusiastically (n = 3)
- More access to resources (n = 3)
- Part of a community of collaborative teachers (n = 2)
- More science leadership roles at school/more confidence as a science leader in building (n = 2)

Findings Related to Cohort 2: 2015 Summer Institute Cohort (SIC) Participants

Question 3: How were the PD activities for the Year 2 Science Institute Cohort (SIC) implemented? (development and delivery of 2015 Science Institute).

A cadre of teacher leaders worked through spring 2015 to develop a professional development plan to be delivered across two days in the summer (the SIC) and will continue to develop and deliver three "just in time" PD sessions during the 2015−16 school year. There will be one PD prior to the 2nd, 3rd, and 4th marking periods. Two to three teacher leaders were assigned to deliver the SIC for each of the grade levels, K−5. The teacher leaders for Grades 2−5 were also trainers for the first cohort during the 2014 summer PD.

The two-day PD was held in a district's elementary school, and participants from each grade level met in a different room. Each grade level focused on one or two NGSS practices and will focus on a different practice during each of the subsequent "just in time" PD sessions. A summary of the PD activities and a chart showing the specific NGSS practices that each grade level focused on during the summer PD can be found in Appendix D.

Before the PD was held, information about the PD was communicated to elementary teachers by a brochure that was sent to all elementary classroom teachers, as well as by posting the opportunity on the MCPS training registration system (PDO). This may be seen in Appendix E.

Question 4: What were the characteristics of the Year 2 SIC participants and their perceptions of science instruction and culture in their classroom and at their school?

A pre-survey (n = 89) and post-survey (n = 91) were collected from the 91 Cohort 2 PD participants before and after their two-day PD in the summer of 2015.

Characteristics of SIC participants. Table 13 shows the characteristics of the PD participants. The teacher participants varied among elementary grade levels with slightly more kindergarten teachers (22%) and somewhat fewer Grade 5 teachers (8%). Also, there were a few non-grade level staff. Teachers had a range of experience, with more than one half (60%) having taught more than five years at MCPS and 64% with more than five years teaching science. Furthermore, 57 elementary schools were represented at the PD, and up to five staff members from each school attended.

Table 13
Cohort 2 PD Participants' Characteristics

Characteristics	Total SIC Participants (N = 91) *n*	%
Role		
Kindergarten Teacher	20	22.0
Grade 1 Teacher	15	16.5
Grade 2 Teacher	17	18.7
Grade 3 Teacher	15	16.5
Grade 4 Teacher	14	15.4
Grade 5 Teacher	7	7.7
Other (Staff Development Teacher; Special Ed multi-grades, Consulting Teacher)	3	3.3
Total years teaching MCPS (N = 89)		
1 year (last year 1st year)	9	10.1
2 years	13	14.6
3–4 years	14	15.7
5–7 years	14	15.7
8–10 years	8	9.0
More than 10 years	31	34.8
Total years teaching Science (N = 88)		
1 year (last year 1st year)	8	9.1
2 years	11	12.5
3–4 years	13	14.8
5–7 years	10	11.4
8–10 years	13	14.8
More than 10 years	33	37.5

Note. One kindergarten teacher is ESOL Kindergarten. One 1st grade teacher is special ed paraeducator The "other" positions followed a grade level training.
Data source. Cohort 2: Pre-PD survey

Science instructional time. Baseline data was collected on the amount of time for teaching science in the classroom. The time reported by teacher participants (N = 84) ranged from 30 – 270 minutes per week with an average of 96 minutes per week and standard deviation of 49.23. No one reported 0 minutes, and five teachers did not respond to the question.

School science culture. A variety of questions were asked to gather baseline data on participants' science teaching culture at their school. When given a list of aspects to rate about the science culture at their school, one half or more of the respondents reported that the *time available for science professional development* (58%) and *time available to plan* (50%) hindered effective instruction (Table 14). Almost one half (46%) of the respondents reported *availability of science resources,* and more than one third reported that the *importance their school places on science* (35%) hinders effective instruction. Almost one half (49%) reported that the contents of the science kits promoted effective instruction.

Table 14
School Science Culture Reported by Cohort 2 PD Participants

Aspect of School Culture		Hindered Effective Instruction = 1/2[a]		Neutral = 3		Promoted Effective Instruction = 4/5[b]	
	N	*n*	%	*n*	%	*n*	%
Contents of materials in the science kits.	88	28	31.8	17	19.3	43	48.9
Time that was available for you to plan, individually and/or with colleagues	88	44	50.0	12	13.6	32	36.4
Importance that your school places on science.	87	30	34.5	31	35.6	26	29.9
Availability of other science resources such as books or materials to support curriculum instruction	87	40	46.0	24	27.6	23	26.4
Administrative support that was provided.	83	15	18.1	47	56.6	21	25.3
Parent expectation and involvement	82	3	3.7	63	76.8	16	19.5
Time available for your own science Professional Development (outside of planning)	84	49	58.3	20	23.8	15	17.9

[a]Ratings 1 and 2, on a 5-point scale, were combined, where 1 = hindered effective instruction.
[b]Ratings 4 and 5, on a 5-point scale, were combined, where 5 = promoted effective instruction.
Note. Respondents who answered "don't know" were not calculated in percentages.
Data source. Cohort 2: Pre-PD survey

Participants were given the opportunity to list anything else that may have hindered effective science teaching in their classrooms. Examples of those open-ended verbatim comments are shown in Table 15. The top category of responses was the lack of time for science instruction, especially given the emphasis on other instructional content areas.

Table 15
Aspects that Hinder Effective Science Instructions Reported by Cohort 2 PD Participants

Hindrances	Example Verbatim Comments (N = 53)	Count
Time/Not enough time in schedule	• *The strong focus on Reading, Math and Writing dominate our planning sessions. No time is allotted for Science planning* • *Math and Reading planning taking precedent over Science* • *Having to teach 5 subjects in a week. Sometimes you have to alternate* • *Lack of dedicated time to teach science. Expectation was to integrate, which leaves very little/ no time for hands on* • *The length of the task in curriculum 2.0. Or they are long and though they can be broken up, it take time to "start up" again.*	24
Lack of resources/type of resources	• *Moon journals got repetitive and "boring" for students* • *I felt my teammates and I need to buy many resources of our own in order to integrate the Science standards* • *Live materials delivery especially w/ecosystems critters die before you can get into ecosystem*	8
More direction/explanations for science kits	• *More explanation of how to use Science kits effectively* • *I like the Science kits, but there needs to be directions on how to use them effectively*	3
Other Miscellaneous	• (i.e., class size, student interventions, student language, grade level appropriateness, etc.)	18

Data source. Cohort 2: Pre-SIC survey

SIC participants were asked what science or engineering activities their school offers. More than one half (58%) of the participants reported that their school offers science or engineering after school programs, just over one half (53%) hold family science or engineering events, and one third (33%) offer science or engineering clubs (Table 16).

Table 16
STEM School Activities Reported by Cohort 2 PD Participants

School STEM Activities	Total SIC Participants (N = 89) *n*	%
Offer after school programs for science and/or engineering enrichment.	52	58.4
Hold family science and/or engineering nights/events.	47	52.8
Offer one or more science and/or engineering clubs.	29	32.6
Participant in local or regional science or engineering fair/event.	18	20.2
Visit to science/engineering sites.	18	20.2
Sponsors meeting with science or engineering professionals.	4	4.5
Host AAAS volunteers in your science classrooms.	4	4.5
Other science or engineering activities outside of classroom instruction.	19	21.3

Note. Respondents may have chosen more than one response.
Data source. Cohort 2: Pre-PD survey

Question 5: What were the immediate outcomes of the Year 2 Cohort PD? (i.e., perception, knowledge, and comfort level)?

A pre- and post-PD survey was administered to the Cohort 2 participants (*n* = 91).

Content knowledge. Not surprisingly, at the beginning of PD, two thirds or more of participants reported they were not at all knowledgeable of *the three dimensions of NGSS* (66%) and *the NGSS practices* (72%) as shown in Table 17. Respectively, one third (33%) and under one third (28%) were somewhat knowledgeable. At the end of PD, this knowledge shifted with just over one fourth (26%−27%) reporting they were very knowledgeable and almost three fourths (73%) reporting they were somewhat knowledgeable with *the three dimensions of NGSS* and *the NGSS practices*. This trend of increased knowledge was evident among all the practices learned during PD. Almost one half (48%−51%) of the appropriate grade level participants reported being very knowledgeable at the end of PD with NGSS practices 1, 3, and 7, and the remaining were somewhat knowledgeable. Practices 2 and 6 had 43% and 33% of participants who reported they were very knowledgeable at the end of SIC; the remaining gave a rating of somewhat knowledgeable.

Table 17
Pre- and Post Knowledge Reported by Cohort 2 PD Participants

		Pre-PD Survey						Post-PD Survey					
		Very		Somewhat		Not at All		Very		Somewhat		Not at All	
Knowledge of…	*N*	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
The three dimensions of NGSS	89	1	1.1	29	32.6	59	66.3	24	27.0	65	73.0	0	0.0
The NGSS Practices	89	0	0.0	25	28.1	64	71.9	23	5.8	65	73.0	1	1.1
P1: Asking Questions and Defining Problems (KG, 1st)	35	0	0.0	4	11.4	31	88.6	18	51.4	17	48.6	0	0.0
P2: Developing and Using Models (4th, 5th)	21	1	4.8	11	52.4	9	42.9	9	42.9	12	57.1	0	0.0
P3:Planning and Carrying Out Investigation (2nd, 3rd, 4th)	46	4	8.7	19	41.3	23	50.0	22	47.8	24	52.2	0	0.0
P6: Constructing Explanations and Designing Solutions (3rd)	15	0	0.0	6	40.0	9	60.0	5	33.3	10	66.7	0	0.0
P7: Engaging in Argument from Evidence (KG)	20	0	0.0	2	10.0	18	90.0	10	50.0	10	50.0	0	0.0

Note. Ratings are: Very knowledgeable, somewhat knowledgeable and not at all knowledgeable.
Note. P1 = NGSS Practice 1, P2 = NGSS Practice 2, etc.
Note. Some items were only asked of appropriate grade level teachers, noted in ().
Data source. Cohort 2: Pre and Post-PD surveys

Comfort level teaching NGSS Practice. In the pre- and post-PD surveys, participants were asked their comfort level with implementing a lesson around the NGSS science practice that they learned about during the week. Comfort level increased from the pre-PD survey, which had 0%−20% extremely or very comfortable, to the post-PD survey, which had 53%−90% of participants reporting they were very or extremely comfortable (Table 18).

Table 18
Pre- and Post-Comfort by Cohort 2 PD Participants

		Pre-PD Survey						Post-PD Survey					
		Extremely/ Very		Somewhat		Slightly/ Not at All		Extremely/ Very		Somewhat		Slightly/ Not at All	
Comfort with…	*N*	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
P1: Asking Questions and Defining Problems (KG, 1st)	35	1	2.9	8	22.9	26	74.3	27	77.1	8	22.9	0	0.0
P2: Developing and Using Models (4th, 5th)	21	1	4.8	8	38.1	12	57.1	14	66.7	7	33.0	0	0.0
P3:Planning and Carrying Out Investigation (2nd, 3rd, 4th)	45	9	20.0	11	24.4	25	55.6	27	60.0	18	40.0	0	0.0
P6: Constructing Explanations and Designing Solutions (3rd)	15	2	13.3	2	13.3	11	73.3	8	53.3	6	40.0	1	6.7
P7: Engaging in Argument from Evidence (KG)	19	0	0.0	4	21.1	15	78.9	17	89.5	2	10.5	0	0.0

Note. Ratings are: Extremely, very, somewhat, slightly and not at all knowledgeable.
Note. P1 = NGSS Practice 1, P2 = NGSS Practice 2, etc
Note. Some items were only asked of appropriate grade level teachers, noted in ().
Data source. Cohort 2: Pre and Post-PD surveys

Participants' perception of PD. Participants reported positive experiences with the Cohort 2 PD; 92%−100% of participants strongly agreed or agreed with all the aspects of the SIC, including: there was a comfortable environment; trainers were knowledgeable and well-prepared; they saw a relevant connection with their science instruction; questions were answered adequately; they had time to process and reflect; objectives were met; they were given appropriate tools to modify a lesson; and there was a good understanding of how to implement the practice they learned. The lowest rated aspect was "expectations were clear" which still had the vast majority strongly agreeing or agreeing (92%). Additional details can be seen in Table 19.

Table 19
Cohort 2 PD Participants Agreement with Survey Statements on Perceptions
(N = 91)

Statements	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	*n*	%	*n*	%	*n*	%
An environment was created in which I felt comfortable taking risks (i.e., asking questions, expressing my ideas, working with unfamiliar content).	73	80.2	18	19.8	0	0.0	0	0.0
The trainers were knowledgeable and well-prepared.	70	76.9	19	20.9	2	2.2	0	0.0
I could see a relevant connection between what I learned this week and science instruction in my classroom.	61	67.0	28	30.8	2	2.2	0	0.0
My questions during the summer institute were answered adequately.	61	67.0	29	31.9	1	1.1	0	0.0
Opportunities were provided for me to process and reflect upon the application of the knowledge and skills learned.	60	65.9	29	31.9	2	2.2	0	0.0
The expectations for what my team or I was to accomplish were clear.	54	59.3	30	33.0	6	6.6	1	1.1
The objectives of the summer institute were met.	51	57.3	35	39.3	3	3.4	0	0.0
I was given the appropriate tools to modify a Curriculum 2.0 Lesson Seed with a Next Generation Science Standard (NGSS) Practice.	46	50.5	43	47.3	2	2.2	0	0.0
I have a good understanding of how to implement my grade levels' NGSS practice in my classroom.	40	44.0	47	51.6	4	4.4	0	0.0

Data source. Cohort 2: Post-PD survey

At the end of PD, more than two thirds (68%) of the participants reported that it was very helpful to learn about literacy connection in science (see Table 20). More than one half also reported it very helpful to: learn about best practices using the science kits (62%), utilize formative assessment probes (60%), and incorporate technology into science instruction (55%). Almost all participants (97% or higher) found all of these aspects very or somewhat helpful.

Table 20
Helpfulness of Cohort 2 PD Reported by Participants

PD Components		Very Helpful		Somewhat Helpful		Not at All Helpful	
	N	*n*	%	*n*	%	*n*	%
Learning about literacy connections in science	87	59	67.8	25	28.7	3	3.4
Learning about best practices using the Science kits to meet the needs of Curriculum 2.0	85	53	62.4	31	36.5	1	1.2
Utilizing formative assessment probes	88	53	60.2	33	37.5	2	2.3
Incorporating technology into science instruction	86	47	54.7	37	43.0	2	2.3

Note. Percents are based on those who gave a rating; some respondents checked not applicable and therefore were not counted in the total.
Data source. Cohort 2: Post-PD survey

PD participants were asked to rate the helpfulness of learning about the NGSS practice they focused on during the two day training as well as the helpfulness of implementing a lesson seed using that practice. The highest ratings were given to practice 1 and 7 for both learning about the practice and how to implement a lesson seed using the practice (Table 21). Practice 1: Asking Questions and Defining Problems was the focus for kindergarten and Grade 1 teachers at PD; 71% reported that learning about this practice was very helpful, and 83% reported learning how to implement a lesson seed using this practice was very helpful. Practice 7: Engaging in Argument from Evidence was the focus for kindergarten teachers at PD; 84% reported that learning about this practice was very helpful, and 74% reported learning how to implement a lesson seed using that practice was very helpful.

Table 21
Level of Helpfulness for Specified NGSS Practices Reported by Cohort 2 PD Participants

Learning about NGSS Practices		Very Helpful		Somewhat Helpful		Not at All Helpful	
	N	*n*	%	*n*	%	*n*	%
Practice 1: Kindergarten and 1st grade staff responded							
Learning about the NGSS practice “Asking Questions and Defining Problems”	35	25	71.4	10	28.6	0	0.0
How to implement a lesson seed using the practice “Asking Questions and Defining Problems”	35	29	82.9	6	17.1	0	0.0
Practice 2: 4th and 5th grade staff responded							
Learning about the NGSS practice “Developing and Using Models”	19	9	47.4	8	42.1	2	10.5
How to implement a lesson seed using the practice “Developing and Using Models”	18	11	61.1	6	33.3	1	5.6
Practice 3: 2nd, 3rd, and 4th grade staff responded							
Learning about the NGSS practice “Planning and Carrying Out Investigations”	46	27	58.7	16	34.8	3	6.5
How to implement a lesson seed using the practice “Planning and Carrying Out Investigations”	45	24	53.3	21	46.7	0	0.0
Practice 6: 3rd grade staff responded							
Learning about the NGSS practice “Constructing Explanations and Designing Solutions”	15	10	66.7	4	26.7	1	6.7
How to implement a lesson seed using the practice “Constructing Explanations and Designing Solutions”	15	9	60.0	5	33.3	1	6.7
Practice 7: Kindergarten staff responded							
Learning about the NGSS practice “Engaging in Argument from Evidence”	19	16	84.2	3	15.8	0	0.0
How to implement a lesson seed using the practice “Engaging in Argument from Evidence”	19	14	73.7	5	26.3	0	0.0

Note. Only appropriate grade level staff were asked about the practice they learned about at PD.
Note. Percents are based on those who gave a rating; some respondents checked not applicable and therefore were not counted in the total.
Data source. Cohort 2: Post-PD survey

Most all participants reported that the PD had a major or moderate effect on their understanding of the NGSS practices, ability to use the science kits more effectively, and science content knowledge (Table 22). More than one half reported that the PD had a major effect on their ability to use the science kits more effectively (59%) and their understanding of NGSS practices (56%).

Table 22
Effect of Cohort 2 PD on Science Content Knowledge and Skills Reported by Participants
(N = 91)

	Major Effect		Moderate Effect		Minor Effect		No Effect	
Knowledge and Skills	*n*	%	*n*	%	*n*	%	*n*	%
Understanding of the NGSS practices	51	56.0	37	40.7	2	2.2	1	1.2
Ability to use the science kits more effectively in your room	54	59.3	29	31.9	5	5.5	3	3.3
Science content knowledge	43	47.3	41	45.1	5	5.5	2	2.2

Data source. Cohort 2: Post-PD survey

Three fourths of kindergarten and Grade 1 participants reported that PD had a major effect on their ability to implement a lesson using practice 1 and three fourths of kindergarten participants reported a major effect on their ability to implement practice 7 (Table 23). Most all participants reported that the PD had a moderate or major effect on their ability to implement the practice they learned about.

Table 23
Effect of Cohort 2 PD on Ability to Implement NGSS Practices
in Their Classroom Reported by Participants

		Major Effect		Moderate Effect		Minor Effect		No Effect	
NGSS Practices: Ability to Implement	*N*	*n*	%	*n*	%	*n*	%	*n*	%
Practice 1: Kindergarten and 1st grade staff responded									
Ability to implement a lesson using the practice “Asking Questions and Defining Problems”	36	27	75.1	9	25.0	0	0.0	0	0.0
Practice 2: 4th and 5th grade staff responded									
Ability to implement a lesson using the practice “Developing and Using Models”	22	7	31.8	11	50.0	3	13.6	1	4.5
Practice 3: 2nd, 3rd, and 4th grade staff responded									
Ability to implement a lesson using the practice “Planning and Carrying Out Investigations”	47	20	42.6	24	51.1	2	4.3	1	2.1
Practice 6: 3rd grade staff responded									
Ability to implement a lesson using the practice “Constructing Investigations and Designing Solutions”	15	7	46.7	6	40.0	2	13.3	0	0.0
Practice 7: Kindergarten staff responded									
Ability to implement a lesson using the practice “Engaging in Argument from Evidence”	20	15	75.0	5	25.0	0	0.0	0	0.0

Data source. Cohort 2: Post-PD survey

As shown in Figure 1, when asked about their overall experience with PD, almost all (94%) rated PD as excellent or good on a 5-point scale.

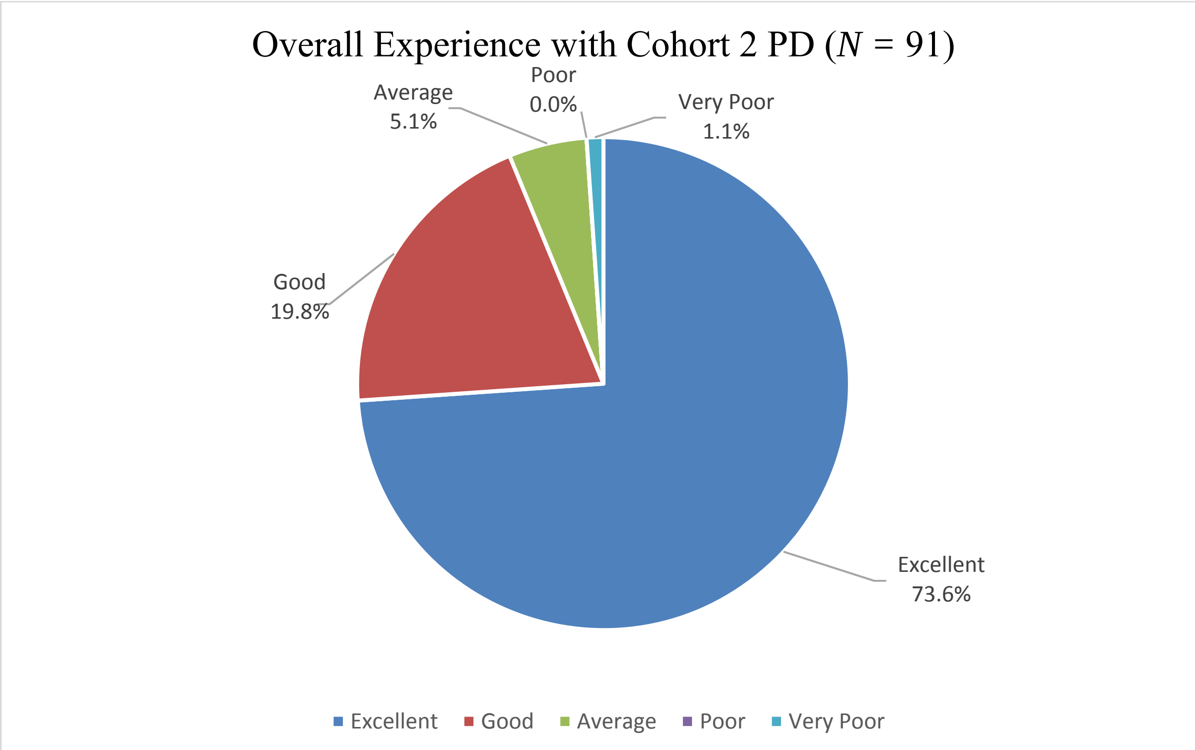

Figure 1. Overall Experience of Cohort 2 PD Participants
Data source. Cohort 2: Post-PD survey

Support needs. PD participants were asked what support they anticipated needing over the next school year to help them successfully implement their learned NGSS practices in their classrooms. From a list given to the respondents (shown in Table 24), most indicated that they would like online resources and materials (82%) and more professional development (64%). Almost one third (31%) indicated that they would like a grade level mentor that they could contact.

Table 24
Areas of Need for Support Reported by Cohort 2 PD Participants

	Total PD Participants (*N* = 91)	
	n	%
Support Needs		
On-line resources and materials	75	82.4
More professional development session(s)	59	64.8
A grade level mentor that I can contact	28	30.8
On site visit from a trainer or coach	10	11.0
Other (specify): science expert, technology expert, more takeaways, sharing ideas with other, science kit materials	10	11.0

Note. Respondents could choose more than one response.
Data source. Cohort 2: Post-PD survey

Most important aspects. In an open ended question, participants were asked what the most important thing was that they gained from attending SIC. As seen in Table 25, the most frequent responses were receiving ideas and resources (44%) and learning about NGSS, the curriculum, and the connection between them (38%). Other aspects reported as important by some participants were: learning about hands-on lessons, how to incorporate science with literacy and other content areas; collaboration and learning from other teachers; science probes and science kits. Several participants also reported that the SIC got them excited or made them more confident about teaching science.

Table 25
Most Important Aspects Reported by Cohort 2 PD Participants

	Total PD Participants (N =86)	
Most Important Aspects Reported (open ended)	*n*	%
Receiving ideas/resources/lesson seeds	38	44.2
Learning about NGSS/Connection to curriculum/science curriculum	33	38.4
Learning about lessons/activities that are hands-on/engaged	11	12.8
How to incorporate with literacy/other content areas/throughout the day	7	8.1
Collaboration/learning from other teachers	6	7.0
Got me excited/more confident/more comfortable about teaching science	6	7.0
Learning about science probes	5	5.8
Learning about science kits	4	4.7

Note. Respondents could provide more than one response
Data source. Cohort 2: Post-PD survey

Suggestions for SIC PD. When participants were asked the open-ended question, "Was there anything about the Summer Science Institute you think would have been more effective if it were done differently?" less than one half of the participants (N = 38) left a response (Table 26). In addition, there was not a common theme among the majority of responses. The top suggestions were: less NGSS and less general information (21% of those responding); and more examples and specific ideas (16%). Other suggestions were to provide more resources; clearer, more focused objectives; and more hands on activities. More than one third had a variety of other suggestions with no common theme.

Table 26
Suggestions for Cohort 2 PD Reported by Participants

Suggestions for PD (open-ended)	Total PD Participants (N = 38) n	%
Less NGSS/first day too general/have us read on our own time so more focus on activities/lessons	8	21.1
More examples/how-to's/specific ideas	6	15.8
More resources	4	10.5
Clearer/more focused objectives	3	7.9
More hands-on	3	7.9
Have more of a connection with curriculum	2	5.3
Other: a variety of different suggestions	13	34.2

Data source. Cohort 2: Post-PDC survey

Other comments. Participants were given the opportunity to leave comments at the end of the post-survey. These comments were primarily gratitude towards the trainers and praises for the SIC.

Future Plans and Recommendations

The second cohort of this Howard Hughes Grant will receive continued professional development on NGSS practices prior to marking periods 2, 3, and 4 during school year 2015−2016. A follow-up survey of Cohort 2 participants is planned for the end of the 2015−2016 school year to elicit participants' experiences of implementing the science practices in their classrooms.

The following recommendations are to provide feedback for the program's improvement and ongoing development and are based on findings from year two of the evaluation.

- Explore ways to increase participation in summer professional development such as SIC. In year two (2015−16), initial enrollment for SIC was at its maximum for most all grade levels; however, not everyone who signed up actually attended.
- Encourage more participants to share their new skills and knowledge with other teachers beyond their grade levels at their schools.
- Continue to explore ways to further expand the knowledge of practices and the skills for implementing lesson seeds using the practices. Especially focus on practices with lower knowledge and comfort ratings from the PD surveys (i.e., Practice 2 from the Cohort 1 follow-up and Practices 2, 3, and 6 in the SIC).
- Continue to support participants in their skill development by offering online resources and specific examples and suggestions for implementing practices.

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Appendix A

Table A1
Guskey's Sequential Level Evaluating Professional Development, Instrument, and Corresponding Evaluation Questions

Level of Evaluation	Instrument/activity	Evaluation Question
1. Participants' reactions	Surveys of participants (administered after Cohort 2 PD)	Q5.What were the immediate outcomes of the Cohort2 SIC? (i.e., perception, knowledge, and comfort level)
2. Participants' learning	Surveys of participants (administered before and after Cohort 2 PD)	Q5.What were the immediate outcomes of the Cohort 2 PD? (i.e., perception, knowledge, and comfort level)
3. Organization support and change	Program document review of SIC and Surveys of participants (administered before summer workshop and the follow-up survey the following school year)	Q1. How were the PD activities supported by the HHMI grant implemented during the 2014–2015 school year? (on-site coaching delivered to Cohort 1) Q3. How were the PD activities for the Year 2 Science Institute Cohort (SIC) implemented? (development and delivery of 2015 Science Institute)?
4. Participants' use of new knowledge and skills	Follow-up surveys of Cohort1 participants	Q2. What were the outcomes of the training and support provided by the HHMI grant for elementary classroom teachers? (i.e., perception, knowledge, and comfort level)

Appendix B

Cohort 1: Classroom Teacher Follow-up Survey Findings

Table B1
Perceptions of Coaching Reported by Follow-up Survey Respondents

		Strongly Agree/Agree		Disagree/ Strongly Disagree	
	N	*n*	*%*	*n*	*%*
The coach was knowledgeable and well-prepared.	5	5	100.0	0	0.0
An environment was created in which I felt comfortable taking risks.	5	5	100.0	0	0.0
My questions were answered adequately.	5	5	100.0	0	0.0
The coaching session helped me improve the skill(s) that the coach addressed with me.	5	5	100.0	0	0.0
The coaching session was helpful for implementing science instruction in my classroom.	5	5	100.0	0	0.0

Data source. Cohort 1: Follow-up survey among teachers who received on-site coaching

Table B2
Comments on Things That Hindered Teachers' Science Instruction

Comments (N = 26)
Time related comments • It's mostly just the time available. I only get 30 minute blocks of time for science. • There is a lack of time because reading, writing, and math have preference. • This is my first year teaching the new curriculum. I hope to integrate more science content into the reading and writing when I become more familiar with the curriculum. • Time available during the school day • Testing schedule and reading/writing/math time allotted is overwhelming compare to shared Science and Social Studies Block. • Honestly, it's scheduling time. I try to incorporate it as much as I can into reading. • Time, time, time to plan and look for other supporting resources. • The main challenge was finding the time to teach science and implement the experiments • Never enough time in the school day to fit in all instructional areas at a high quality level! • Instruction time available, time spent on standardized test prep, getting used to using new Chrome books • Time! Testing! Pressure to get students reading and writing. We had a lot of students entering below grade level, so we extended our reading block. • Due to frequent snow days and delays this year, science often left off of the daily schedule. • Lack of time is the biggest concern, as well as a lack of physical science courses offered by the county at this time. It would be highly beneficial if there was a class that covered the physical science content that is taught in the curriculum. • Always time! • It was difficult teaching each subjects' requirements in such a restricted time. Writing won out many days because of the demands and inquiry projects. But science/social studies is not valued. • The following will be helpful to increase students' achievement: Time for planning, PD and materials for foreign language
Materials related comments • Lack of materials needed outside the science kit (scales, etc) that are not in the school • Some of the materials are not in the kits. For example, for making thermometers, there were no straws or bottles. • Some of the science kits at our school were missing supplies that were listed, so we had to divide up the materials so there was less hands on for the kids because of larger grouping.
Other comments • Compacted math impacts science because those students leave my classroom at that time.

• Chromebooks will help with our Science instruction. Longer class periods (and) finding more resources on investigations which relate to what students are learning. This engages students so much more than the research. It would be nice to have a STEM coordinator at our school who could help us plan and implement better activities. • I wish every school was provided an Enviroscape model. There needs to be more engineering seeds. We created our own but would appreciate more feedback on what other schools are doing. • Seed lessons for 2.0 curriculum need to be strengthened. I would like to see lessons, assessments and materials from kit aligned. More hands-on lessons need to be incorporated.
Positive comments • I switched grades right before school began this fall and am often planning science for the short term. I am still learning the curriculum and not sure of the big picture. My participation in the Summer Science Institute prepared me really well for teaching a different grade. • The curriculum appears to build on student knowledge acquired in previous grades. When students do not master information in earlier educational settings it is difficult to continue building on a weak foundation. • This training has encouraged and helped me to teach ESOL through science. • I have been very pleased with the science instruction in my classroom this year

Data source. Cohort 1: Follow-up survey

Appendix C

Cohort 1: Teacher Leader Follow-up Survey Findings

Table C1
Change in Implementation of Science Instruction
Reported by Teacher Leader Follow-up Survey Respondents

Change in Science Instruction	Teacher Leaders (*N* = 18)		Teacher Leaders: Same Grade Level[a] (*N* = 15)	
	n	%	*n*	%
Changed a lot	8	44.4	8	53.3
Changed a moderate amount	7	38.9	4	26.7
Changed a little	2	11.1	2	13.3
No change at all	1	5.6	1	6.7

Note. Does not include teacher leaders who no longer teach in a grade-level classroom
[a]Does not include three teacher leaders whose current position differs from when they delivered SSI
Data Source. Cohort 1: Teacher Leader Follow-up survey

Table C2
Science Instruction Changes Reported by
Teacher Leader Follow-up Survey Respondents

School STEM Activities	Teacher Leaders (*N* = 18)		Teacher Leaders: Same Grade Level[a] (*N* = 15)	
	n	%	*n*	%
Increased use of MCPS science kits	12	66.7	10	66.7
Modified a lesson seed using the practice "Planning and Carrying out Investigations"	11	61.1	9	60.0
More time spent on science instruction	10	55.6	8	53.3
Utilized formative assessment probes	10	55.6	8	53.3
More technology used in science instruction	9	50.0	8	53.3
Modified a lesson seed using the practice "Developing and Using Models"	8	44.4	6	40.0

Note. Does not include teacher leaders who no longer teach in a grade-level classroom
[a]Does not include three teacher leaders whose current position differs from when they delivered SSI
Data Source. Cohort 1: Teacher Leader Follow-up survey

Table C3
Sharing New Skills and Knowledge
Reported by Teacher Leader Follow-up Survey Respondents

Sharing New Skills and Knowledge	Total Participants (N = 20) *n*	%
Shared at a grade level meeting	17	85.0
Shared at a schoolwide staff meeting	8	40.0
Shared with the Science or STEM committee	7	35.0
Have not shared with anyone (yet)	1	5.0
Other: with other teachers using Google Drive, with science department, with individual teams teachers	3	15.0

Note. More than one response may be chosen
Data Source. Cohort 1: Teacher Leader Follow-up survey

Table C4
Average Weekly Minutes of Science Instruction Reported
by Teacher Leaders: Pre- and Follow-up (N = 15)

	Pre- Survey		Follow-up Survey			
Science Instructional Time from 2014 to 2015	Mean	SD	Mean	SD	Mean Diff	ES
Average weekly minutes taught science.	114.33	57.16	134.67	51.46	20.34	0.37

Note. ES = Effect Size
Note. Statistical comparison of means revealed the difference as not significant (p > .05).
Data source. Cohort 1: Pre- and Follow-up surveys

Table C5
Subject Teaching Comfort Level Reported by Teacher Leaders: Pre- and Follow-up

	Pre- Survey			Follow-up Survey				
Subject area	N	Mean	SD	N	Mean	SD	Mean Diff	ES
Mathematics	17	4.82	.393	17	5.00	.000	0.18	.648
Science	17	4.41	.712	17	5.00*	.000	0.59	1.17
Reading/Language Arts	17	4.53	.624	17	4.65	1.06	0.12	.138
Social Studies	17	4.24	.752	17	4.76	.970	0.52	.599

*p< .05
Note. A scale of 1 to 5 was used where 1 = Not at all comfortable and 5 = Extremely comfortable.
Data source. Cohort 1: Teacher Leader follow-up survey

Table C6
School Science Culture Reported by Teacher Leaders: Pre- and Follow-up

	Pre- Survey			Follow-up Survey				
Aspect of School Culture	N	Mean	SD	N	Mean	SD	Mean Diff	ES
Parent expectation and involvement	14	2.79	1.369	14	3.00	1.710	0.21	.279
Administration support that was provided	14	4.14	1.027	14	4.00	1.301	-0.14	.186
Time available to plan individually or with colleagues	14	3.43	1.785	14	3.71	1.858	0.28	.372
Time available for your own PD	14	2.14	1.875	14	4.00*	1.519	1.86	2.47
Importance that your school places on science	14	3.57	1.651	14	3.43	1.399	-0.14	.186
Contents of materials in science kits	14	2.71	1.899	14	3.57	1.651	0.86	1.14
Availability of other science resources	14	2.86	1.657	14	3.29	1.729	0.43	.572

*p < .05
Note. Scale 1 to 5 was used where 1 = Hindered Effective Instruction and 5 = Promoted Effective Instruction.
Data source. Cohort 1: Teacher Leader Follow-up survey

Appendix D

Cohort 2: NGSS Practices Focused on at SIC by Grade Level

Grade Level	SIC: NGSS Practice Focus for Marking Period 1
Kindergarten	Practice 1: Asking Questions and Defining Problems Practice 7: Engaging in Argument from Evidence
1st grade	Practice 1: Asking Questions and Defining Problems
2nd grade	Practice 3: Planning and Carrying Out Investigations
3rd grade	Practice 3: Planning and Carrying Out Investigations Practice 6: Constructing Explanations and Designing Solutions
4th grade	Practice 2: Developing and Using Models Practice 3: Planning and Carrying Out Investigations
5th grade	Practice 2: Developing and Using Models

Appendix E

STE

Science Institute Cohort

Science Institute Cohort 15/16

Kindergarten:
Course #85561
Section #99398

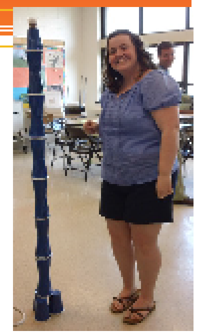
Grade 1:
Course #85562
Section #99399

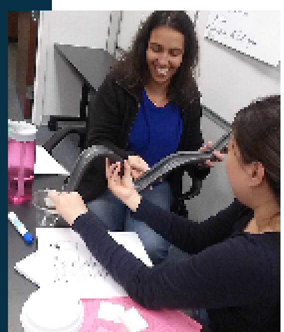
Grade 2:
Course #85563
Section #99400

Grade 3:
Course #85564
Section #99401

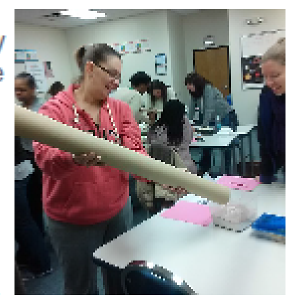
Grade 4:
Course #85565
Section #99402

Grade 5:
Course #85566
Section #99403





Last summer and this past fall, teachers in grades 2 through 5 registered to participate in a Science Institute, where they delved into Curriculum 2.0 Science while gaining an understanding of the recently released Next Generation Science Standards. Teachers explored problem based learning practices to engage their students in their grade level curriculum, utilizing engineering designs and challenges.



In addition, teachers utilized technology and literacy applications to teach science in their grade level classroom. They explored hands on investigations to deepen science concepts the students can do during science, as well as considering formative assessment opportunities.

Due to an overwhelming positive response to these institutes, it will be offered again...for grades K—5! The 5 day long sessions will begin in July and meet 3 days during the school year prior to the coming marking period. Substitutes will be provided during the school day professional development and a stipend for completing the Science Institute Cohort will be awarded. Participants should register for their grade level on PDO and come ready to examine science in the elementary classroom through the lens of the Next Generation Science Standards.

Participants registered for the 5 Day Science Institute Cohort MUST attend all 5 days.

If you have any questions, please contact Carrie Zimmerman of the Science, Technology & Engineering Office at Carrie_L_Zimmerman@mcpsmd.org

MCPS Science, Technology