Seeking the "S" in CMSI: History and Implementation of the Science Initiative

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A Data brief for the CPS Office of Mathematics and Science
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Abstract: The purpose of this data brief is to provide a descriptive and analytical treatment of the elementary science strand of the Chicago Math Science Initiative (CMSI). The report has two purposes: to a. provide historical documentation of the elementary science strand; and b; describe and analyze the use of CMSI science instructional materials in a sample of implementing schools. The historical documentation piece is based on interviews with Office of Math and Science (OMS) staff and document analysis. This portion of the report was created by request of OMS science staff for the purpose of providing usable documentation of the development of the science strand. The history of the development of the elementary science 'Scope and Sequence" is considered and a description of the shift to teacher-led professional development is described. Findings in this portion of the brief suggest that both science staff and participants commonly understand the strengths and weaknesses of teacher-led professional development, but that attention still needs to be focused on improving the weaknesses.

The analysis of the implementation of the CMSI science strand in the second section of the brief is based upon interviews in a sample of 27 schools implementing CMSI science materials. A portion of these schools are Intensive Support schools who were provided with incentives and support to begin implementation in 2003-04 while the majority are Voluntary schools, schools that have more recently opted to implement science materials without these material supports. Findings in this section of the brief provide descriptive accounts of implementation in Intensive Support and Voluntary Schools, focusing on time spent on science instruction, grade level structures, in-classroom support and professional development attendance. Materials management is also explored in both types of schools. The extent of kit sharing in sample schools is explored and six distinct approaches to the management and refurbishment of science materials are shared. Descriptions are provided and questions are raised about the impetus for science implementation and unique forms of implementation including subject integration, science lab separation, and partial adoption.

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Introduction

The purpose of this data brief is to provide a descriptive and analytical treatment of the elementary science strand of the Chicago Math Science Initiative (CMSI). The report has two purposes: to a. provide historical documentation of the elementary science strand; and b; describe and analyze the use of CMSI science instructional materials in a sample of implementing schools.

The report will begin by tracing the historical development of the science elementary Initiative, paying special attention to the unique design and use of a model of teacher-led professional development. This descriptive section of the data brief will lead into a consideration of participant evaluation of the professional development offerings. The second section of the brief provides a description and analysis of implementation of CMSI science materials in a sample of 27 schools during the fall and early winter of 2005-06. The final section of the report offers concluding remarks and recommendations for improvement and future inquiry.[1]

Mapping the Historical Development of the Elementary Science Initiative

We begin at the beginning! Part of the impetus for this data collection and report was to provide Office of Math and Science staff with a written historical documentation of the development of the elementary science strand, specifically the unique aspect of teacher-led professional development. In this section, a brief history of the strand is presented, highlighting essential points on the timeline and documenting the critical decisions made in the process.[2]

The History: Scope and Sequence, the Materials and Teacher-led Professional Development

The history of the elementary science strand, in several important respects, has its roots in the same set of processes and approaches as the elementary math strand of the CMSI. For both, development began in the Leadership Academy for the OMS staff. An intensive 3-month professional development workshop for the members of the new staff of the Office of Math and Science, the Academy served multiple purposes including building a sense of community among the staff members, exposing the staff to a diverse set of standards-based math and science materials, and providing time to design what was to become the CMSI.[3]

While sharing this starting point in common, the trajectory of development of the elementary science strand differed from the math strand in several important respects. In the first place, while the Academy exposed participants to both math and science curricula, participants believed that the primary focus was math. "The whole purpose was to get the science people onboard with the math," one Science Facilitator stated. The science Facilitators made this assessment based on the fact that a greater majority of Academy workshop time was spent focused on math materials (63% of Academy time spent on standards-based materials was mathematics-focused; 37% was science-focused. See

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[1] Throughout the report, findings are often presented separately for Intensive Support schools and Voluntary schools. Intensive Support schools were those chosen through an application process in 2003-04 to participate in the Initiative. (Please see http://www.oms.cps.k12.il.us/cmsi/k8support_application.html for details on Intensive Support selection).These schools were given a high level of financial and human capital in their implementation efforts. Voluntary implementers are schools that opted to introduce CMSI science materials without these incentives and supports. OMS staff anticipated differences in the implementation progress and issues in these two populations based on the difference in initiation of the Initiative and the length of time of participation. Thus, they are analyzed separately in appropriate places throughout the report.

[2] A description of the evaluation and analysis method used for this historical section is included in Appendix I.

[3] For details about the Leadership Academy, its design, content and the strengths and weaknesses identified by the OMS staff, please see Hallman, Fendt and Wenzel, 2003.

Hallman, Fendt and Wenzel, 2003 for additional details). In addition, the OMS science staff based this understanding of the primary focus on math on the fact that the co-teaching assignments for OMS staff were all made in math rather than in math and science classrooms.

It is important to note that this understanding of "math is first," while it made science staff long for more opportunities to learn about science and share their love of the subject with OMS colleagues, was not met with bitterness. Rather, science staff expressed repeatedly in interviews their understanding that math was foundational for science and that creating a partnership of the two disciplines in the district would make both stronger. "I preach all the time at workshops that science without mathematics is mythology," one science Facilitator stated. "That if you can't measure it and you can't classify it and you can't count how many babies it had, then you're just making up stories for children."

This being said, in the minds of OMS science staff, when the Academy ended the elementary Initiative was much further developed in math than it was in science. The science staff found that their colleagues had selected four sets of standards-based math curricula that would be the basis for the elementary math Initiative. They soon discovered that a parallel approach of providing schools with multiple recommended curricula, each of which would contain all of what a school would need for their science instruction, was not going to be possible. "We thought that we would follow the model that math was setting and that was to choose two materials, one for [grades] K through five and one for 6 through 8," one science Facilitator explained. "After we looked at tons and tons of materials, we realized a couple of things. One of them was there wasn't one set of materials for science that would do everything."

<u>The Scope and Sequence & Choosing Materials</u>

It was March of 2003 and the science team, consisting of the Elementary Science Manager, the High School Science Manager, several science Facilitators and some Chicago Public Schools' teachers, began their quest to create a unique approach to the design of the science Initiative. There were two initial foci to their work together. One was to choose topic areas in science that they thought were essential for the focus of elementary school scientific learning. The second was to choose sets of materials that matched with these topic areas, were aligned with Illinois State standards and were of the highest quality.

The science team worked on these two goals iteratively, moving back and forth between the two. For the kindergarten through fifth grade content foci, the team chose a combination of introductory concepts in earth, life and physical sciences. For example, the first grade content framework included units on plants; solids and liquids; rocks, soil and dirt; and living organisms. At the sixth, seventh and eighth grade, the content focus was narrowed. The sixth grade would provide a focus on earth science, the seventh grade topic would be life science and the eighth grade content would center on physical science. Narrowing the content focus in the intermediate and upper grades would allow for the development of a "deeper content knowledge that would build upon earlier introductory concepts and prepare students for high school science," one science team member explained.

In tandem with developing this list of topic areas and assigning them to grade level programs, the science team engaged in the long process of assessing standards-based science curricular materials. The team evaluated the quality, alignment with the Illinois state standards as well as the fit with the topic areas and grade level schema they were designing. "We got tons of materials in and we began looking to see first, how they were aligned with our Illinois standards," one science Facilitator stated. "We [also] looked at our kids' test scores in the past, the areas that our kids routinely did not do well." The team set up a matrix and check list, using the combined years of experience of those on the team in science instruction and drawing upon tools from the Education Development Center (EDC).

The team of the Managers, Facilitators and teachers worked together to create a draft scope and sequence, a framework that contained the topics that students would study grade by grade, and the corresponding curricular units that might be used. The team chose units of four sets of standards-based science materials to fill their framework: the Full Option Science System (FOSS); Science, Technology and Children (STC); Investigating Earth Systems (IES); and the Science Education for Public Understanding Program (SEPUP). The Elementary Science Manager circulated this first draft framework to science experts at Northwestern University and the University of California-Berkeley.

A round of revisions on the scope and sequence framework followed based on the comments from these and other experts. At the same time, the OMS Science Manager and Facilitators began the process of selecting schools for the designation of being Intensive Support Science Schools.[4] In this process, twenty-one schools were selected to participate in the first year of implementation of the elementary science scope and sequence.

At the end of the first year of implementation, in the spring of 2004, science staff at OMS had a series of focus groups with teachers in the elementary science strand to "find out what worked, what didn't, how would you change it." Based on teacher feedback, science staff made changes to the scope and sequence. For example, in the initial year, living organisms was taught first. The reasoning of placing this first in the scope and sequence was "that teachers were more comfortable with living things, and kids knew more about it," explained one science Facilitator. However, managing and disposing of these organisms was an issue. "What teachers were telling us was, 'ok, we have these animals and it is the dead of winter, what are we going to do with them?'" explained one science staff member. Upon this suggestion, living organisms was moved to the spring. Another example was the fourth grade teachers' suggestion that having electricity and magnetism in the last quarter meant students didn't learn concepts critical to doing well on the Illinois Standards Achievement Test (ISAT). The final example, and one that sparked much humor for the science staff, was the placement of solar energy. "We had solar energy second quarter-in December," one staff member explained. "Guess what, no sun!"

The staff made adjustments in the scope and sequence based on this critical feedback from teacher focus groups. At the same time, a crucial decision was made that sparked the introduction of one of the unique components of the elementary science strand: its teacher-led professional development.

The Initiation of Teacher-Led Professional Development

The acknowledgement that teacher professional development is in need of and in the process of improvement in the field of education has been widely discussed by scholars (Corcoran, 1995). The movement of standards-based reform and educational reforms aimed directly at classroom instruction calls for a similar revision and re-conceptualization of teacher professional development. In the literature, this has been documented as underlying the evolution even in language from "in-service" to "professional development" (NCREL, 1994). The expectation that these teacher-training sessions are ongoing, linked directly to instructional practice, and focused on teacher strengths rather than deficits are all characteristics of this new approach. Some scholars envision teacher-facilitated professional development as an essential characteristic of this ideal approach; teachers learning from fellow teachers and learning from teaching fellow teachers (Walling, 1994).

[4] For additional detail on the application and selection process of schools to participate in the Intensive Support portion of the CMSI, please see http://www.oms.cps.k12.il.us/cmsi/k8support_application.html and Hallman et al, 2004.

The extent to which this model appears in practice is still limited. Finding the time and resources to train teachers in this practice is problematic as is securing their time from the ongoing demands of being a classroom teacher and leader in schools where resources are already stretched thin (Bull et al, 1994).

The OMS science staff opted to move to this model of teacher-led professional development in the second year of the elementary science Initiative. Beginning in the summer of 2004, teacher professional development became teacher-led for the science strand. The reasoning from science staff was increasing the richness and contextual relevance to participating teachers. "When we started our first year of professional development, we used consultants from the publishers," explained one science staff member. "Yes, some of the consultants were teachers who had taught, but they weren't from Chicago," she explained. "They didn't know the culture and they really didn't have a lot of respect from our teachers." As a result, "the professional development wasn't as rich as it could have been."

The science staff decided to identify and develop leadership in their implementing Intensive Support schools. They invited a group of teachers and school Specialists who exhibited knowledge of the curricula and leadership skills to participate in training to become Professional Development Leaders (PDLs). OMS science staff led the training workshops. These sessions allowed the training of PDLs to develop frameworks as well as more specified workshop plans. "We created a matrix that would just show the structure of professional development," a science staff member explained. "I asked them to list activities, how long it would take, the materials they would use…" The training PDLs then filled in the matrices with their ideas of professional development sessions they would like to teach. "Then we asked critical questions to them. Ok, so you do this activity, why did you choose it?" The developing PDLs justified their selections and fellow participants helped one another to improve their workshop plans.

In this way, initial workshop matrices were developed and piloted in professional development with teachers. Ongoing revisions were then incorporated as PDLs implemented workshop plans and discovered, "this took way too long," or "this was confusing for teachers." This process of training initial PDLs and the ongoing development of training materials has led to a solid workshop plan in which new PDLs can step in to offer workshops

> Now we are at a point where we can have a new Professional Development Leader come in and pick up a matrix and although they may not fully understand why these activities were chosen, at least they can follow them. And then after their first year of doing it, they make their own changes. Or sometimes, they make their own changes [right away] because they are such an experienced teacher.

Science staff acknowledges that while this teacher-led professional development option has the strength of bringing the richness of teacher perspective that is contextualized within Chicago Public Schools, it also has weaknesses. Two of the main identified weaknesses are the maintaining of workshop materials and the unevenness of quality. "It is not perfect, we pick up some notebooks and they are all over the place because the PDL decided to take something out and they didn't put it back, or whatever reason," one science staff member explained. "And then some you find that they go off on their own…they wanted to bring in their other stuff." Quality control can be difficult, as science staff at OMS do not have the time to attend each PDL-led session.

Participant Comments on Professional Development

Discussion of the elementary science professional development is a natural place to transition from OMS staff interviews to the comments of teachers and principals collected in 22 of the 27 sample schools during the late fall and early winter of 2005-06.[5] Respondents in implementing schools were asked specifically about theirs or their teachers' attendance at OMS science professional development and perceptions of it. In this section comments from respondents in Intensive Support and Voluntary schools are considered together, given the overlap in their comments on professional development.

More than half of the 22 respondents who commented on CMSI science professional development identified as positive the fact that it was hands-on and teacher-led. One respondent commented on the demonstration approach of the science workshops

> It is informative and helpful. I think every activity is self-explanatory if you really want to just read over it and go from there but when you go to PD, they actually demo it to you. It is a lot easier than if you just read through it. Anybody can read a book and teach from it. But when you go to PD you are like, that is another loophole that I can go to. It is pretty much a lot of hands-on training, it is very good.

Respondents spoke about the direct benefits of the previewing of specific lessons that teachers would be using in their classroom:

> Whatever lessons they have to work with the students, when they go through professional development, they kind of go through and over those particular activities so therefore they know exactly what they need to do.

Ultimately, this focus on hands-on training focused on the very lessons that teachers would be introducing in their own classrooms brought with it another benefit: it saved teachers time. The professional development "really helps them," one respondent commented. "It is a great time-saver. Once you see it, it just saves you so much time."

Beyond the appreciation for hands-on training that previewed appropriate lessons, saving teachers time, respondents also saw the benefits of attending sessions led by teachers from their own context. One principal commented

> If you have a teacher who has actually taught the program in CPS, they can say I tried this and it didn't work and I think you need to do it this way. So that has really been a plus.

Eight of the 15 Voluntary school respondents talked about the fact that professional development was teacher-led or led by someone with knowledge of the CPS context as a positive attribute of the sessions.

Identified weaknesses of the CMSI science professional development were similarly parallel to those identified by OMS science staff. Respondents informed researchers that "some trainers were better than others," and that "if you got the right session it was amazing." Five of the 15 Voluntary school respondents and two of the seven Intensive Support school respondents saw this as the weakness of OMS elementary science professional development.

These results raise questions about the process of quality control of the professional development

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[5] Descriptions of the defining of the population for this data collection and details of sampling procedures are included in Appendix I and thus are not discussed here.

sessions and the potential need for ongoing training of PDLs to improve and make more consistent the quality of offerings. This is considered in more detail in the concluding section of this report.

Reporting on Implementation in Intensive Support and Voluntary Schools

Having provided the context for the design and revision of the OMS elementary science Initiative, this section focuses on the state of implementation in a sample of elementary schools using CMSI science materials. The section begins with descriptive data on the characteristics of the science Initiative in the sample of Voluntary implementers are shared. This is followed by a similar section, which considers the character of implementation in seven Intensive Support schools. A final section looks at implementation questions and issues that are common to both populations.[6]

Exploring Voluntary Implementers

In this section, a description of implementation in the fifteen Voluntary schools in the sample is provided. The timing and character of school participation is explored followed by a description of the existence of science Specialist roles and the level of in-classroom support teachers are receiving in these schools. Finally, professional development attendance is considered.

The vast majority of Voluntary schools where data were collected were in their first year of implementation of the materials. Eleven of the schools had started implementation at the beginning of the 2005-06 school year, with the majority of these schools having ordered the materials in the spring of 2005. One of the schools started science implementation during the 2004-05 school year. Three of the Voluntary schools were still in the process of ordering and distributing materials, despite the fact that it was November or in one case January. Two of these schools planned to implement the materials mid-year in 2005-06. One principal acknowledged that it was more likely that implementation would occur in 2006-07.

Table 1: Implementation (Voluntary)

Year of Implementation			Level of School Participation		
2004-05	2005-06	In process	Full	Partial	Ordered
1	11	3	9	3	3

The level of school participation across these Voluntary schools also varied. Nine of the 15 schools in the sample reported being at full implementation of all of the science materials in the CMSI scope and sequence. The three schools that were still in the process of implementation still had all or some of the materials on order. Three of the schools reported partial usage of CMSI materials. In two of these schools, the partial use was a result of only a small number of teachers using the materials. For example, a seventh and eighth grade departmentalized science teacher was using IES with students while the rest of the school was using a text-based approach. In another case, two primary grade teachers were "piloting" FOSS in the hopes that the rest of the school would follow. Finally, one school was only using FOSS in a science lab. The lab teacher had materials from many sources, including FOSS, and would pick and choose labs that matched with the school's science textbook. It is unclear how appropriate the use of these materials is given that she reported using FOSS kits for 8th grade labs.

In 11 schools, respondents provided data on the number of minutes per week science was being taught. These were often given in a range that gradually increased at the higher grade levels. In the 4

[6] A description of the evaluation method, defining the population of inquiry and the criteria of sample selection is included in Appendix I.

schools where these data were not collected, three were not asked and in one case the respondent responded that science was being taught "the required number of minutes" at each grade level.

Table 2: Minutes per Week of Science & Grade Level Meetings (Voluntary)

Minutes per Week in Science Instruction			Grade Level Meetings	
80-150	150-250	>250	Yes	Did not report
2	8	1	12	3

In 12 schools, data reflected responses on the use of grade level meetings. In 100% of the schools where respondents were asked about grade level meetings, they responded that structures did exist for these meetings to take place regularly. Respondents were also asked if science was discussed in these meetings. Most respondents said "yes," although most acknowledged when asked that these meeting agendas were not monitored. Four Specialists and 2 administrators replied that they did attend grade level meetings and could verify that science was discussed.

In the fifteen Voluntary schools where data were collected, 4 had freed science Specialists. Three of the four described duties that included in-classroom support of teachers using co-teaching, demonstration and observation methods. Four schools had science Specialists with split-duties. The most popular of these formats was to have a Specialist also teach departmentalized 7th and 8th grade science in addition to their role as Specialist. In one case, the individual was both the math and science Specialist. In seven Voluntary schools, no science Specialist was designated.

Table 3: Specialist and In-Classroom Support (Voluntary)

In-school Specialist			In-Classroom Support	
Freed	Split-duties	None	Yes	No
4	4	7	6	9

In-classroom support was occurring in 6 of the fifteen Voluntary schools. Three of these are in-school Specialists assisting teachers. In the other three schools, in-classroom support was pieced together through outside sources including a Citywide Specialist, the Shedd Aquarium and an Area Coach. In nine Voluntary schools, no in-classroom support existed.

Table 4: Professional Development Attendance (Voluntary)

Yes, school-year 2004-05 & summer 2005	Summer 2005 but no school-year 04-05	School-year 04-05 but no summer 2005	2005-06
5	1	9	15

Respondents were asked about teacher attendance at CMSI science professional development and these responses were checked against OMS attendance data. Five of the Voluntary schools attended both school year 2004-05 professional development and summer 2005. One school did not send teachers in the school year of 2004-05 but teachers did attend in the summer. Nine schools sent teachers during the school year of 2004-05 but not in the summer of 2005. Recall that materials were purchased in the majority of these schools in the spring of 2005. Thus, not surprisingly, professional development attendance in 2004-05 is lumped at the end of the year for most of these schools. Many attended the last quarter of training in the 2004-05 school year. Importantly, all of these schools continued to send the majority of teachers to training throughout the 2005-06 school year.

Catching up with Intensive Support Schools (IS)

The seven Intensive Support schools where data were collected were all in the midst of their third year of science implementation. Four of the Intensive Support schools in the sample reported having a freed science Specialist. Three of these Specialists reported in detail on their role to researchers. Two of the freed Specialists reported working directly in teachers' classrooms. One Specialist described co-teaching, observations and demonstration lessons as a regular part of her duties. The second had a set schedule of planning a lesson with each teacher in the school every week and providing co-teaching and modeling services based on the planning sessions. The third freed Specialist primarily worked with her teachers through materials management and grade level meetings. The fourth freed Specialist was not interviewed directly and we do not have a report on her role enactment from the principal who served as the respondent.

In one of the sample Intensive Support schools, the science Specialist is also serving as a full-time teacher and thus does not have time to support teachers in classrooms. In two schools, there is no science Specialist designated.

Table 5: Specialist and In-classroom Support (IS)

In-school Specialist			In-Classroom Support	
Freed	Split-duties	None	Yes	No
4	1	2	5	2

In-classroom support was reported in each of the four schools with freed Specialists. A fifth school included the outside source of an Area Coach as an in-school support in science for their school.

Respondents provided data on the number of minutes per week science was taught in the school. This ranged from 80 minutes per week to a high of 275 minutes per week. All of the respondents asked reported that there were grade level meetings at the school and that science was discussed. In one case, the science Specialist regularly attends and could verify that science was a topic of discussion. In another Intensive Support school, the principal and assistant principal take turns attending the meetings and could verify science as a discussion topic.

Table 6: Minutes per Week of Science & Grade Level Meetings (IS)

Minutes per Week in Science Instruction			Grade Level Meetings	
80-150	150-225	>225	Yes	Did not report
2	3	2	6	1

Professional development attendance at each of the Intensive Support schools in the sample showed parallel trends. All of the schools in the sample were sending the majority of their teachers to CMSI science professional development in 2004-05. This number dropped to a little less than half of the sample schools in the summer of 2005. In 2005-06, it was generally the accepted practice for these third year implementing schools to send only new teachers or teachers who were teaching at a new grade level to the professional development.

Table 7: Professional Development Attendance (IS)

2004-05	Summer 2005	2005-06	
Yes	Yes	Yes for all	New Ts only
7	3	2	5

At the same time, data collected at Intensive Support schools revealed a shift from the reliance on professional development for experienced users, to in-school supports and use of material supports such as the videos provided. One principal explained

> I think they think [the professional development is] valuable but as far as the experienced users what I am hearing is the kits are so comprehensive that they don't necessarily need a

> demonstration because there is a video with the kit that tells you exactly how to teach that concept so if you spent time with that video you may not necessarily need to spend time watching someone else doing the same thing. I think they feel pretty comfortable in doing the activities.

Respondents also reported frustration with both the weekday and Saturday options, one requiring substitutes which are "lousy" and "require a whole day to clean up the mess in the room and dealing with unruly kids," and the other taking teachers away from their own families. Respondents from four of the seven Intensive Support schools in the sample specifically mentioned difficulties with substitutes as a deterrent from using school-day professional development and two suggested that getting teachers to attend on Saturdays was becoming increasingly difficult. It appears that the cumulative effects of attending this ongoing training over time was wearing on Intensive Support school participants.

In five of the seven Intensive Support schools, respondents reported that only new teachers or teachers who had switched grade levels were now attending the professional development. The extent to which this is aligned with OMS staff understanding of the need for these experienced teachers to attend professional development or not may be a productive discussion for the Lead Team and staff.

Considering all Schools: Issues in Science Implementation

In this section, issues in science implementation are considered. The first two issues were particular concerns that OMS staff expressed about the management, refurbishment and use of materials. These issues are addressed in the first sub-section. In the two sub-sections that follow, issues that emerged from the data are considered, the impetus for Voluntary implementation and unique formats of science implementation.

Management, Refurbishment & Sharing Kits

In planning for the data collection and analysis for this report, OMS science and evaluation staff expressed particular concern about several aspects of handling and managing science materials. These concerns were written into data collection protocols because of the knowledge that implementation of the science scope and sequence comes with it the unique challenges of managing live organisms and a wide range of other materials. OMS staff wanted a clearer sense of how these tasks were being undertaken and what creative solutions implementing schools had found to these unique challenges.

First, materials management and refurbishment are considered. Sample schools showed a great deal of creativity in how they solved the challenges of management of materials.

- *Specialist management:* In 4 Intensive Support schools and 4 Voluntary schools, the Specialist was responsible for materials management and refurbishment. The inventory process varied slightly in these cases. In 6 cases, the Specialist was responsible for the inventory completely. In 2 schools, teachers provided the Specialist with inventory and the Specialist ordered materials to refurbish kits.
- *Teachers:* In 0 Intensive Support and 2 Voluntary schools teachers were responsible for inventory and submitting supply orders to the assistant principal or business manager.
- *Grade level reps:* Two Intensive Support and 1 Voluntary school had a grade level representative system of managing, inventorying and ordering materials. In the two Intensive Support schools, it was primarily the first-wave teachers who took on this responsibility.

One teacher per grade level would inventory all of the kits and then the grade level representatives put an order together for the refurbishment.

Table 8: Materials Management and Refurbishment (Voluntary & IS)

Responsible for Materials Management and Refurbishment						
Specialist	Teachers	Grade level Rep	Science Com	Lab Teacher	Admin	Don't Know
8	2	3	1	3	2	3

- *Science Committee:* One Voluntary school had the unique solution of a committee system to inventory and refurbish kits. In a large school with a well-developed committee structure, 15 teachers had volunteered to serve on the science committee. These teachers inventoried the kits and worked together to put together the refurbishment order.
- *Lab teacher:* In 1 Intensive Support school and 2 Voluntary schools, the lab teacher was charged with the duty of managing, inventorying and refurbishing kits. This approach to CMSI science implementation, of separating the lab component from the in-classroom piece, is explored in more detail in the sub-section on unique formats of science implementation below.
- *Administration:* In 1 Intensive Support school and 2 Voluntary schools, the assistant principal and/or principal took complete responsibility for the management, inventory and refurbishment of materials, sometimes in cooperation with a volunteer or teachers' aide.
- *Don't know:* The 3 Voluntary schools that had not yet started implementation were not yet sure how management and refurbishment would be handled.

The sharing of kits was another issue on which OMS staff wanted information. Table 9 summarizes this information.

- *Own kits:* In 5 Intensive Support schools and 2 Voluntary schools, teachers all have their own kits and all materials necessary for full implementation of the science scope and sequence.
- *Sharing at departmentalized and split grades:* One Intensive Support school and 1 Voluntary school reported "strategic sharing" of kits. This meant that all teachers in the building had their own kits except in cases of departmentalization and/or split grade levels. In the situation of departmentalization, only one teacher at a grade level would need the kits. For split grade level teachers, these schools allowed sharing access to the materials at both of the grade levels. Thus, a teacher with 5/6 split would share materials with both the 5th and 6th grade teachers as necessary.
- *Sharing kits:* In 1 Intensive Support school and 3 Voluntary schools, all teachers shared kits. The level of sharing varied from school to school. In one case, two teachers shared each kit. In another, each grade level (in this case 4 teachers) shared a kit. The management of materials was particularly challenging in these schools, as was scheduling of science classes.

Table 9: The Sharing of Kits[7] (Voluntary & IS)

Sharing Kits		
No	"Strategic sharing"	Yes
7	2	4

[7] This data does not account for all of the schools in the sample. This is because 2 Voluntary schools have only individual teachers implementing, 3 Voluntary schools that have ordered did not report or are not yet sure and in 2 Voluntary schools data wasn't collected on this issue.

In the schools that reported that the sharing of kits was taking place, funding was the most important contributing factor in the minds of respondents. These schools, especially schools with large numbers of students, had trouble finding ways to budget for individual kits for each teacher.

Impetus for Science Implementation & Unique Forms of Implementation

In the two sub-sections that follow, unique approaches to science implementation that emerged in the data are considered. The goal of these sections is to promote discussion on OMS staff. What can be learned from the varied motivations and approaches to science implementation? What are OMS staff impressions of the unique formats of science implementation that emerged from the data? Are these acceptable? Each issue is presented in the form of a short vignette of a school in the sample. Discussion questions follow.

Impetus for Science Implementation: Teacher-Initiated

In the fall 2004-05, six teachers at Samatos Elementary who worked together on a science committee were impressed by the CMSI science scope and sequence. "They decided that it was time to revitalize science instruction at Samatos," the principal explained. The six teachers asked the principal if they might attend CMSI science professional development during 2004-05, to check out the materials and to possibly pilot them if the program seemed promising. "Their motivation and commitment was impressive to me," the principal stated. "I was all for it." The teachers were so positive about their professional development experience and about the materials that they asked the principal if they could pilot the materials the spring semester of 2005. At the same time, the teacher leaders began to drum up support for the materials and worked to convince the other teachers at the school of the benefits of going to full implementation in 2005-06. The rest of the teachers "voluntarily entered into an agreement with the six teachers who went to training last year and used the kits during the spring semester…" the principal explained. "They came back and shared with the other teachers and they recommended that we buy it." The participation of Samatos teachers in CMSI science professional development was 100% in the summer of 2005. The enthusiastic adoption and participation is attributed by the principal to the fact that implementation was teacher-inspired and led.

Discussion: What are the benefits to the approach of teacher-initiated adoption of the CMSI science program? What are the potential shortcomings? How can interested teachers in non-adopting schools be drawn upon as leaders to bringing implementation to schools?

Impetus for Science Implementation: Administration-Initiated

A researcher was surprised to hear upon talking with the Poppleton assistant principal that CMSI science materials were not being used by teachers. How could this be, the researcher asked, when fifteen teachers had been registered for CMSI science professional development in 2005? The assistant principal explained that the administration at Poppleton encourages teachers to attend the science professional development to encourage the teachers *to want to adopt*. "Exposing our teachers to different ways of thinking about instruction is our goal in this," the Poppleton assistant principal explained. "The training is there and available. For us, our purpose in using it is not implementation today but perhaps implementation down the road."

Discussion: Is sending teachers to CMSI professional development for the purpose of motivating them to want to adopt a reasonable use of these sessions? What other types of sessions, informational or motivational, could be designed to recruit and educate non-implementers?

Unique Forms of Science Implementation: Subject Integration

At Bennett Elementary, time is seen as a precious commodity and learning is understood to span across subject area lines. "We are committed to interdisciplinary learning and our new science adoption will fit into that," the principal explained. A FOSS unit on weather is extended into a lesson that has students creating their own book to demonstrate the concepts they have learned, an art and language arts application. "We do this to strengthen their use of the science vocabulary they are learning and at the same time there are discrete pieces of the lesson that are art and language arts." The Bennett staff understands this approach not only as a creative solution to time constraints but as a way to build upon a sounder theory of the way children process and share information. "Make it separate subjects and children learn to memorize and perform tasks," the principal stated. "Make it a whole and they will learn something deeper that they can take with them in life."

Discussion: What are the benefits of integrating science implementation with other subjects as a solution to time constraints and to deepen student understanding? What are the weaknesses of this approach if not done well? How can the positive aspects of this approach be promoted in schools implementing CMSI science materials?

Unique Forms of Science Implementation: Science Lab Separation

At Greenberg Elementary, implementation of CMSI science materials has a unique form: it occurs at the hands of two teachers for each class. The classroom teacher attends to the teaching of the scientific background, including the preparation work and set up for labs. The actual labs, however, are performed in a separate laboratory room under the supervision of the Science Lab Teacher. In some cases the classroom teacher stays for these labs, in other cases she uses it as a preparatory period. The administration at Greenberg sees this implementation approach as a creative solution to problems of teacher reluctance to get their rooms dirty and the lack of sinks and appropriate space in most classrooms.

Discussion: Is the separation of background teaching and lab application an "acceptable" form of implementation of CMSI science materials? Would variations on the approach at Greenberg better represent the philosophy of OMS staff? What other creative solutions can be proposed to deal with teacher reluctance and lack of appropriate space and water?

Conclusion: Critical Findings and Discussion Questions

This data brief ends by highlighting the critical findings of the report and providing some corresponding questions for discussion on those findings.

Finding A: Both OMS staff and school staff point to the many strengths of teacher-led professional development. At the same time, both have also identified the uneven quality of PDL sessions as a challenge of PDL-led professional development (pp. 7-8). The monitoring of quality of all OMS-sponsored professional development sessions is an area of ongoing focus recommended by external evaluation staff.[8]

> Discussion Question A: What types of evaluation are necessary to determine the overall strengths and weaknesses of PDL-led professional development? What systems of quality control and training can be designed to strengthen the sessions of all PDLs?

Finding B: Respondents at Intensive Support schools generally believe that there is little need for their experienced teachers to attend CMSI science professional development sessions. In their third year of implementation, these schools generally only send their new users and those who have changed grade levels (pp. 10-11).

> Discussion Question B: Is there a time at which experienced users do not need to attend further CMSI science professional development? Could new sessions be designed that are more appropriate for the most advanced science implementers?

Finding C: Voluntary schools in the sample that were sending teachers to professional development were largely in their first year of implementation. Slightly more than 50% of these schools were at full implementation of the science scope and sequence. Slightly more than 50% of these schools had allocated between 150 and 200 minutes for science instruction per week and the vast majority of them had grade level meeting structures in place. Roughly 50% of these schools had designated a science Specialist, although half of these Specialists were not freed. A high level of commitment to professional development attendance existed in these schools (pp. 8-9).

> Discussion Question C: Given the characteristics of Voluntary implementing schools, what kinds of supports can be provided to them beyond professional development? Which aspects of the description suggest strong implementation? Which should be the focus of improvement in these schools?

Finding D: Approximately 1/3 of Voluntary implementers were using a partial adoption plan of the CMSI science materials, either through isolated grade levels using the program or by using only certain components, such as lab activities (pp. 8-9, 14)

> Discussion Question D: What forms of partial adoption make sense to OMS staff? Which should be discouraged?

[8] For additional detail see Hallman et al, Report C, 2004.

Finding E: A little more than 30% of Voluntary implementers have in-classroom support for teachers while roughly 70% of Intensive Support schools report in-classroom assistance (pp. 9, 10).

Discussion Question E: How critical is in-classroom support to successful implementation of science materials? Are these numbers of schools reporting in-classroom support high or low in the estimation of OMS staff?

Finding F: The vast majority of both Voluntary implementing and Intensive Support schools reported having structures in place for regular grade level meetings (pp. 9, 10).

Discussion Question F: How does OMS staff recommend that grade level meetings can be used to support science implementation? Are there formal guidelines and recommendations available for schools?

Finding G: Respondents identified six distinct approaches to the management and refurbishment of kits including the Specialist, teachers, grade level representatives, science committee, lab teacher, and administration (p. 11-12).

Discussion G: Which of these approaches to management and refurbishment seem most promising? What kinds of materials can be designed for schools with insights into some of the creative solutions to management schools in this study are using?

Finding H: Of the thirteen schools with full implementation who provided information, 7 reported that teachers all had their own materials, 2 reported "strategic sharing" in cases of departmentalization and split grades and 4 reported sharing among pairs or grade levels of teachers. Respondents reported that the sharing of kits was often due to lack of ability to budget for kits for every teacher (pp. 12-13).

Discussion H: What does OMS staff think about sharing kits? Are there cases in which it makes sense and not? What message should be sent to schools about kit sharing? What assistance can OMS provide schools on how to budget for individual kits for teachers? Are there creative solutions to these funding issues?

Appendix I: Evaluation & Sampling Method

Historical Mapping Evaluation Method

The mapping of the historical development of the elementary science Initiative draws upon narratives from semi-structured interviews with Office of Math and Science staff (OMS) and document analysis. Specifically, this section relies upon analysis of five interviews with science-focused staff from OMS conducted between the spring of 2003 and the fall of 2005 and analysis of materials that document the historical development of the elementary science initiative.

Science Implementation Sample and Evaluation Method

The story of science implementation in schools begins with the challenge of identifying the population of science implementers. For this report, through our conversations with OMS science and internal evaluation staff, we chose to use attendance and registration lists for CMSI science professional development to define the population of science implementers. We began with a list of all schools that sent teachers to CMSI science professional development during the 2004-05 school year *or* that registered teachers for professional development in summer of 2005.[9] A total of 281 schools were on this list. We then worked with OMS staff to narrow the population. In analyzing the initial list, we realized that there were a large number of schools that had sent a single teacher to professional development in 2004-05 or only one teacher had registered for summer 2005. Sending a team of researchers to schools with such small numbers of participating teachers did not seem like a good use of resources.

Thus, our team decided to narrow the population to only those schools that had sent more than 7 teachers to CMSI science professional development during 2004-05 or had registered more than 7 teachers for the summer of 2005. These125 schools were defined as the population of the study of CMSI science implementers.

OMS staff had two concerns about the sample that would be selected. First, it was important that the selection of the sample across the Areas and Clusters was consistent with the actual distribution of CMSI science schools.[10] Second, it was important that a reasonable portion of the original science Intensive Support schools were also included in the sample to provide information on how implementation was progressing in that particular population of CMSI science schools. The population was analyzed to chart the distribution of schools across Areas and to document the original Intensive Support schools. A random sample was then chosen of about 30% of the population. The selection of a 30%, we reasoned, would provide for us (after data attrition) data on 25% of the population. The initial random sample was checked for distribution across Area and for the inclusion of at least 30% of the original science Intensive Support schools. Five schools from the original sample were returned and redrawn to more closely approximate the distribution of science implementers by Area. The original sample contained a reasonable percentage of Intensive Support science schools by chance.

Data was collected using a "drop-in" method first utilized for the study of probation schools implementing CMSI materials in 2005.[11] UIC researchers stopped into sample schools and explained that they were there to obtain information about implementation of CMSI science materials. In total,

[9] At the time of the designing of this study, the actual attendance numbers for the summer 2005 professional development were not yet available. For this reason, the registration numbers were used.
[10] The Chicago Public Schools' district is sub-divided into 17 elementary and 5 high school Areas. These Area offices are located within the section of the city they are assigned. Groups of three elementary school Areas and the corresponding high school Area are grouped together in a shared office space called a Cluster. For example, elementary school Areas 1, 2 and 3 and high school area 19 make up the Cluster One office. These sub-district offices are responsible for oversight of schools that fall into a set geographic portion of the city.
[11] For additional details, please see Stoelinga, Fendt and Wenzel, 2005.

UIC researchers visited 34 schools. Twenty-seven sample schools chose to participate in the interviews. Researchers used an interview protocol, co-designed by PRAIRIE and OMS science and evaluation staff, to collect information.[12] These interviews were then either tape recorded directly or summarized on tape. These interviews and interview summaries were transcribed. The data from each were put into a matrix allowing for a brief summary of the character of implementation in each school as well as making it possible for cross-school analysis. The table below summarizes the respondents with whom interviews were conducted.

Table 10: Pattern of Respondents

Principal (PR): 7
Assistant Principal (AP): 8
Science Specialist[13] (SP): 9
AP & SP: 1
PR & AP: 1
Citywide Specialist[14]: 1
Teacher: 1

Of the twenty-seven schools where data were provided, 7 were Intensive Support Schools, 15 were Voluntary first or second year implementers, and 5 schools reported that they were not implementing CMSI science despite the fact that teachers had attended or had been registered to attend CMSI science professional development.

The distribution of the selected sample across Areas aimed for data to be collected on approximately 25% of the implementing schools. Here, we summarize the actual data collected by Cluster.

Table 11: Distribution of Sample by Cluster

Cluster	Schools in Population	~25% sample	Actual Number	Actual % of population
1	13	3-4	2	15.4%
2	19	4-5	4	21.1%
3	17	4-5	4	23.5%
4	22	5-6	5	22.7%
5	29	7-8	7	24.1%
6	25	6-7	5	20.0%

The table below provides summary information about the population and sample used for the data collection. The total actual percentage of the population of schools where data was collected was 21.6%. The total percentage of the original science Intensive Support schools that participated was 30.0%.

Table 12: Summary of Report Population and Sample

[12] The protocol is included in Appendix II of this report.
[13] In several cases, the Science Specialist was also a classroom teacher. For the purposes of this table, these individuals with split roles are counted as Specialists.
[14] A citywide Specialist was present in one school when researchers came to interview the in-school science Specialist. Two separate interviews were conducted in this school. For this reason, the number of respondents is 28 though the number of schools with data is only 27.

Total schools sending teachers to 2004-05 CMSI science PD or registering teachers for summer: 281
Total schools in population of sending >7 teachers to PD, 2004-05 or summer 2005: 125
Total schools in sample: 27
Intensive Support Schools: 7
Voluntary first and second year implementers: 15
Schools not implementing CMSI science: 5
Overall percentage of population: 21.6%
Percentage of original Intensive Support school population: 30.0%

Appendix II: References

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Appendix III: Research Materials

Science Road Trip Protocol
11/05

School Background

- Confirm principal
- Is there another contact for Science-related work? Specialist?

Materials Purchased

- When did you buy the CMSI science materials?
    - Which curricula? (For primary grades—FOSS and STC; for middle grades—SEPUP and IES)
    - For whom?
    - Are teachers sharing kits or do each have their own

Teacher Use of Curricula

- Are the teachers using the curricula?
    - Who using what?
    - Grade levels
    - All teachers
    - Voluntary or required
- How do you know what is going on in classrooms?
- How many minutes per week does your school spend on science instruction? How is this time allocated (for example, 1 period per day; two periods of science on MW, 1 on F, etc.)

Professional Development

- Are they going to PD?
    - Who? How often?
    - How are subs paid? How are teachers paid for Saturdays?
    - What are your/your teachers' perceptions of PD?

Teacher Support

- Do teachers meet in grade levels at your school?
    - Do they discuss science implementation?
- Is anyone working with teachers in their classrooms on use of the science materials?
    - Specialist? Principal? Coach? Facilitator? Other teacher? Other?

Materials Management/Refurbishment

- Who manages the science materials?
    - What strategies do you have to manage?
    - What are your plans for refurbishment of science kit

CMSI Science Manager/Facilitator Interview
Fall, 2005

1. Talk about the history of the CMSI Science strand, beginning with the kick-off of the Initiative in February of 2003.

    a. What were the goals for science in the CMSI?
    b. What was the process of choosing the CMSI science materials?
    c. What was the process of designing the science professional development?

2. Trace the evolution of the science strand from 2003 to present.

    a. What have the successes been?
    b. What have the challenges been?
    c. What aspects of the science program and the professional development that support it have changed?
    d. What aspects of the science program and the professional development that support it have remained the same?
    e. In what ways will the science Initiative continue to evolve?

3. Talk about the science strand teacher-led professional development.

    a. How was this approach designed and by whom?
    b. What have been the strengths and weaknesses of the design?
    c. How has this approach developed throughout the Initiative?
    d. In what ways do you hope that this model will continue to evolve as you move into the future?

4. Talk about implementation of the science program in CPS.

    a. What is your perception of the breadth, depth and quality of implementation in the system?
    b. What are the challenges of implementing these programs in schools?
    c. What supports are in place to assist schools in overcoming these challenges?

5. Is there anything else you would like to tell me about the science Initiative that is relevant to telling the story of development?