

## Permission as support: Teacher perceptions of schoolyard pedagogy

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### Abstract

There is a growing body of literature emphasizing the use of the schoolyard as a teaching tool, however there is limited research that investigates how to support the development of schoolyard pedagogy. Plains Public Schools is home to 17 elementary schools, 12 of which include one or more features of an enhanced schoolyard, such as garden beds. This manuscript investigates the research questions: 1) In what ways do Plains Public School (PPS) elementary teachers use their schoolyard to teach science? and 2) What types of support are needed for the development of schoolyard pedagogy for PPS elementary teachers? Four hundred and fifty-nine elementary teachers in PPS were solicited for participation in an online survey to investigate their perceptions of the opportunities for teaching in the schoolyard (response rate of 8.27%). Survey results indicate that although elementary teachers are teaching science, a limited number are capitalizing on the opportunities for science instruction within the features of the schoolyard. The findings reported in this manuscript further add to the literature base regarding teacher-perceived opportunities, barriers, and constraints for schoolyard pedagogy. In addition, these findings can help support the development of pre- and in-service programs that aim to improve schoolyard pedagogy for elementary teachers.

Key Words: schoolyard pedagogy, school garden, teacher perceptions, elementary science

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### Introduction and Background

There is a growing body of literature emphasizing the use of the outdoors as a teaching tool, however there is limited research that investigates how to support the development of schoolyard pedagogy. Rationales for the inclusion of schoolyard-based teaching have included the broadening of children's experience of ecosystem complexity, clarifying the nature and learning continuum through place-based learning, teaching food system ecology through vegetable gardening, and shaping environmental attitudes and behaviors through exposure to nature and gardening (Blair, 2009). Without a complete redesign of the schoolyard, enhancing the schoolyard with the inclusion of a school garden has been found to positively increase student attitudes and behaviors (Blair, 2009; Skelly & Bradley, 2007) as well as academic achievement (Klemmer, Waliczek, & Zajicek, 2005; Skelly & Bradley, 2007). In addition, when the schoolyard has been intentionally redesigned to support outdoor learning, the garden emerges as a primary pedagogical tool (Moore, 1995) serving as a catalyst to support teaching in the schoolyard.

However, positive impacts of including the schoolyard and school gardens in elementary education cannot be realized without the active participation, support, and practice of classroom teachers. To overcome the barriers associated with teaching outdoors (Blair, 2009; Dymont, 2005; Foran, 2005; Feille, 2013), classroom teachers require support in their development of an effective schoolyard pedagogy (Feille, 2013; Feille, 2016). Campuses which regularly incorporate the schoolyard or school garden in classroom learning have been found to include enthusiastic administrators, dedicated garden coordinators, and community partnerships that include professional development providers and garden care-takers (Blair, 2009; Feille, 2013; Feille, 2016; Graham & Zidenberg-Cherr, 2005).

Due to the increase of attention on the positive impacts of school gardens and outdoor learning labs over the last three decades, there are a number of national non-profit organizations in the United States that work with schools to help fund the schoolyard movement (e.g. The Whole Kids Foundation, The Edible Schoolyard Project, Education Outside, and Out Teach - formerly REAL School Gardens). The level and type of support from organizations such as these ranges from the funding of basic gardening supplies and plants to full schoolyard redesign, installation, and ongoing educator professional support. With the variance in levels of support provided to campus leaders and educators paired with the complexity of implementing effective schoolyard pedagogy, it remains to be shown how enhanced schoolyards are utilized for teaching after initial supports have been removed.

### **Place Based Education**

Incorporating experiential learning, problem-based learning, democratic education, community-based education, among others, place-based education (PBE) provides a venue for collaborative science learning. PBE combines a social constructivist epistemology with the notion that children should be educated in a context and about a context to which they can directly relate (Greenwood, 2008). PBE is not a single procedural pedagogy for teaching, but rather, “Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum” (Sobel, 2004, p. 6). The schoolyard provides an opportunity for teachers to respond to PBE’s calls for a context relatable to students. *Schoolyard pedagogy*, the theories, methods, and practices of teaching that extend beyond the four walls of a classroom, capitalizes on the teaching tools available in the surrounding place of the schoolyard. School gardens, whether included as a full schoolyard redesign or the installation of a single garden bed, can provide an opportunity to incorporate schoolyard pedagogy.

### **3-Dimensional Teaching Practice**

The Next Generation Science Standards (NGSS Lead States, 2013) encourage a shift in science instruction where teachers are asked to guide students to understand complex phenomena and design solutions to problems with an understanding of the nature of science woven throughout. This shift encourages learning to occur integrated within the three dimensions of cross-cutting concepts (CCCs), science and engineering practices (SEPs) and disciplinary core ideas (DCIs). The integration of CCCs, SEPs and DCIs allows students to make sense of complex phenomena and solve problems the way that scientists and engineers do, rather than focus explicitly on experiencing and understanding content (Krajcik, 2015). The place of the schoolyard can provide

an opportunity for integrated instruction and student experiences, and schoolyard pedagogy capitalizes on such opportunity by engaging students in the practices of science and engineering across concepts and disciplinary core ideas.

### **Teacher Perceptions and Use**

Previous studies have found that classroom teachers recognize the appropriateness of natural spaces for teaching of science, in particular environmental science topics (Simmons, 1998). However, the schoolyard is not always included in the teacher's perception of natural spaces and therefore potentially overlooked as an opportunity for science teaching. Few studies investigate teachers' use of the schoolyard and *learnsapes* included on the school grounds (Skamp, 2009). A *learnscape* is an intentional schoolyard feature where learning is intended to be paired with the experience of the schoolyard (Skamp & Bergman, 2001), such as a school garden or outdoor learning lab.

To understand teachers' level of use of outdoor *learnsapes*, Skamp (2009) interpreted teachers' changes in reactions to the pedagogical innovation utilizing a framework which identified the participants' stage of concern, level of understanding, and typology of use. The participants in the study all experienced the design and development of intentional *learnsapes* on their school campus. Throughout the year of implementation, all six participants held appropriate understandings of the nature of *learnsapes* and moved to a stage of concern that focused on the management of the innovation with students. However, not all participants found success in the utilization of the *learnsapes* as a pedagogical tool. The findings illustrate that further support is required for the development of effective schoolyard pedagogy within the learning opportunities found or created within the outdoor setting of the schoolyard.

The research presented in this article adds to the literature base regarding teacher perceived opportunities, barriers, and constraints for schoolyard pedagogy and further investigates how teachers perceive opportunities for three-dimensional instruction within the schoolyard. In particular, this study highlights the perceptions of elementary classroom teachers in campuses where *learnscape* features (such as a school garden beds) have been included in the schoolyard. These findings can help support the development of in-service programs that aim to improve schoolyard pedagogy for elementary teachers striving towards three-dimensional science instruction. The purpose of this study was to investigate the following questions:

- 1) In what ways do Plains Public School (PPS) elementary teachers use their schoolyard to teach science?
- 2) What types of support are needed for the development of schoolyard pedagogy for PPS elementary teachers?

### **Method**

Plains Public Schools (PPS) is a suburban school district in the central United States that educates approximately 16,000 students in 17 elementary schools, four middle schools, and two high schools. Of the district students, 49% are eligible for free and reduced lunch. The student demographics include 57% Caucasian, 15% Hispanic, 6% African American, 5% Native American, 3% Asian, and 14% Multiracial. The district itself is largely supported through resident funded bond projects and has multiple community partnerships with surrounding organizations and a local university.

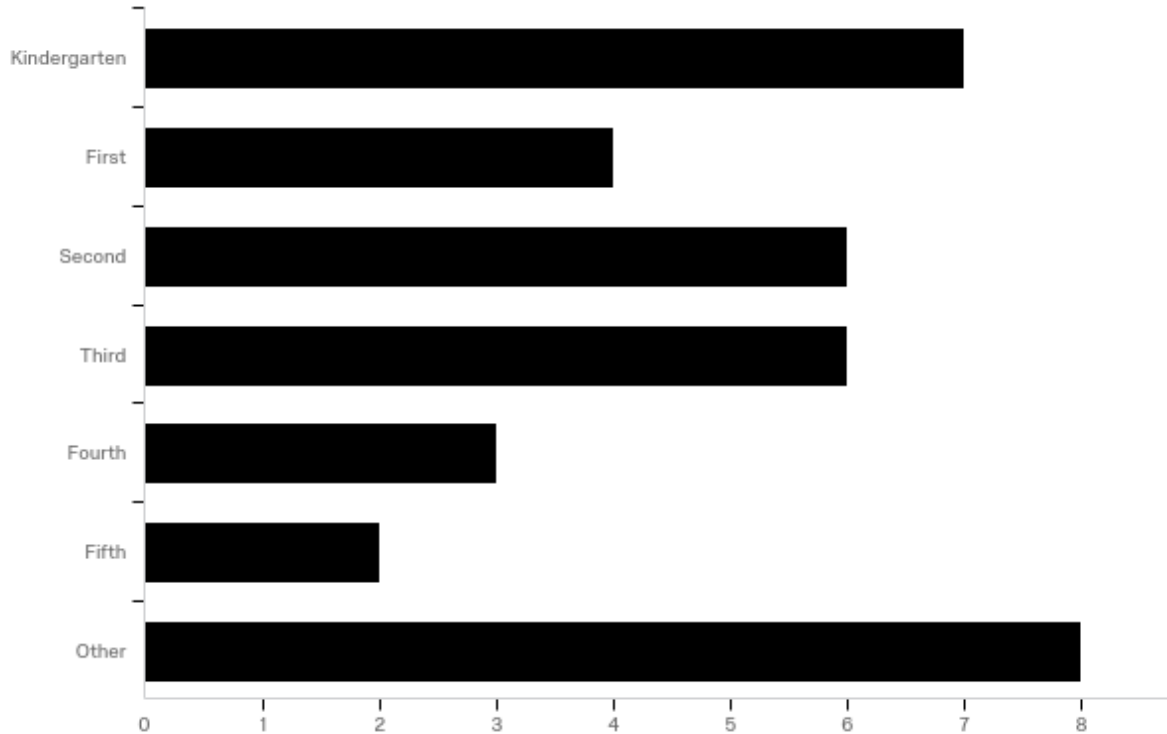
Beginning in 2012, a local non-profit set a goal to establish a garden at each of the district's school campuses. Twelve of the elementary schools in the district have one or more features of an outdoor learning lab on their campus including raised vegetable and flower garden beds, butterfly gardens, pond features, stream tables, habitat areas (e.g. bird feeders or lizard hotels), and/or compost bins with 10 of those possible because of the partnership with the local non-profit. Two of the elementary schools are also visited regularly by volunteers who “work with students in the garden learning the STEM-based curriculum and maintaining the garden” (Earth Rebirth, 2018).

Table 1  
*Age of participants*

Age	Count	%
21-25	4	11.11%
26-30	8	22.22%
31-35	6	16.67%
36-40	1	2.78%
41-45	7	19.44%
46-50	6	16.67%
51-55	2	5.56%
56-60	2	5.56%
Total	36	100%

*Note. Two consenting participants did not respond to this question.*

From the 17 elementary schools, 459 classroom teachers were solicited for participation via email. Forty teachers responded to the solicitation with a final number of 38 (response rate of 8.27%) consenting participants completing the survey. Of the 38 participants, 35 are female, 1 preferred not to say, and 2 did not respond to the question regarding gender. The ages of participants vary from 21 to 60 (see Table 1). Grade levels taught include Pre-K-5 with four participants teaching all grades K-5 (see Figure 1).



*Figure 1.* Indicated grade level of participants. Participants who responded “Other” included four Pre-K teachers and four participants who teach grades K-5.

### Data Sources and Procedures

There are two data sources used in this study. The first consists of anonymous survey data from 38 participants. Recruitment emails included a link to the online survey where, after consenting, participants responded to the survey questions. We collected and analyzed responses using Qualtrics (Qualtrics, 2018). Survey questions focused on the participants’ time spent teaching science, use of the schoolyard for teaching science, features of the schoolyard available on their campus, and a series of questions directed at participants who explicitly indicated they have used the schoolyard for science teaching. The first section of questions seek to understand the science teaching context of the teacher as well as features of the schoolyard. The next section includes a series of likert scale questions that were developed relying on previous research regarding utilization of the outdoors for teaching (e.g. Blair, 2009; Skelly & Bradley, 2007; Klemmer, Waliczek, & Zajicek, 2005; Dymment, 2005; Foran, 2005; Feille 2013; Feille 2014; Feille 2016; Skamp, 2009). These questions seek to elicit the teacher’s perceptions of curricular, administrative, and professional development support as well as their view of the ease and accessibility of schoolyard-based teaching on their campus. The final section of questions solicits a response from teachers who indicate they use the schoolyard to teach at least one to two times a year. These questions align with the goals and purpose of the phases of the 5-E Instructional Model (Bybee, 2015) and the NGSS Disciplinary Core Ideas, Science and Engineering Practices, and Cross Cutting Concepts. This series of questions asks teachers to indicate how they believe schoolyard pedagogy aligns with the goals of 5-E instruction and the NGSS. The complete survey can be found in Appendix A.

The second data source includes the transcriptions of in-person interviews with two

participants. Of the 38 participants, four indicated they would be interested in participating in follow-up interviews. However, when contacted only two responded to agree to the in-person interview. Each interview was audio recorded and hand transcribed for analysis by the primary author who then analyzed transcriptions of the interview utilizing a constant comparative approach (Glaser, 1965). This allowed for the continuous checking and re-checking of alignment of interview data with survey data. The interviews served as a way to gain further information regarding some of the responses to the online survey questions. The interviews were semi-structured using the following five questions as discussion-starting stems:

1. Describe how you use areas beyond your classroom for science teaching.
2. What do you see as the most accessible areas of your schoolyard for teaching?
3. What science topics do you feel benefit the most from using areas beyond your classroom as an instructional setting? Why?
4. What kind of support do you have for teaching science in the schoolyard?
5. What kind of support would help you use your schoolyard as a teaching tool for science?

The purpose of this study was exploratory in nature. With a majority of elementary campuses in the district having at least one feature of an outdoor learning environment but little to no additional pedagogical support, it is important to understand if and how teachers are utilizing those features. The results described below give an introductory understanding regarding the culture of schoolyard pedagogy in PPS.

## Results

### Survey Data

The participants reported spending between zero and 120 minutes on science instruction in a week. Most participants indicated they devoted 20-40 minutes and 60-90 minutes to science teaching. Only one teacher indicated devoting zero minutes to teaching science, and that teacher was not a K-5 classroom teacher. Most teachers devoting 20-90 minutes to science teaching, taught Kindergarten through second-grade. Teachers devoting over 90 minutes to science teaching were primarily from second through fifth-grade classrooms (See Table 2).

*Table 2*  
Class time devoted to science by grade level

	Kindergarten	First	Second	Third	Fourth	Fifth	Other	Total
0-20 minutes	0	0	0	0	0	0	1	1
20-40 minutes	5	1	2	0	0	0	1	9
40-60 minutes	1	0	0	2	0	0	3	6
60-90 minutes	1	3	2	3	1	0	2	12
90-120	0	0	2	1	2	1	0	6

minutes								
120								
minutes or more	0	0	0	0	0	1	1	2
Total	7	4	6	6	3	2	8	36

Most (N=16) reported using the schoolyard (field, playground, garden, outdoor classroom, or any other outdoor space) for science teaching one to two times a semester. The remaining majority of participants indicated they used the schoolyard one or two times a year or one or two times a month. Two participants indicated they never use the schoolyard for science teaching and one participant reported using the schoolyard weekly. Most of the teachers who reported using the schoolyard to teach were in Kindergarten through third-grade classrooms (see Table 3).

Table 3

Frequency of schoolyard use by grade-level

	Kindergarten	First	Second	Third	Fourth	Fifth	Other	Total
Never	0	0	0	0	1	0	1	2
1 or 2 times a year	1	0	1	2	1	0	1	6
1 or 2 times a semester	4	3	3	3	0	1	2	16
1 or 2 times a month	2	1	2	1	1	1	3	11
At least once a week	0	0	0	0	0	0	1	1
Total	7	4	6	6	3	2	8	36

When asked what features are included in the participants' schoolyard, the three most commonly found features were playground structure(s) (N=33), blacktop or paved play area (N=31), and field (e.g. soccer, baseball, etc) (N=32). A significant number of participants indicated their schoolyard included seating areas for students (N=22), an unmanaged area or naturescape (N=18) and maintained flower beds (N=16). Table 4 details the frequency count for participants' responses regarding the features of their schoolyard.

Table 4

*Outdoor features included in participants' schoolyards.*

Schoolyard Feature	Frequency	%
Playground structure(s)	33	17.55%

Blacktop/Paved play area	31	16.49%
Vegetable garden bed(s)	9	4.79%
Flower bed(s)	16	8.51%
Field (soccer, baseball, etc)	32	17.02%
Unmanaged area/naturescape	18	9.57%
Water feature (pond, stream, dry creek bed, etc)	11	5.85%
Weathering and erosion sites	2	1.06%
Stream table	1	0.53%
Sand/digging box	5	2.66%
Seating areas	22	11.70%
White board/Chalk board	0	0.00%
Rainwater collection	3	1.60%
Irrigation system (drip, sprinklers, etc)	4	2.13%
Other	1	0.53%
Total	188	100%

*Note. One participant indicated that their schoolyard neighbors a city park with picnic area, grills, and covered play area with turf.*

Next participants were asked their level of agreement (1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree) with a number of statements related to the use of the schoolyard, common barriers related to schoolyard pedagogy, and common means of support for outdoor science instruction. Their summarized responses can be found in Table 5. All statements except one had a mean of greater than two. The statements finding the most agreement among participants ( $\bar{x} > 3.0$ ) were “My principal supports using the schoolyard for science teaching,” “I think using the schoolyard to teach science is important,” “My district administration supports using the schoolyard for science teaching,” “I am confident in managing student behavior in the schoolyard for teaching science,” “I can teach multiple science topics in the schoolyard,” and “The weather provides opportunities for me to use the schoolyard for science teaching.” “I received professional development in using the schoolyard for science teaching” received the lowest rate of agreement among participants ( $\bar{x} = 1.97$ ).

Table 5  
*Likert scale statements*

	N	Minimum	Maximum	Mean	Std. Deviation
My curriculum supports using the schoolyard for science teaching	32	1	4	2.75	.803
My principal supports	33	1	4	3.30	.728



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using the schoolyard for science teaching						
My district administration supports using the schoolyard for science teaching	33	1	4	3.18	.635	
Using the schoolyard to teach saves me time	32	1	4	2.50	.672	
I am confident in managing student behavior in the schoolyard for teaching science	32	1	4	3.13	.707	
I think using the schoolyard to teach science is important	32	1	4	3.19	.592	
I received professional development in using the schoolyard for science teaching	32	1	4	1.97	.897	
My schoolyard is convenient to access for teaching science	32	1	4	3.00	.672	
There are good spaces in the schoolyard for teaching science	32	1	4	2.78	.832	
I can teach multiple content subjects in the schoolyard	32	1	4	2.78	.832	
I can teach multiple science topics in the schoolyard	32	1	4	3.09	.588	
Using the schoolyard to teach science helps my students be successful on state or district required tests	30	1	4	2.83	.699	
The weather provides opportunities for me to use the schoolyard for science teaching	32	1	4	3.09	.734	
State or district required	29	1	4	2.59	.682	

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tests are supported by  
using the schoolyard to  
teach science

Valid N (listwise) 29

Note: Likert scale 1-4 with 1 equivalent to “Strongly Disagree” and 4 equivalent to “Strongly Agree.”

Participants who indicated they used the schoolyard to teach at least one to two times per year then sorted six science teaching experiences into two categories indicating which experiences they used the schoolyard to teach. Figure 2 shows their responses. Participants indicated they used the schoolyard to have students make observations, to allow students to explore a content topic, for student-conducted investigations or experiments, to elaborate on a content topic, and engage students with a topic. Participants reported they did not use the schoolyard to evaluate student learning or content understanding.

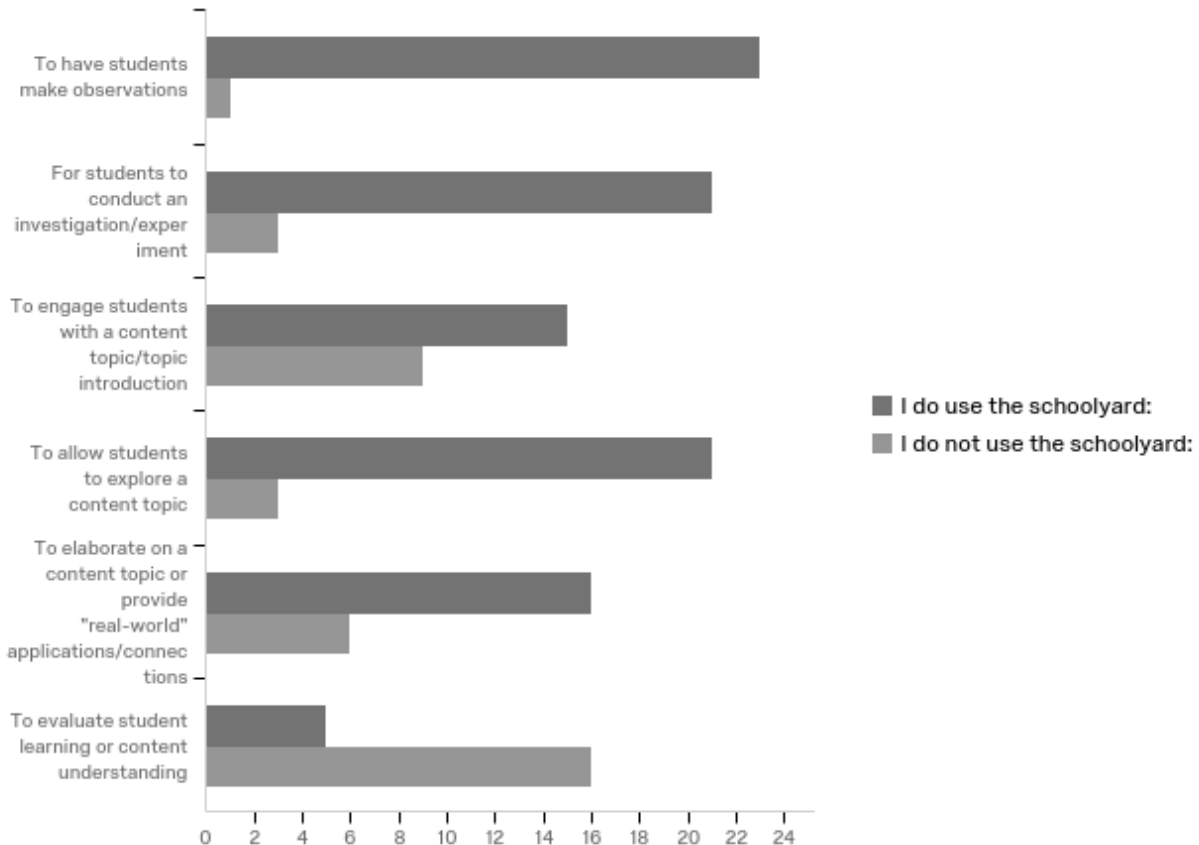


Figure 2. How participants report their use of the schoolyard for science teaching.

The primary science content topics participants indicated they used the schoolyard to teach are Weather and Climate (N=24), Interdependent Relationships in Ecosystems (N=14) and Life Cycle and Traits (N=14). Figure 3 shows the results of the survey question, “Which topics are you able to teach in the schoolyard?”

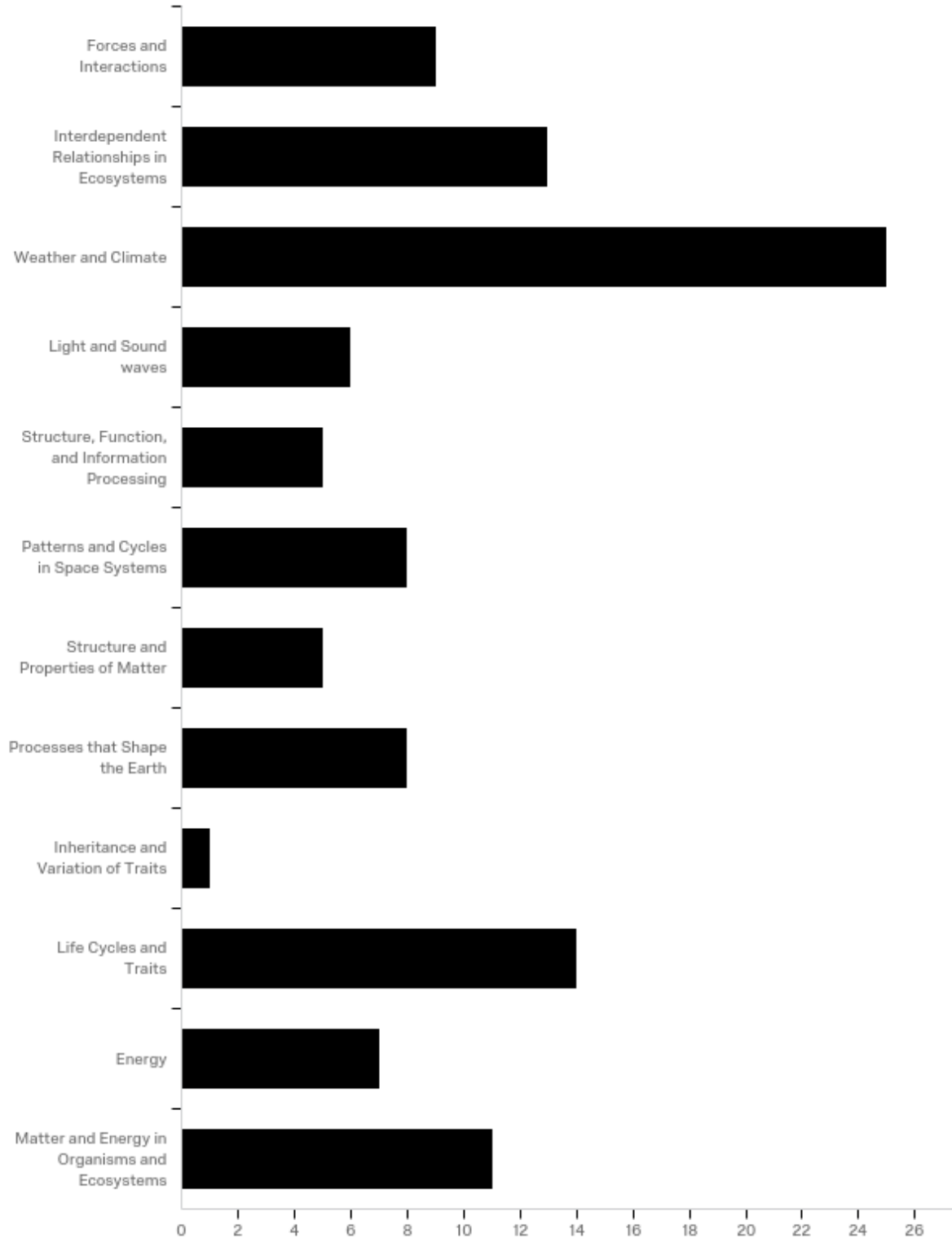
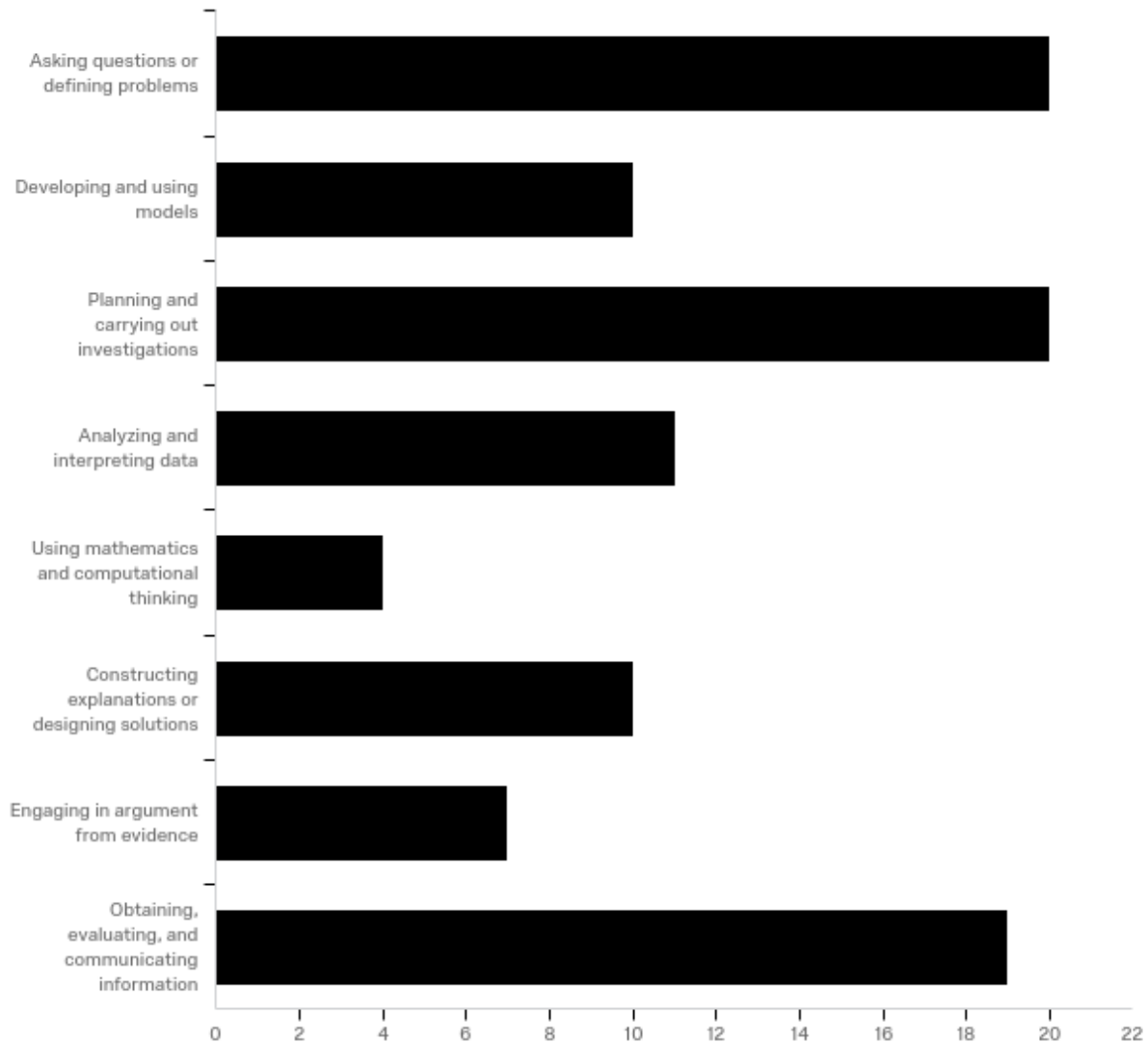


Figure 3. Science content topics participants report they are able to teach using the schoolyard.

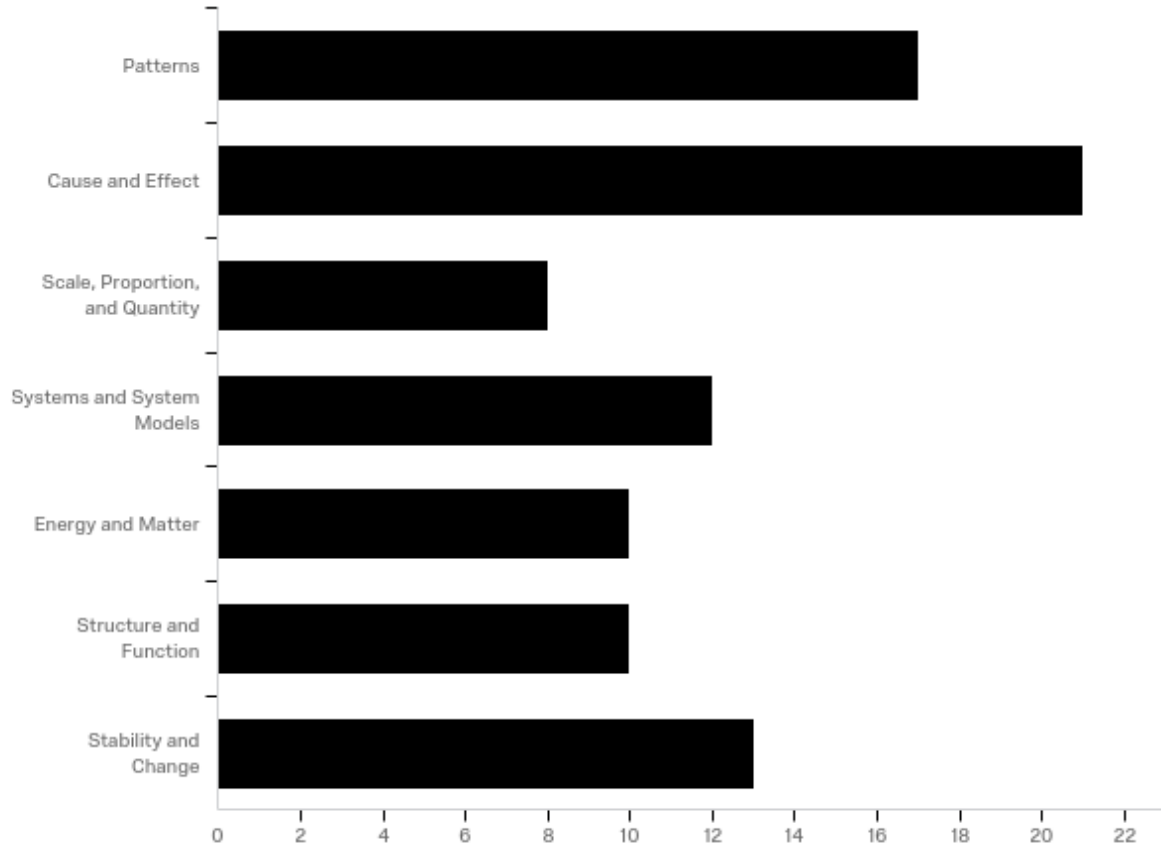
The science and engineering practices participants found most applicable to teach using the schoolyard are Asking Questions/Defining Problems (N=20), Planning and Carrying out

Investigations (N=20) and Obtaining, Evaluating and Communicating Information (N=19). Few participants (N=4) found the schoolyard appropriate for Using Mathematics and Computational Thinking and Engaging in Argument from Evidence (N=6). Figure 4 shows the tabulated responses.



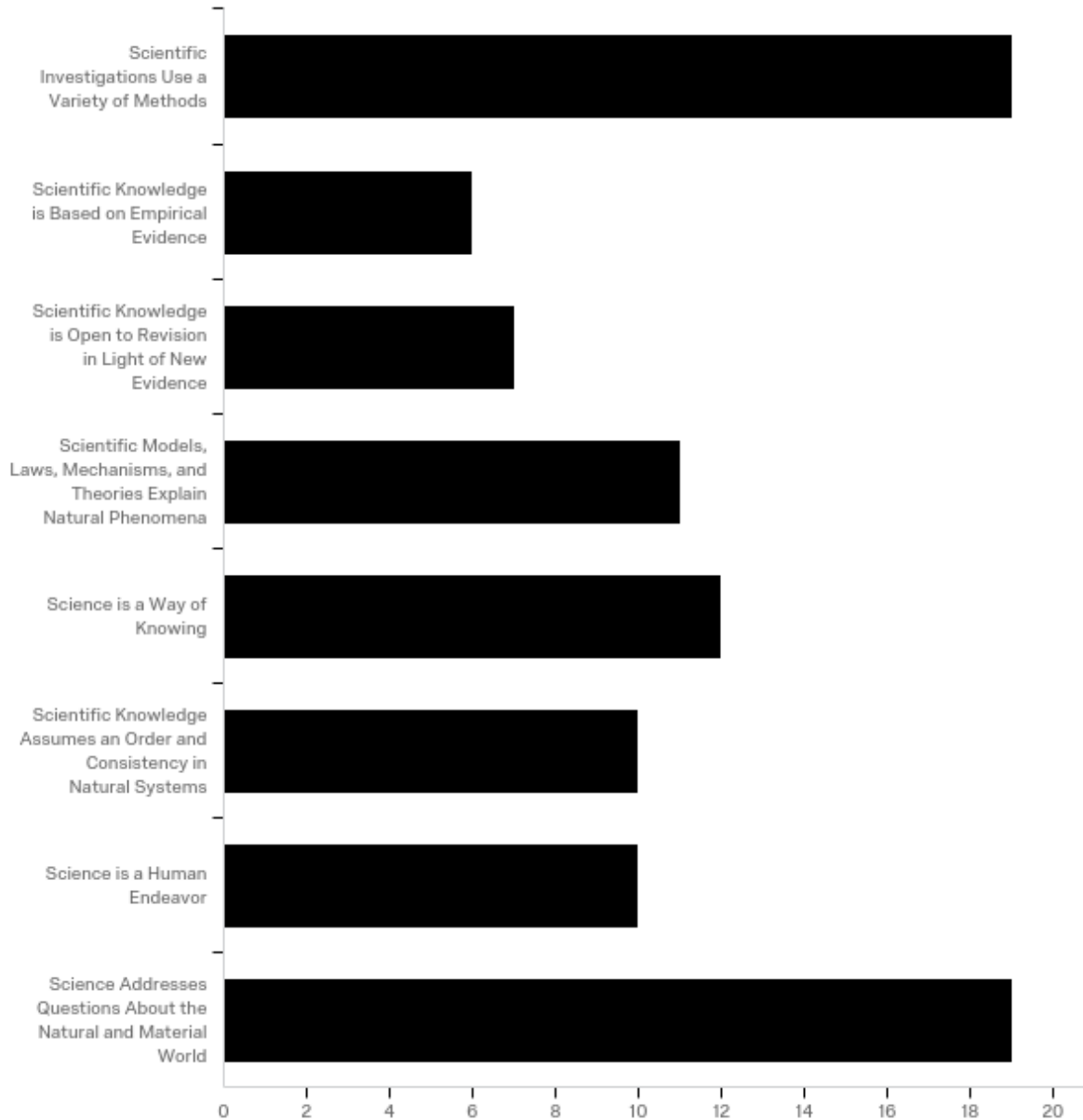
*Figure 4.* Science and engineering practices participants report they are able to teach using the schoolyard.

The participants indicated they were able to teach all of the cross cutting concepts (CCC) using the schoolyard. Cause and Effect (N=21) and Patterns (N=18) were the two most common CCC reported (see Figure 5).



*Figure 5.* Cross cutting concepts participants report they are able to teach using the schoolyard.

The two most common tenets of the Nature of Science participants indicated they used the schoolyard to teach were Scientific Investigations Use a Variety of Methods (N=19) and Science Addresses Questions About the Natural and Material World (N=19). Scientific Knowledge is Based on Empirical Evidence (N=6) and Scientific Knowledge is Open to Revision in Light of New Evidence (N=7) were the two least frequently reported tenets participants indicated they used the schoolyard to teach (see Figure 6).



*Figure 6.* Tenets of the nature of science participants report are supported by using the schoolyard to teach science.

When compared by frequency of use, participants who reported using the schoolyard between one to two times a semester to one to two times a month reported the greatest variety of schoolyard features (see Table 6). Interestingly, the single participant who reported using the schoolyard at least once a week only indicated the inclusion of three schoolyard features: playground structure(s), seating areas, and a field. Whereas, the participants who indicated they never used the schoolyard for teaching reported the inclusion of six-seven schoolyard features.

Table 6  
Frequency of use versus schoolyard feature.

	Playground structure(s)	Vegetable garden bed(s)	Flower bed(s)	Water feature (pond, stream, dry creek bed, etc.)	Unmanaged area/naturescape	Weathering and erosion sites	Stream table	Seating areas	White board/Chalk board	Sand/digging box	Field (soccer, baseball, etc)	Rainwater collection	Irrigation system (drip, sprinklers, etc)	Other	Blacktop/Paved play area	Total
Never	2	1	0	1	2	0	0	2	0	0	2	0	0	0	2	2
1 or 2 times a year	5	2	3	3	2	0	0	4	0	0	5	1	0	1	5	6
1 or 2 times a semester	16	3	8	4	7	0	0	9	0	3	15	2	1	0	15	16
1 or 2 times a month	9	3	5	3	7	2	1	6	0	2	9	0	3	0	9	11
At least once a week	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1
Total	33	9	16	11	18	2	1	22	0	5	32	3	4	1	31	36

Finally, a chi-squared test was performed and a significant relationship was found between how frequently a teacher reported using the schoolyard and their agreement with the following statements: “My curriculum supports using the schoolyard for science teaching,”  $X^2(12, N = 31) = 42.91, p < .001$ . “My principal supports using the schoolyard for science teaching,”  $X^2(12, N = 31) = 20.82, p = .05$ , “I can teach multiple science topics in the schoolyard,”  $X^2(12, N = 31) = 33.86, p < .001$ , and “My district administration supports using the schoolyard for science teaching,”  $X^2(12, N = 31) = 33.49, p < .001$ . No other significant relationships were found (See Appendix B).

### Interview Findings

Two PPS elementary teachers consented to participating in the interview portion of the study. The findings from those two interviews are discussed here. Sarah is a fourth grade teacher in a self-contained classroom. Jennifer is a third grade teacher, also in a self-contained classroom.

**Teaching outside of the classroom.** Sarah described one lesson in her grade-level curriculum that takes the students outside. She referred frequently to the district-provided science curriculum. To her knowledge, there was only one instance within the school-year where the lesson required the use of the outdoors. Therefore, there were no other topics she recalled using the schoolyard to teach. Jennifer referred to multiple lessons where she took her students outside. However, unlike Sarah, many of the experiences were ones in which she was inspired by the accessibility of the schoolyard in relation to the science content. She did recall some lessons from the curriculum which indicated the students should go outside, but much of the time she said, “Things will come to me while we’re reading it that Oh! We should go do this outside.”

On Jennifer’s campus there is one dedicated garden bed, but it is only used by the fourth grade team. She misses a bed that used to be accessible from her classroom. The bed itself was removed during recent construction to the school. Her proximity to an outdoor exit makes taking her students outside easy. Sarah described some trees and an area that used to contain a water feature. In addition, there is a small garden that the second grade team uses for planting at the beginning of the academic year. Sarah had a more difficult time considering instances in which she would use areas beyond the classroom for teaching science. If it was not included in her district-provided curriculum, she did not teach it.

**Science topics.** When asked about the science content that the schoolyard would support, Sarah mentioned the possibility of looking for evidence of erosion to support a unit on the grand canyon. In addition, she referred again to a nature walk included in the curriculum to support a unit on plants. Jennifer began to list the science content she felt was supported by the schoolyard. After mentioning weather and plants she paused to say all life science content was supported by using the schoolyard. She also mentioned using the schoolyard to support a force and motion unit where the students attempted to fly paper airplanes.

**Support.** Jennifer described her support for using the schoolyard by beginning with the fact that she had permission to use it. “I never feel like I have to ask to take my kids out, just have to make sure the weather is the right temperature.” She did mention that having access to a garden bed, perhaps the bed used primarily by the fourth grade team, would help support her when teaching



about plants. Sarah mentioned she could rely on her second grade team for support, since they currently use a garden bed. Both teachers mentioned a district-wide professional development day that provides opportunities for teachers to choose classes and content they are interested in attending. Sarah did not recall any topics that were focused on using the schoolyard to teach. Jennifer described a lesson on agriculture that has given her multiple activities she can use in the schoolyard. An additional support both teachers discussed included the district-provided curriculum. Sarah identified teacher notes as a possible area where ways to modify a lesson to utilize the schoolyard could be included.

## Discussion

The survey data indicate that PPS elementary teachers are devoting time to science teaching as required by their district guidelines, with upper-elementary grades devoting more time to science each week. Despite a wide variety of schoolyard features, for the most part students are using the schoolyard to learn science only once or twice a semester. No teacher in grades Kindergarten through fifth indicated that they use the schoolyard weekly. Teachers in the younger grades (Pre-K through second) are using the schoolyard more than upper-elementary teachers.

### Schoolyard use

The survey data paired with the interview findings indicate that PPS teachers who do use the schoolyard do so in unsurprising ways. Content relating to weather and climate seems to connect quite easily to outdoor lessons using the schoolyard, supported by the district-provided curriculum. Topics most closely related to environmental science content are those that teachers most readily see as appropriate for schoolyard teaching (Simmons, 1998). Exposure to opportunities to integrate content in the physical and earth sciences into schoolyard pedagogy could increase the possibility that elementary teachers enact schoolyard pedagogy.

Despite a majority of campuses having a component of an outdoor classroom installed (primarily one or more garden beds), many teachers indicated that there are not good spaces in the schoolyard to teach science. This indicates that additional support is needed in care and maintenance of such areas as well as the development of teachers to take pedagogical advantage of less-formal teaching areas on their campus.

Teachers in the study appear to present themselves as strugglers (using the innovation at a very mechanical level) to succeeders (uses the innovation, but not independent of the curriculum) as described by (Skamp, 2009). In contrast to Skamp (2009), this study does not follow participants along an intervention, rather we investigate the teachers' use of the schoolyard either without intervention or one to five years after installation of garden beds. A greater variety of schoolyard features tended to result in a higher frequency of use. This was not true however for the survey participant who indicated using the schoolyard to teach at least once a week. In addition, this participant indicated that although the curriculum supported teaching in the schoolyard, campus and district administration did not. Also, this participant did not indicate using the schoolyard to teach any science content topics (DCIs) or SEPs. The participant indicated that she/he disagreed that multiple contents and multiple science topics could be taught using the schoolyard. Leaving the most frequent user of the schoolyard quite the anomaly.

The DCIs the participants reported being able to use the schoolyard to teach were not surprising. With a majority of participants indicating they were able to teach Weather and Climate and nearly half indicating Life Cycles and Traits, the topics of Environmental and Life Science seem to be the most approachable topics for the participants to teach using the schoolyard. The lack of focus on physical science topics such as Forces and Interactions indicates a missed opportunity given that nearly all participants indicated the inclusion of playground equipment, open field areas, and blacktops. Each of these features provide tools to support students as they investigate the complex phenomena found in the physical sciences. Playground equipment such as swings, slides, and firepoles support investigations into Forces and Interactions. The wide spaces of field areas and blacktops allow investigations to move beyond the space constraints of the classroom to understand implications of increased force on motion. Paved areas such as blacktops also allow for student investigation into the apparent motion of the sun across the sky through investigating the changing size and direction of shadows throughout the school day.

### **Support for schoolyard pedagogy**

Participants in this study generally indicated as though they have support from administration to use the schoolyard to teach, but may lack professional development or curricular support to take full advantage of the opportunities that exist. The means for the survey questions regarding administrative support were high (My principal supports using the schoolyard for science teaching  $M=3.30$  and My district administration supports using the schoolyard for science teaching  $M=3.18$ ). Whereas, questions regarding curricular support (My curriculum supports using the schoolyard for science teaching  $M=2.75$ ) is somewhat lower. Finally, the mean for the survey question regarding professional development support (I received professional development in using the schoolyard for science teaching  $M=1.97$ ) is particularly low.

While the teachers surveyed were likely to reply in the affirmative to statements regarding supports, very few teachers indicated that they have received professional development regarding the use of the schoolyard for science teaching. This brings to question the participants' definition of administrative support for the use of the schoolyard. Without the inclusion of explicit professional development on schoolyard pedagogy, we could interpret the participants' understanding of support from administration to mean permission (as Jennifer indicated in her interview) rather than active support. Allowing teachers to utilize the learning areas around the school and encouraging or developing them to do so well are distinct measures of administrative support.

The Chi-squared test of independence suggests a relationship between curriculum, principal, and district administrator support and schoolyard use. This too could be attributed to participant definitions of support. According to the interviews, curricular support could include teacher notes or flexibility written into the district curriculum that many seem to rely on heavily. A district provided curriculum that includes specific teacher notes or the inclusion of more schoolyard-based activities would be seen as supportive of schoolyard use and could serve to redirect teachers to the option of the schoolyard as an educational resource.

Surprisingly, no relationship was found between professional development and schoolyard use. Skamp (2009) described a matrix of processes involving several factors. He found that indirect

and informal interventions left teachers unaware of campus schoolyard use policies, suggesting that explicit, formal professional development could raise teacher awareness of curriculum, principal, and district administration support for schoolyard pedagogy. He further specified that the professional development address content particular to the schoolyard (learnscape), challenge teachers' conceptions what can be achieved, and present the schoolyard as more conducive to collaborative learning. To further the development of schoolyard pedagogy of PPS elementary teachers, it is clear additional intentional and ongoing support is needed (Feille, 2019). In addition, rich professional development that highlights the science content and practices that are supported by the schoolyard may help teachers identify the ways in which their students will benefit by mastering state science standards in more contextualized settings such as the schoolyard.

### **Limitations and Future Research**

By focusing on a single district, our data is limited. However, the findings do suggest that merely enhancing a schoolyard to include features such as garden beds is not enough to support enacted schoolyard pedagogy. Repeating the survey study in similarly enhanced districts will add to the findings. This study is also limited in scale. With less than 10% of classroom teachers from PPS responding, there is chance of selection bias. Potential participants who showed no interest in science teaching or the utilization of the schoolyard for teaching may have self-selected out of the study. This however implies that those who may be most inclined to enact a schoolyard pedagogy are those who responded, indicating a very low level of use of the schoolyard if selection bias is present. In addition, relying on self-report of the participants may not have resulted in the most reliable of data. However, because the focus of the study was the teacher perceptions of the schoolyard and their use this does not necessarily negatively impact the findings. Finally, with a small number of surveys returned, we hesitate to rely too heavily on the Chi-squared tests of independence.

Additional research is needed to gain a more complete image of the schoolyard pedagogy of PPS elementary teachers. The inclusion of additional interview and observation data could add richness to the findings. Furthering the study to include additional districts with similar proportions of campuses that include intentional features of outdoor learning environments (such as garden beds or outdoor learning labs) would enrich the data by including comparative findings.

### **Implications**

Frequent and repeated use of the schoolyard for teaching can support student learning and social development. The variety of features and the schoolyard as familiar context can provide a venue for collaborative science learning across the three dimensions of CCCs, DCIs, and SEPs. PPS elementary schools provide a variety of opportunities to implement schoolyard pedagogy from Pre-Kindergarten through fifth grade. Enhancing the schoolyard to include additional educative opportunities should encourage the enactment of schoolyard pedagogy. However, additional professional and curricular support is needed for the development of schoolyard pedagogy among PPS elementary teachers.

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## Appendix A

### Schoolyard Pedagogy

Please select the gender you identify with

- Male
- Female
- Prefer not to say

Please indicate your age:

- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- 51-55
- 56-60
- 61-65
- 65+
- Prefer not to say

What grade level do you teach?

- Kindergarten

- First
- Second
- Third
- Fourth
- Fifth
- Other \_\_\_\_\_

What is the average amount of class time you devote to teaching science each **week**?

- 0-20 minutes
- 20-40 minutes
- 40-60 minutes
- 60-90 minutes
- 90-120 minutes
- 120 minutes or more

How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any other outdoor space) for science teaching?

- Never
- 1 or 2 times a year
- 1 or 2 times a semester
- 1 or 2 times a month
- At least once a week

Which of the following features are included in your schoolyard?

- Playground structure(s)
- Blacktop/Paved play area
- Vegetable garden bed(s)
- Flower bed(s)
- Field (soccer, baseball, etc)
- Unmanaged area/naturescape
- Water feature (pond, stream, dry creek bed, etc)
- Weathering and erosion sites
- Stream table
- Sand/digging box
- Seating areas
- White board/Chalk board
- Rainwater collection
- Irrigation system (drip, sprinklers, etc)
- Other \_\_\_\_\_

Indicate your level of agreement or disagreement with the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
My curriculum supports using the schoolyard for science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



teaching

My principal supports using the schoolyard for science teaching

My district administration supports using the schoolyard for science teaching

Using the schoolyard to teach saves me time

I am confident in managing student behavior in the schoolyard for teaching science

I think using the schoolyard to teach science is important

I received professional development in using the schoolyard for science teaching

My schoolyard is convenient to access for teaching science

There are good spaces in the schoolyard for teaching science

I can teach multiple content subjects in the schoolyard

I can teach multiple science

topics in the schoolyard

Using the schoolyard to teach science helps my students be successful on state or district required tests

The weather provides

opportunities for me to use the schoolyard for science teaching

State or district required tests are supported by using the schoolyard to teach science

Is there anything else you would like to add?

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*Display This Question:*

*If How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any ot... != Never*

Given the following types of science teaching experiences, identify how you use the schoolyard for science teaching.

I do use the schoolyard:

\_\_\_\_\_ To have students make observations  
 \_\_\_\_\_ For students to conduct an investigation/experiment  
 \_\_\_\_\_ To engage students with a content topic/topic introduction

I do not use the schoolyard:

\_\_\_\_\_ To have students make observations  
 \_\_\_\_\_ For students to conduct an investigation/experiment  
 \_\_\_\_\_ To engage students with a content topic/topic introduction

\_\_\_\_\_ To allow students to explore a content topic

\_\_\_\_\_ To elaborate on a content topic or provide "real-world" applications/connections

\_\_\_\_\_ To evaluate student learning or content understanding

\_\_\_\_\_ To allow students to explore a content topic

\_\_\_\_\_ To elaborate on a content topic or provide "real-world" applications/connections

\_\_\_\_\_ To evaluate student learning or content understanding

*Display This Question:*

*If How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any other... != Never*

Which topics are you able to teach using the schoolyard?

- Forces and Interactions
- Interdependent Relationships in Ecosystems
- Weather and Climate
- Light and Sound waves
- Structure, Function, and Information Processing
- Patterns and Cycles in Space Systems
- Structure and Properties of Matter
- Processes that Shape the Earth
- Inheritance and Variation of Traits
- Life Cycles and Traits
- Energy
- Matter and Energy in Organisms and Ecosystems

*Display This Question:*

*If How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any other... != Never*

Which practices of science and engineering are you able to teach using the schoolyard?

- Asking questions or defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations or designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

*Display This Question:*

*If How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any other... != Never*

Which cross cutting concepts are you able to teach using the schoolyard?

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Function
- Stability and Change

*Display This Question:*

*If How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any other... != Never*

Which statements about science do you find are supported by using the schoolyard to teach science?

- Scientific Investigations Use a Variety of Methods
- Scientific Knowledge is Based on Empirical Evidence
- Scientific Knowledge is Open to Revision in Light of New Evidence
- Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Science is a Way of Knowing
- Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science is a Human Endeavor
- Science Addresses Questions About the Natural and Material World

*Display This Question:*

*If How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any other... != Never*

Is there anything else you would like to add?

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Appendix B Frequency of Use Significant Factors

Frequency of Use Significant Factors

		Indicate your level of agreement or disagreement with the following statements. - My curriculum supports using the schoolyard for science teaching				Indicate your level of agreement or disagreement with the following statements. - My principal supports using the schoolyard for science teaching				Indicate your level of agreement or disagreement with the following statements. - I can teach multiple science topics in the schoolyard				Indicate your level of agreement or disagreement with the following statements. - My district administration supports using the schoolyard for science teaching											
		Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	Total	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	Total	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	Total	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	Total
How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any ot...	Never	1 0.03 0.97 100.00% 100.00%	0 0.29 -0.29 0.00%	0 0.52 -0.52 0.00%	0 0.16 -0.16 0.00%	1.00	1 100.00% 3.23%	0 0.00 0.00 0.00%	0 0.06 -0.06 0.00%	1 0.50 0.50 100.00%	0 0.44 -0.44 0.00%	3.00	1 100.00% 3.13%	0 0.00 0.00 0.00%	0 0.03 -0.03 0.00%	1 0.77 0.23 100.00%	0 0.19 -0.19 0.00%	3.00	1 100.00% 3.23%	0 0.00 0.00 0.00%	0 0.03 -0.03 0.00%	1 0.69 0.31 100.00%	0 0.28 -0.28 0.00%	3.00	1 100.00% 3.13%
	1 or 2 times a year	0 0.19 -0.19 0.00%	1 1.74 -0.74 16.67%	5 3.10 1.90 83.33%	0 0.97 -0.97 0.00%	2.83	6 100.00% 19.35%	0 0.00 0.00 0.00%	0 0.38 -0.38 0.00%	5 3.00 2.00 83.33%	1 2.63 -1.63 16.67%	3.17	6 100.00% 18.75%	0 0.00 0.00 0.00%	0 0.19 -0.19 0.00%	6 4.65 1.35 100.00%	0 1.16 -1.16 0.00%	3.00	6 100.00% 19.35%	0 0.00 0.00 0.00%	0 0.19 -0.19 0.00%	5 4.13 0.88 83.33%	1 1.69 -0.69 16.67%	3.17	6 100.00% 18.75%
	1 or 2 times a semester	0 0.45 -0.45 0.00%	7 4.06 2.94 50.00%	6 7.23 -1.23 42.86%	1 2.26 -1.26 7.14%	2.57	14 100.00% 45.16%	0 0.00 0.00 0.00%	0 0.88 -0.88 0.00%	6 7.00 -1.00 42.86%	8 1.88 1.88 57.14%	3.57	14 100.00% 43.75%	0 0.00 0.00 0.00%	0 0.45 -0.45 0.00%	11 10.84 0.16 78.57%	3 2.71 0.29 21.43%	3.21	14 100.00% 45.16%	0 0.00 0.00 0.00%	0 0.44 -0.44 0.00%	10 9.63 0.38 71.43%	4 3.94 0.06 28.57%	3.29	14 100.00% 43.75%
	1 or 2 times a month	0 0.29 -0.29 0.00%	1 2.61 -1.61 11.11%	4 4.65 -0.65 44.44%	4 1.45 2.55 44.44%	3.33	9 100.00% 29.03%	0 0.00 0.00 0.00%	1 0.63 0.38 10.00%	4 5.00 -1.00 40.00%	5 4.38 0.63 50.00%	3.40	10 100.00% 31.25%	0 0.00 0.00 0.00%	0 0.29 -0.29 0.00%	6 6.97 -0.97 66.67%	3 1.74 1.26 33.33%	3.33	9 100.00% 29.03%	0 0.00 0.00 0.00%	0 0.31 -0.31 0.00%	6 6.88 -0.88 60.00%	4 2.81 1.19 40.00%	3.40	10 100.00% 31.25%
	At least once a week	0 0.03 -0.03 0.00%	0 0.29 -0.29 0.00%	1 0.52 0.48 100.00%	0 0.16 -0.16 0.00%	3.00	1 100.00% 3.23%	0 0.00 0.00 0.00%	1 0.06 0.94 100.00%	0 0.50 -0.50 0.00%	0 0.44 -0.44 0.00%	2.00	1 100.00% 3.13%	0 0.00 0.00 0.00%	1 0.03 0.97 100.00%	0 0.77 -0.77 0.00%	0 0.19 -0.19 0.00%	2.00	1 100.00% 3.23%	0 0.00 0.00 0.00%	1 0.03 0.97 100.00%	0 0.69 -0.69 0.00%	0 0.28 -0.28 0.00%	2.00	1 100.00% 3.13%
	Mean	1.00	3.00	3.06	3.80	-	-	0.00	4.50	2.81	3.29	-	-	0.00	5.00	2.92	3.50	-	-	0.00	5.00	2.95	3.33	-	-
Total	1 3.23% 100.00%	9 29.03% 100.00%	16 51.61% 100.00%	5 16.13% 100.00%	-	31 100.00% 100.00%	0 0.00% 100.00%	2 6.25% 100.00%	16 50.00% 100.00%	14 43.75% 100.00%	-	32 100.00% 100.00%	0 0.00% 100.00%	1 3.23% 100.00%	24 77.42% 100.00%	6 19.35% 100.00%	-	31 100.00% 100.00%	0 0.00% 100.00%	1 3.13% 100.00%	22 68.75% 100.00%	9 28.13% 100.00%	-	32 100.00% 100.00%	

		Indicate your level of agreement or disagreement with the following statements. - My curriculum supports using the schoolyard for science teaching	Indicate your level of agreement or disagreement with the following statements. - My principal supports using the schoolyard for science teaching	Indicate your level of agreement or disagreement with the following statements. - I can teach multiple science topics in the schoolyard	Indicate your level of agreement or disagreement with the following statements. - My district administration supports using the schoolyard for science teaching
How frequently do you use the schoolyard (field, playground, garden, outdoor classroom, or any ot...	Chi Square	42.91*	20.82*	33.86*	33.49*
	Degrees of Freedom	12	12	12	12
	p-value	0.00	0.05	0.00	0.00

\*Note: The Chi-Square approximation may be inaccurate - expected frequency less than 5.