Program Evaluation of CitySprouts and the Cambridge Public School District
Science in the Garden Workshops

January 2011

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Executive Summary

The science department of the Cambridge Public School District (CPSD), in partnership with CitySprouts, conducted a piloting of a *Science in the Garden* workshop in three CPSD K-8 schools in spring and fall 2010. The goal of the workshops was to strengthen instruction of the district science curriculum by: 1) demonstrating to all teachers of science how the gardens can be used to teach key topics in the science curriculum; and 2) familiarizing teachers with the school gardens as a resource for science instruction.

Connected to the pilot project, an evaluation was commissioned by CitySprouts to assess the impact of the *Science in the Garden* workshop on teachers' use of the garden, and investigate teachers' perceptions of the impact of garden-based instruction on student learning in science. A preliminary report was conducted in spring 2010 which included a review of the empirical literature on the use of school gardens for science instruction and provided formative feedback on the workshops. The preliminary report found that the design of the CitySprouts program was aligned with the features identified in the research that supported teachers' use of school gardens: the presence of a dedicated staff members to maintain the garden, collaboration with CPSD to highlight connections with the district science curriculum, support from school administrators for teachers' use of the garden, and strategies to build teachers' understanding of the science content that can be taught in the garden, such as the *Science in the Garden* workshops.

This final report focused on teachers' perceptions of the impact of garden-based instruction on their science teaching and on student learning. Data was collected in fall 2010 through in-person interviews with eight K-8 teachers who attended the workshop, two science coaches in CPSD, and surveys of all teachers at the schools involved in the pilot project.

Highlighted findings from the evaluation were:

- **Teachers viewed the gardens as providing a learning experience which helped students understand science concepts more deeply and fully.** In interviews, teachers described a general sense that students benefited from learning science in the gardens, with specific reference to students with IEPs and ELL students benefiting from garden-based instruction. Teachers believed that students had greater retention of the knowledge that they learned in garden-based lessons. There was strong agreement among respondents that the gardens supported learning by helping students transfer what they learned in class to new settings.

- **Interview respondents were uniform in their belief that students were more engaged in learning when taught in garden-based lessons, compared to lessons taught solely in the classroom.** Teachers believed that students responded with notable excitement and curiosity to garden-based lessons, which aligned well with teachers' goals for science learning.

- **The *Science in the Garden* workshop, in conjunction with other science department activities to support garden-based lessons, expanded teachers' use of the garden for science instruction.** Interview and survey data indicated that classroom teachers have benefited from the efforts of CitySprouts and the Cambridge science department to highlight the connection between the science curriculum and the school gardens. Teachers reported that the *Science in the Garden* workshop raised the awareness of teachers in their schools to the potential for using the school gardens as an instructional resource.

Introduction

This report is the final part of an evaluation project to examine the effect of the Cambridge Public School District (CPSD) *Science in the Garden* workshops and the CitySprouts team on teachers' use of school gardens. The findings in this report center on teachers' perceptions of the effects of garden-based lessons on student engagement and student learning.

This report builds upon an earlier report of preliminary findings, which examined the design and implementation of the workshops and other activities of the partnership between the science department and CitySprouts. Activities for this final report were conducted between August 2010 and January 2011. Activities for the earlier report were conducted between March and June 2010.

This report begins with an Overview of the context of the evaluation with descriptions of CitySprouts, CPSD, and the *Science in the Garden* workshops. The Overview is followed by a description of the Data Collection and Analysis procedures used for this report, the presentation of Findings, and Discussion and Next Steps for actions based on the findings.

Overview

A formal partnership between CitySprouts and the science department of Cambridge Public School District (CPSD) was formed in fall 2009. Staff from each organization collaborated on the creation of the *Science in the Garden* workshops and additional activities connected to the workshops. This section presents an overview of CPSD and the schools involved in the pilot project, CitySprouts, and the workshops.

Cambridge Public Schools District[1]

The Cambridge Public School District is an urban school district which consists of twelve elementary and middle (all but one is K-8) schools and one high school. Several of the district K-8 schools also include pre-K classrooms. The district serves nearly 6,000 students and has an ethnically diverse student body that is 34% African-American, 11% Asian, 14% Hispanic, and 36% white. The *Science in the Garden* workshop was piloted in two schools (Amigos and Peabody) in spring 2010 and in a third school (Maria L. Baldwin) in fall 2010. A fourth school was originally included in the plans for the piloting in the fall of 2010, but requested to postpone its involvement. At the time of this report, an additional school had tentatively been scheduled to receive the workshop in spring 2011 and was not included in the data collection for this report. Brief descriptions of the three pilot schools are provided here.

Amigos is one of the smallest schools in the district, serving 295 students in grades K-8. Amigos is a bi-lingual school with instruction conducted in English and Spanish. The

[1] Retrieved on 12/29/10 from http://profiles.doe.mass.edu/profiles/general.aspx?topNavId=1&orgcode=00490000&orgtypecode=5&

student demographics of the Amigos differ from that of the rest of the district, with 55% Hispanic students, 30% White, and small populations of African-American and Asian students.

Peabody is the largest K-8 school in CPSD, serving 520 students. The student demographics of the school are similar to those of the entire district, with a slightly higher percentage of African-American students (39%) and a slightly lower percentage of Hispanic students (8%).

The Maria L. Baldwin school serves 383 students and is a mid-sized school in the district. It includes a slightly higher percentage of white students (49%), and lower percentage of African-American students (27%) and Hispanic students (8%) than the averages for the district.

Table 1: Student demographics

	Total students	% African-American	% Asian	% Hispanic	% White	% Other
District	**5,950**	**34**	**11**	**14**	**36**	**5**
Amigos	295	8	3	59	30	0
Peabody	520	39	12	8	37	4
Mariah L. Baldwin	383	27	10	8	49	1

CitySprouts [2]

CitySprouts is a nonprofit organization which, through a variety of programs, supports the use of gardens in the CPSD. The mission of CitySprouts is to work with students and families in the community to strengthen their knowledge of nutrition, sustainability, and connection to the environment. CitySprouts operates a summer internship program, out-of-school time activities in the garden for families and students, and professional development in science for CPSD teachers. CitySprouts staff members work in the school gardens and directly with children, families, interns, and CPSD teachers.

Garden coordinators are part-time, CitySprouts employees assigned to each school garden, who are responsible for maintaining the garden as well as supporting the use of the garden by teachers. In the spring and fall of 2010, the five garden coordinators in spring 2010 were each responsible for 1-3 gardens and spent 10 hours per week at each. Garden coordinators are supported by the CitySprouts Outreach and Education Coordinator, a Program Manager and Executive Director.

Since its inception in 1999, CitySprouts has grown from a presence in two K-8 Cambridge schools to working with all twelve K-8 schools and preschool classrooms in the district, as of 2009-2010. While CitySprouts has enjoyed a strong partnership with CPSD throughout its history, the expansion district-wide contributed to a new level of collaboration between the district science department and CitySprouts staff which culminated in the *Science in the Garden* workshops to support teachers' use of the school gardens to teach the district science curriculum.

[2] Retrieved on 12/30/10 from http://www.citysprouts.org/

The gardens in the pilot schools vary in their design, size, and how long they have been in existence. The gardens and their history are briefly described here:

- The garden in the Peabody school was created in 2002 as part of a school renovation and is located in a central courtyard in the school, surrounded by one-story hallways and classrooms. CitySprouts assumed responsibility for the school garden in 2004 and retained existing features, such as brick paths, a greenhouse, and a tool shed, and replaced many of the landscape plants with fruit shrubs, vegetables, herbs and flowers.

- The garden at the Amigos school was developed by CitySprouts in 2006. The garden is shared between the Amigos School and the M. L. King School which are housed in the same building. The garden fills a large internal courtyard area, surrounded by the two-story tall school building. Similar plants are grown in the Amigos garden as are found at the Peabody school, with the addition of grapes in an arbor. The garden is next to a large indoor storage space, which houses a water table and gardening supplies.

- The garden at the Maria L. Baldwin school was one of the most recently completed school gardens in the district, installed in fall 2009. The garden is one of the smallest, consisting of four raised beds that occupy one side of the school's concrete recess area and one additional small plot along the sidewalk that borders the school. The garden area includes a variety of vegetables, herbs, and flowers.

Science in the Garden Workshops

The CPSD *Science in the Garden* workshops were conducted in the Peabody and Amigos schools during spring 2010 and the Maria L. Baldwin school in fall 2010. The goal of the workshops is to strengthen instruction of the district science curriculum by: 1) demonstrating to all teachers of science how the gardens can be used to teach key topics in the science curriculum; and 2) familiarizing teachers with the school gardens as a resource for science instruction. The workshops were designed in response to comments the district science coaches heard from teachers, in which teachers noted that their lack of content knowledge of science made it difficult for them to teach the curriculum and/or utilize the school gardens. The schools selected for the pilot were chosen based on the presence of: a defined science curriculum (as opposed to core subject-based or Montessori-based curriculum); a principal who is returning the next year and supportive of receiving the professional development workshop; and a school garden that has been in place for more than one year.

The workshop originally piloted in the Peabody and Amigos school in spring 2010 was revised based on feedback and the recommendations in the preliminary evaluation report. The original design of the workshop included three discrete sections: a Garden Experience, Curriculum Review and Content Professional Development. More information on the original design of the workshop can be found in the preliminary report.

The fall 2010 workshop was redesigned to combine these three sections and increase the focus on modeling use of the gardens to teach science. Consistent with the original design, the workshops remained two hours long and designed for teachers in grades K-5 and science teachers in grades 6-8. During the workshop, teachers were split into cross-grade breakout groups organized around science units in the curriculum. For example, 3rd, 6th, and 7th/8th grade teachers formed one group that focused on "Diversity in the Garden Ecosystem/Habitat." The demonstrated lessons touched upon units taught in science in each of these grade levels.

Each group was led by a member of the CPSD science department who was assisted by a CitySprouts staff member. The workshop consisted of two sections that were closely tied together: Curriculum Review and Garden Experience. The leader of the group demonstrated a garden-based lesson that could be adapted by the teachers for their grade levels. The lesson also included components to be taught in the classroom. The groups discussed how the lesson tied into their science units and also other units that could be taught using the garden. During this discussion, group members received a Curriculum Connections document from the CPSD science department, which highlighted units in the science curriculum of each grade level that could be enhanced through use of the garden. Teachers were asked to take the Curriculum Connection document and place it into their Teacher Binders for future reference.

Data Collection and Analysis

This section reviews the data collection and analysis strategies employed during the fall of 2010. Data consisted primarily of two sources: interviews with teachers in the three pilot schools and district science coaches, and results from biannual surveys on garden use, administered to all teachers in the district. The evaluator also attended the presentation of the workshops as an observer and kept field notes on the workshop.

Interviews were attempted with the principals of the three schools involved in the pilot but were ultimately not available for the study. Despite several attempts, the evaluator was unable to schedule interviews with two of the principals. The third principal met with the researcher but, as he was in his first months on the job, he described himself as having little knowledge of his teachers' instruction in science nor of their use of the school garden at this point, so his comments played a very limited role in this analysis.

Interviews:
Interviews were conducted with teachers who attended the *Science in the Garden* workshop from three schools involved in the pilot and the two CPSD science coaches who provide support to all the schools in the district in 2010-2011 and help lead the workshops.

Teacher Interviews

- Eight teachers were interviewed. Participation was voluntary, in response to an email invitation to all teachers who attended the workshop. Only teachers who had used the garden for science lessons in the previous year were interviewed,

because they had the necessary background for sharing their perceptions of the impact of garden-based science lessons on student learning.

- Interviews were semi-structured and lasted between 20-30 minutes. The interviews focused on teachers' perceptions of: the utility of the garden to teach science concepts in the district curriculum, the utility of the garden for leading scientific investigations; and the impact of garden-based lessons on student learning of science.
- All interviews were conducted in-person by the evaluator. Field notes were created as a record of each interview.
- Three teachers were interviewed from each of the Amigos and Maria L. Baldwin schools. Two teachers were interviewed from the Peabody school.

Table 2. Characteristics of teacher interview respondents

Teacher Identification	Grade level	Years experience	Science units taught in the garden
Teacher 1	6, 7, 8	8	6th- Ecosystems/Environment 7th – Geology, Photosynthesis 8th- Genetics and Evolution
Teacher 2	K	25	Organisms
Teacher 3	1	2	Living Things, Weather
Teacher 4	6, 7, 8	8	6th- Ecosystems/Environment 7th- Biodiversity 8th- Genetics
Teacher 5	2	17	Soils, Lifecycles
Teacher 6	3	10	Plants
Teacher 7	2	5	Soils, Lifecycles
Teacher 8	2	6	Soils, Lifecycles, Seeds

- The teachers represented a range of grade levels, although the majority taught early elementary grades (K-3). Two teachers taught middle grades science in their schools.
- The teachers represented a range of years of teaching experience, although all but one had taught for at least five years.

Science coach interviews

- Interviews were conducted with the two CPSD science coaches who provide support to all of the schools in the district.
- The two coaches had been in their roles as district-based coaches for more than five years. However, the number of teachers with whom they worked had changed in the fall of 2010, as the district reduced the number of cross-district coaches to two, from four. In 2010-2011, the coaches were each assigned six K-8 schools and split their time among the schools. As determined by the district, the coaches spent much of their time working with new teachers and preparing and leading science professional development for teachers.
- The interviews focused on the coaches' perceptions of the influence of the gardens on science instruction and possible impact of garden-based lessons on student knowledge of science.

- Interviews were semi-structured and lasted approximately 30 minutes.
- All interviews were conducted in-person by the evaluator. Field notes were created as a record of each interview.

Teacher surveys

- Since 2002, CitySprouts has collected bi-annual data on teachers' use of the gardens. CitySprouts administers a short survey to all teachers at the schools that have gardens. The survey is administered in the fall and spring of each school year and is distributed and collected by the school principal. The survey is not confidential, as teachers sign their names to the top of the survey, so this must be considered when assessing the validity of the information reported by the teachers.
- Surveys were administered to all teachers, assistant teachers, and specialists in the school. For the purpose of this evaluation, survey results included only teachers of science (teachers in grades preK-5, who are generalists and teach science, and science specialists in grades 6-8) and surveys from the three schools involved in the piloting of the workshop.
- In the survey, teachers report their frequency of use and which units were taught using the garden. The survey asks teachers to record all instances in which they use the gardens and is not focused solely on teacher use of the gardens for science instruction.
- In this evaluation, the survey results from 2008-2010 were used to examine trends in teachers' reported use of the gardens and possible effects of the workshop on teachers' use of the garden for science.
- The number of non-respondents was not recorded by CitySprouts. However, CitySprouts employees noted that the response rate to the survey was very high, typically 100%, attributed to multiple rounds of follow up and personal efforts to contact teachers.

Analytic Process

Data analysis was based on a framework adapted from a review of descriptions of high-quality science instruction. The framework used in analysis was based on three sources:

1) *The National Science Education Standards (1996),* produced by the National Academies.

The NSES present K-12 standards for producing science literate students. Within the NSES are standards for student learning, instruction, administrator support, and teacher knowledge in science. The framework for this evaluation adapted the standards listed for "Science Teaching Standards." This section covers a range of features of quality instruction, such as classroom assessments and planning a science curriculum. The framework developed for the analysis in this evaluation drew upon a subset of these standards for high quality science instruction that were pertinent to the evaluation's research questions: Teachers' efforts to plan inquiry-based programs; teacher efforts to guide and facilitate learning by modeling and encouraging curiosity and openness to new ideas; encouraging all students to participate fully in science learning; challenging students to accept and share responsibility for their own learning.

2) Horizon Resource Institute *Inside the Classroom* (2003).
This paper reported on an assessment of the quality of mathematics and science instruction in a sample of schools from across the nation. The section of the report which defines the characteristics of high-quality instruction was reviewed to inform the analytic framework for the evaluation. High quality science instruction featured teacher efforts to: Portray science as a dynamic, rather than static, body of knowledge, build on students' prior understanding, connect activities with learning goals, have students interact purposefully with science content, provide opportunities for students to grapple with content in meaningful ways, interest and engage students in real-world experiences, utilize multiple ways of representing concepts.

3) Description of quality science instruction from the science department of CPSD.
Staff of the science department of Cambridge Public Schools and from CitySprouts participated in a two-hour module to build a shared vision of quality instruction. The session was led by the evaluator and used the video-based module "Leadership Team and Quality Instruction" from the *Success at the Core* collection of modules. The session focused on identifying the observable instructional strategies that would demonstrate high quality science instruction in the school gardens. Examples of such strategies included the use of hands-on activities that were connected to science content, and utilizing students' curiosity to create questions that guide scientific investigations.

A framework that described the characteristics of high quality science instruction was developed by the evaluator based on a review of these three sources. The framework identified common characteristics of high quality science instruction in the source materials and highlighted those that were especially pertinent to garden-based instruction. The framework informed the design of the interview protocols. In data analysis, interview and survey data were analyzed against this framework to assess the effect of use of the garden on the quality of science instruction and student learning. Findings emerged through this analysis and are presented here.

Findings

Findings were identified on three topics: the impact of the school gardens on the quality of instruction, the influence of the garden on students' science learning, and the impact of the workshops on teachers' use of the gardens. Quotes and statements from interviews are presented to illustrate the findings. The findings provide the basis for the conclusions and discussion of next steps in the final section of the report.

Findings on the influence of the garden on students' science learning
For interview respondents, the gardens were viewed as providing a learning experience for students which helped them understand science concepts more deeply and fully. All

interviewed teachers described a general sense that students benefited from learning science in the gardens. These benefits were described as manifested in variety of ways.

A pair of teachers noted that garden-based lessons supported equity by involving all students in science learning. The two middle-grades science teachers noted benefits of garden-based lessons for their disadvantaged students (English-language learners and students with Individualized Education Plans). Said one teacher, "Garden-based lessons help students with IEPs because, in the garden, students need to take in information in different ways and these students aren't at a disadvantage." Another teacher said, "Teaching in the garden helps ELL students because language isn't as big of a barrier (as in classroom instruction)."

These teachers depicted a similar benefit for these students, as garden-based lessons were less dependent on language- and text-based learning that was challenging for these students in traditional classroom instruction. This finding suggests that the school gardens may be an effective way for teachers to differentiate science instruction for the range of learning needs of students in their classes.

Teachers believed that students had greater retention of the knowledge that they learned in garden-based lessons. Teachers tended to attribute this effect to the sense of immersion that students felt when doing science in the garden so that science concepts were not seen by students as isolated and disconnected from other science content. One middle grades teacher reported "[In garden-based lessons] Students understand the concepts more deeply and see the interconnections within a unit." A 2nd grade teacher said that students' understanding and retention was enhanced because "…the garden is realistic and students get to look at the natural world, rather than a re-created world as in the classroom experiments."

There was strong agreement among respondents that the gardens supported learning by helping students transfer what they learned in class to new settings. Interview respondents commented that the gardens helped students see science as part of their everyday world, rather than just a subject taught in school. Teachers and the science coaches noted that the gardens provided an opportunity for students to apply their knowledge in real settings, rather than the contrived setting of the classroom. Said a district science coach "The garden gives children a real-world application of what they're learning about and makes it more relevant and meaningful. It helps kids make connection that science is happening around them, to see more about how science fits with their life." A 2nd-grade teacher reported that garden-based instruction "supports students' ability to transfer what they've learned and apply it to new settings."

Some teachers had anecdotal evidence to support their beliefs in the benefits of garden-based science instruction, although for the majority of teachers, this was based on their sense of students' experience and not based on any formally constructed comparisons or examinations of testing data. For example, one teacher noted that when her students discussed concepts taught in the garden, they appeared more engaged in the materials and noted more details in their conversations. However, teachers could not cite evidence from classroom assessments of student work or from comparisons of teaching a lesson in

the garden versus the same lesson taught in the classroom. This indicates that, while there is some evidence to support the claim that garden-based instruction benefits students' learning of science, more research is warranted to increase confidence in the validity of this claim.

Findings on the impact of the school gardens on the quality of science instruction
In interviews, teachers were uniform in their belief that students were more engaged in learning when taught in garden-based lessons, compared to lessons taught solely in the classroom. Teachers believed that students responded with notable excitement and curiosity to garden-based lessons, which aligned well with teachers' goals for science learning.

Teachers described how the garden suited their aims to design hands-on experiences for students. One middle grades teacher said, "Garden-based lessons help students make the connections through sensory experience, for example, the students can feel that the compost is hot. Students can see the process of decomposition as it happens. The garden helps students see and make connections and students enjoy being there, actually see what its like to conduct an experiment and not just read about it."

A first-grade teacher echoed this sentiment, "It's boring in the classroom. The garden presents a multi-sensory experience, it's more engaging. Learning in the garden allows the students to build connections among concepts and builds more excitement."

Teachers viewed the gardens as a valuable resource for specific phases of scientific investigations. The majority of teachers interviewed had used the gardens as a place for students to practice the ability to record natural observations and sketches. This statement was supported by the survey responses, in which natural observations was the most frequently cited form of use. About half the teachers reported that they used the gardens for other phases of investigations, in data collection (for example, to find the acidity of soil) and to make predictions and hypotheses (such as for variation in the rate of plant growth). Teachers noted that the gardens were well-suited for generating hypotheses because students encounter things in the garden that spur their imagination and make them wonder why things are the way they are in the garden.

Findings on the impact of the *Science in the Garden* workshop on teachers' use of the gardens
The *Science in the Garden* workshop, in conjunction with other science department activities to support garden-based lessons, has expanded teachers' use of the garden for science instruction. Interview and survey data indicated that classroom teachers have benefited from the efforts of CitySprouts and the Cambridge science department to highlight the connection between the science curriculum and the school gardens.

Teachers reported that the *Science in the Garden* workshop raised the awareness of teachers in their schools to the potential for using the school gardens as an instructional resource. The majority of the teachers who volunteered for interviews described themselves as committed, regular users of their gardens, and respondents noted that the workshop and Curriculum Connections documents confirmed their existing beliefs in

using the garden. Further, teachers commented that the activities motivated them to use the garden more often and provided a clear game plan for increasing their usage.

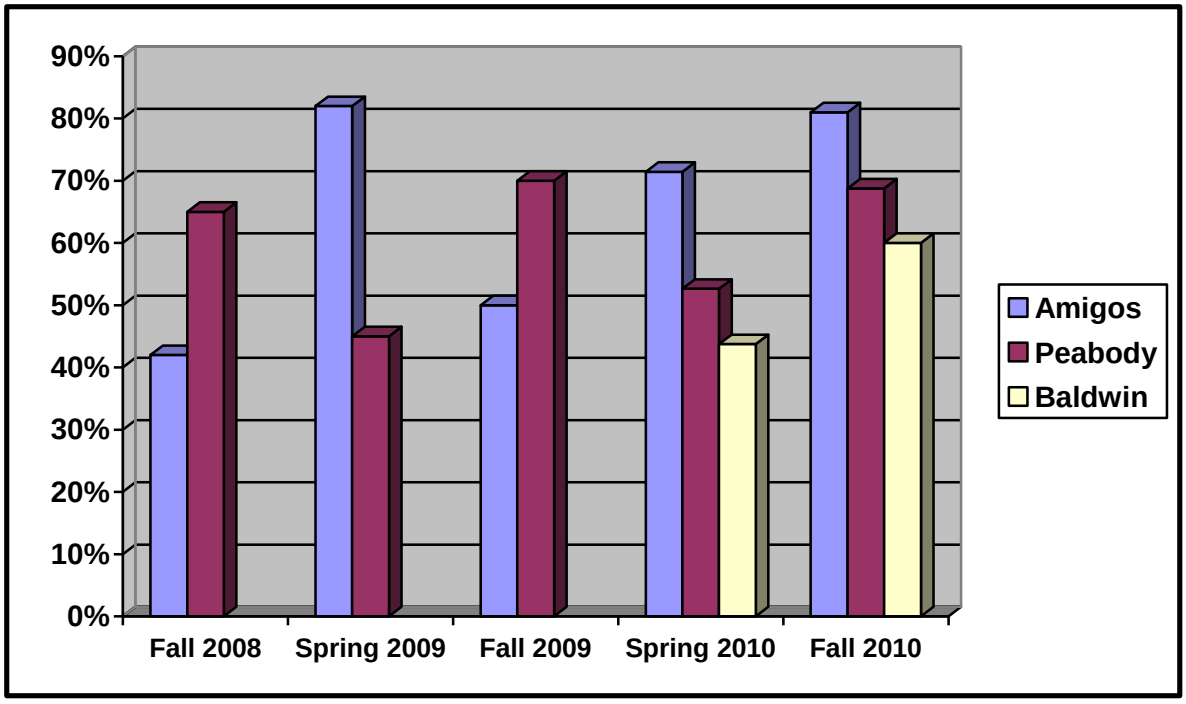
Interview respondents reported that the workshop may benefit teachers who had not used the garden previously. One coach described the potential of the workshop to support new users: "The workshop provides a chance to rehearse instruction with the teachers. If you haven't taught using the garden, it's hard to see the value of it; you'll just see the challenges. The workshop presentations give teachers concrete ways to access the garden. At the workshop, teachers seemed excited, able to practice a lesson and discuss it with the coaches and colleagues."

The Curriculum Connections document has been a helpful tool for expanding teachers' use of the gardens. Teacher respondents noted that the Curriculum Connections had helped them increase the number of science lessons they taught using the garden. Said one teacher, "[The Curriculum Connections] is like a guidebook for using the garden- it's been a good resource and has made a difference in how much I've used the garden."

Two teacher respondents noted that the Curriculum Connections had provided them with a way to talk about the gardens with their colleagues and to encourage others to teach science in the gardens. A science coach also noted that he had seen teachers using the Curriculum Connections and believed that teachers had found it helpful.

CitySprouts survey data also provides insight into teachers' reported use of the gardens and suggests that the workshop and other activities has increased teachers' use of the gardens for science instruction. The survey reports on the number of teachers who used the school garden for science instruction at least one time during the semester. When reviewing the data, it is important to consider that teachers' use is influenced by the sequence of the units taught in the science curriculum and which units are suited for garden-based instruction. For example, teachers in grades K-2 teach a unit on Soils and Decomposition in the fall semester, and this results in higher use of the gardens by these teachers during that time of year. Data for the Maria L. Baldwin school is included beginning in fall of 2009, which was when the garden was launched in that school. The workshop was piloted in the early April, 2010 in the Peabody school, late May, 2010 in the Amigos school and in October of 2010 in the Maria L. Baldwin school.

Chart 1. Teachers' use of the garden for science instruction



The data suggests that teacher use of the gardens for science instruction increased slightly at Peabody in the spring of 2010 (compared to spring 2009) and was essentially the same in the fall of 2010 and fall of 2009. Use of the Amigos garden increased substantially when comparing the fall of 2010 and the fall of 2009.

Discussion and Next Steps

While CitySprouts has been in existence for several years, the fall of 2010 marked the completion of the first year of district-wide programs to support use of the gardens for science instruction. The findings of this evaluation are signs that the initial efforts to utilize school gardens to improve science instruction have been effective. Interview data indicated that teachers believed that garden-based lessons contributed to improved student knowledge of science. This belief was supported by the descriptions of teachers' use of the gardens for science instruction, which was consistent with several of the characteristics of high-quality instruction from NSES, HRI and the science department's descriptions of quality instruction.

When reviewing this report, it is important to note that there were some threats to the validity of the findings, based on the data collection and analysis strategies. This evaluation relied on data sources (interview and survey) that were self-reported, although an effort was made to involve reports from multiple sources to mitigate this threat. Also, the evaluator was the sole researcher involved in data analysis, introducing the possibility of bias. To reduce the threat of researcher bias, this report and the data collection strategies were reviewed at different points by external advisors.

No matter how much support is provided for teachers' use of the gardens, it is important to recognize that the garden is only one factor that influences the quality of science instruction, and that teachers' own background and experience is likely a far larger impact on the quality of science instruction than the garden. Still, this evaluation found that teachers believed that the garden was an important asset that improved science teaching and learning. One factor may be that garden-based lessons appeared to have a number of scaffolds available to teachers that could, overall, help teachers become stronger teachers of science: the garden coordinators and their knowledge of botany and other science topics, the science coaches and their familiarity of the gardens as an object of science instruction, the demonstration lessons of the *Science in the Garden* workshops, and the Curriculum Connections. While the effect of these supports is not quantified, the findings from this study suggest that teachers utilize these supports in ways that are consistent with quality instruction, and which may, therefore, help them become better teachers.

The interview data indicated that the activities had successfully promoted the value of the gardens as a resource for science instruction. More importantly, the design of the activities included scaffolding that appeared to help teachers who were already regular users of the garden see new opportunities and strategies for utilizing the garden for science instruction. This effect was seen in the Amigos and Peabody schools that had had long-standing school gardens as well as in the Maria L. Baldwin school, which had launched its garden the previous year. The continued production of the *Science in the Garden* workshop and distribution of the Curriculum Connections document, in conjunction with on-site support from the district science coaches and the CitySprouts garden coordinators, would seem likely to continue to expand the quantity and quality of teachers' use of the garden for science instruction.

The act of leading garden-based instruction appeared to support teachers' vision of themselves as competent teachers of science. In interviews, several teachers noted their own enjoyment of using the garden to teach science when describing the way that their students reacted to lessons in the garden. The findings from the evaluation report suggest that, among this group of regular users of the garden, the recent activities between CitySprouts and the Cambridge Science Department solidified their standing as teachers who teach science in the garden, rather than simply teachers who use the garden. The apparent effect of the garden and the activities of the partnership to raise the profile of science instruction are valuable in the existing environment of annual student achievement tests. As a result of such testing the percentage of instructional time devoted to science has dropped as instructional time for mathematics and English-language arts has increased. The garden-based programs may appeal to teachers and compel them to focus more on science instruction than they would otherwise.

Some of the interviewed teachers described a growing awareness among their colleagues of the garden as a resource for science instruction due to the workshop and conversations about the Curriculum Connections. This relationship to the garden may parallel the relationship that has been observed among elementary grades teachers and science instruction as a whole. Research has found that teachers may be reluctant to engage deeply in the content of science lessons with their students because of the teachers' lack

of confidence with the content (Alonzo, 2002; Sanders, Borko, & Lockard, 1993). A similar effect may limit teacher use of the gardens, as those who are unfamiliar with how science instruction can be done in the gardens are less likely to engage in use of the gardens. The activities of the past year have put in place adequate scaffolding that could help inexperienced teachers begin to use the gardens for science instruction, and encourage sporadic users to incorporate the garden into more lessons. This possible effect on new and irregular users bears monitoring in the near future to more fully gauge the impact of the workshop and other activities on expanding teachers' use of the gardens.

A goal for this evaluation was to lay the groundwork for possible future investigations. The preliminary report included in its findings that the CitySprouts program was aligned with the design features that promoted use of school garden programs in other research studies. This evaluation points to possible areas for future research that may highlight the benefits of the CitySprouts/Cambridge science department partnership. Other research has indicated that interventions typically require a three-to-five year timeframe to accurately assess the impact on teachers' instructional practices: impact on student achievement can require more time (Murray, Henry & Hogrebe, 2009; Loucks-Horsley & Matsumoto, 1995). That type of timeframe for a rigorous empirical investigation may be beyond the means and needs of the partnership. Alternative studies that can investigate other measures associated with increased student learning and knowledge of science may be worthwhile to pursue, with a quicker return of findings that are aligned to national goals for science education.

There is evidence that hands-on science activities, such as those that teachers conducted in the garden, can have a lasting impact on improving students' interest in science (Peyrot & Ziolo-Royer, 2006). Studies have found that students need more experience in science at an early age, in formal and informal settings, to develop an interest and motivation to learn science (National Research Council, 1996). The findings from this evaluation are consistent with the evidence from these studies: students' interest in science increased in response to learning in the gardens. This presents a fruitful area for future research for the science department and CitySprouts which could highlight positive effects of the program that are linked to national goals for science education.

Another potential area for future research may be an examination that more closely analyzes teachers' instructional practice based on observations. Observation protocols may be available for use for continued study that examine the quality of scientific inquiry in lessons (such as instrument in development through the Inquiry Science Instruction Observation Protocol Project at Education Development Center, Inc.) or the district could develop such an instrument for use by the coaches. Such an instrument could be used to draw comparisons between the quality of classroom- and garden-based investigations and provide insight into the effect of the gardens on the quality of classroom instruction.

The strong beginning of the partnership between CitySprouts and the science department of CPSD provides a solid foundation for the future. The continuation of the workshop and its follow up activities will likely yield more positive results for supporting teachers' science instruction in the district.

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