Report on Results of the Pilot Study on School Grounds and Health
Funded by the Centre for Urban Health Initiatives

Prepared for Evergreen

by Dr. Anne C. Bell and Dr. Janet E. Dyment

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1. Introduction

In 2007, Evergreen received seed grant funding from the Centre for Urban Health Initiatives to identify, test and refine appropriate research methods for a future, in-depth study investigating the influence of school ground design on children's physical activity and related health benefits. This report presents the results of that work, based on a literature review and a pilot study, and provides insights, recommendations and logistical information to guide further research by Evergreen in this area.

The results of the literature review are presented in section 2. The results of the pilot study are presented in sections 3 – 9. Each method is presented in a separate section that includes a description of the method, the protocol used, insights about the strengths and weaknesses of the method, and recommendations for future research. In addition, data gathered using each method are also presented and discussed.

Other logistical information that would be useful to include in future studies is presented in section 10. This includes sample letters and consent forms and suggestions for organizing future research..

The conclusion presents a summary of the recommendations for future research.

2. Literature Review

Prior to conducting the pilot study, the lead researchers completed a literature review of potentially appropriate methods. While they gathered information on each of the methods used, they focussed in particular on approaches to direct observation and to using accelerometry and Geographical Positioning System technology. The results are summarized in the tables in Appendix 4.

In addition to the review of methods, the researchers continued to build on their knowledge of the literature pertaining generally to children's physical activity and the design of school grounds. For a summary of this literature, please see Appendix 5.

3. Methods investigated

3.1 Introduction to methods

Several methods were tested during the pilot study, each chosen to offer different insights into the relationship between school ground design and physical activity. The researchers engaged in direct observation of physical activity on the school ground (before and after school and during recess and lunch hour) to ascertain where children were playing, what activities they were engaged in and what relationship their activities had to the designed landscape. There were two sets of observations, dubbed 'macro-observations' and 'micro-observations.' The macro-observations entailed general, broad brushstroke observations of play patterns among the whole student population. The micro-observations involved observing individual students (five girls and five boys from one particular grade-four class) for five 10-minute periods each.

To measure the intensity and location of physical activity we combined the micro-observations with accelerometry: we asked students involved in the micro-observations to wear accelerometers throughout the pilot study (while at school only). For the purpose of this study, the only accelerometer data used were those that corresponded with the 50 minutes that each individual student was observed. This allowed us to associate the measurements of the intensity of physical activity with the location of play.

To investigate children's perspectives on school ground play (e.g., reasons for their play choices, motivating factors, desires and dislikes), we involved 18 students from the grade four class (including the 10 involved in the micro-observations) in three additional research activities: mapping, guided walks and interviews. For the mapping activity, each child drew and explained on his/her map the areas and features of the playground that they use for particular types of play. For the guided walks, the children led (some individually, some as a group) a field researcher on a tour of the playground and photographed and discussed areas and features of particular relevance for their play. The interviews provided an occasion for the field researcher to revisit the maps and photographs with the children, to clarify meanings, and to discuss the maps and photographs with respect to the field researcher's observations of play on the school ground.

The researchers who designed and conducted the study were:

Dr. Anne Bell (lead researcher)
Dr. Janet Dyment (lead researcher)
Amy Ouchterlony (data collector)
Erin Walsh (data collector)

Ethical clearance was granted from the school board. The principal and the parents/guardians of the grade four children involved provided written consent for participation in the study.

4. Macro-Scans

4.1 Purpose and description of method

The purpose of the macro-scans was to track the location and intensity of play behaviours at the school population level. Two approaches to the macro-scans were tested, each entailing the observation of all students on the school ground before school, during recesses and after school. The first was based on the System for Observing Play and Leisure Activity in Youth (SOPLAY) developed by Dr. Thomas McKenzie at San Diego State University. The second was based on behaviour mapping method developed by Dr. Robin Moore and Dr. Nilda Cosco of the Natural Learning Initiative at North Carolina State University.

SOPLAY method:

This method involved systematic and periodic scans of individuals in pre-determined target areas throughout the schoolground. During each scan, each individual in each target area was coded as Sedentary (S), Moderately Active (M) or Vigorously Active (V), based on momentary time-sampling. Separate scans were conducted for males and females, and a number of other factors were also recorded, including: time of day, weather, accessibility, usability, supervision, organized activity and portable equipment used.

Prior to using this method, the researchers read the detailed SOPLAY protocol[1] and watched the training video developed by Dr. McKenzie. The lead researchers divided the playground into seven target areas before beginning the observations, based on key design elements (treed concrete steps area, fixed play equipment area, major greened area, open playing field, treed grassy berm, open asphalt, and tennis courts). Two tally counters were purchased for the study, one for each data collector.[2]

The data collectors conducted a total of 37 scans on seven days, before school (beginning 15 minutes before school started), at lunch (two scans beginning 15 and 30 minutes after lunch started), during afternoon recess (beginning 5 minutes after it started), and after school (beginning 10 and 20 minutes after school ended).

Behaviour Setting method:

After Dr. Bell visited Drs. Moore and Cosco at North Carolina State University, she decided to trial their behaviour mapping method as an alternative approach to macro-observations during the final days of the pilot study. The perceived advantage was to be able to focus on finer-scale design features by recording on a map the exact points where children were observed playing during the scan. The challenge was to see whether this method could be adapted for use at an elementary school with a population of just over 700 students, as it had been used only to observe much smaller groups of people in prior studies (primarily children at daycare centres in the US).

Dr. Bell was able to observe field researchers using this method while in North Carolina and to discuss its potential application in the pilot study with Dr. Cosco. She

[1] For the official SOPLAY protocol see http://www-rohan.sdsu.edu/faculty/sallis/SOPLAYprotocol.pdf
[2] Suitable tally counters were obtained from Forestry Suppliers Inc., www.forestry-suppliers.com

prepared a map of the school ground[3] indicating all of the key design features and explained the procedure to the field researchers.

A total of seven scans were conducted on the final two days of the pilot study. During the scans, the researchers marked each individual student observed on the school ground, recording the gender and level of activity (S, M or V, based on SOPLAY categories).[4] Afterwards, Dr. Bell compiled all the data onto one summary map, in order to see where activity was occurring and what patterns emerged.[5]

4.2 Strengths and weaknesses of the methods

SOPLAY

Strengths:

- easy, quick, can accommodate large numbers of children, easy to see distribution patterns of children
- equipment involves only counters
- easy to train field researchers
- easy to get results
- widely used and recognized in related research

Weaknesses:

- able to compare play patterns (number of children, levels of activity) among target areas, but unable to comment on the design features in the target area that are influencing physical activity
- doesn't take into account the size of target area (would need to measure this for future studies)
- target areas are not necessarily comparable across schools (would it be possible to develop meaningful broad categories for future studies?)
- doesn't isolate variable of ages (would it be possible to differentiate, for example, whether students are at elementary or junior level?)

Behaviour Setting

Strengths:

- can consider finer design implications because the method allows you to see where activity is concentrated, around which design features (e.g. near fence, around picnic tables or trees) and at what level of intensity
- method allows for a comparison across different school grounds (need this for larger study)
- able to make design recommendations
- provides a more powerful visual tool (precise dots on map)
- can generate data that are consistent with SOPLAY

Weaknesses:

[3] For future studies, the map should be drawn by a professional landscape architect, but this was not possible given the timelines and budget for this pilot study.

[4] In their research, Drs. Moore and Cosco use five levels of activity: Stationary with no movement, Stationary with movement, Low movement (walking), Moderate movement (jogging and vigorous) and High movement (full run, very vigorous). In practice, however, the fourth and fifth categories tend to be collapsed into one.

[5] In their research, Drs. Moore and Cosco use hand-held computers to enter the data so that they are immediately available for GPS analysis. This technology should be used for future studies, as it allows researchers to more readily gather and correlate data related to design (e.g., ground surface, topography, shade) and social interactions.

- it takes longer to conduct a scan and may not be feasible with ver large numbers of students
- it focuses the analysis on clusters of activity, but does it draw attention away from the outlying children who aren't in the cluster? (What are the implications of this? Is it mismatched with the argument about providing areas for children who don't want to or aren't able to participate in rule-bound, vigorous play?)
- requires sophisticated equipment and so is more expensive
- doesn't isolate variable of ages (would it be possible to differentiate, for example, whether students are at elementary or junior level?)

4.3 General comments and recommendations for future research

In future studies, a macro-observation technique is needed. Ideally the SOPLAY and Behaviour setting methods could be combined to offer a method that is simple enough to analyse the play behaviours of large numbers (hundreds) of students and sophisticated enough to produce data that can support design recommendations.

Future studies should be conducted throughout the school year to reflect seasonal variations in the use of school grounds. This pilot study occurred in late spring, when the fields were muddy, when there was no need to seek shade, and when the trees and gardens were not yet in leaf. This may explain why the highest number of children played on the hard asphalt surfaces.

Note that the coding needs to be further refined so that it offers insight into the social dimensions of play.

4.4 Interesting findings using each method

*comments regarding the social dimensions of play or the types of activities that were occurring are derived from the notes of the data collectors, taken in conjunction with the method in question, and do not reflect the data typically gathered by the SOPLAY or Behaviour setting methods

<u>SOPLAY</u>

Table 1. Macro-population SOPLAY results

The mean number of girls and boys in each target area per scan and the percentage engaged in sedentary, moderate and vigorous intensity of physical activity.

Target Area	Mean # Girls in Target Area/scan	% Girls engaged in each intensity of PA			Mean # Boys in Target Area/scan	% Boys engaged in each intensity of PA		
		S	M	V		S	M	V
Treed concrete steps	6.05 ± 6.78	54	36	10	5.32 ± 4.39	30	39	31
Fixed play equipment	12.16 ± 8.89	31	30	39	8.78 ± 4.95	21	34	45
Greened area	12.51 ± 11.97	39	48	14	9.84 ± 9.28	28	55	17
Open playing field	15.32 ± 12.39	44	33	23	14.68 ± 15.27	27	45	28
Treed grassy berm	7.68 ± 8.47	50	36	14	7.14 ± 5.79	40	40	19
Open asphalt	27.57 ± 18.52	42	41	17	33.92 ± 18.90	29	44	27

Tennis courts	5.11 ± 6.12	37	47	16	19.14 ± 12.62	21	43	36

- The area supporting the most Vigorous activity for both boys (45%) and girls (39%) was the fixed play equipment.
- **The area supporting the most Moderate activity for both boys (55%) and girls (48%) was the greened area.**
- The area supporting the most Sedentary activity was the treed concrete steps for the girls (54%) and the treed grassy berm for the boys (40%). (N.B. Both of these areas are very small and provide seating.)
- The area where the highest number of boys and girls were observed was the open asphalt, but this is likely a function of size of the asphalt area (the largest target area).
- On the open asphalt, the greatest number of girls were engaged in Sedentary activity (42%), followed closely by Moderate activity (41%), with notably fewer engaged in Vigorous activity (17%).
- On the open asphalt, the greatest number of boys were engaged in Moderate activity (44%), with an almost equal number engaged in Sedentary (29%) and Vigorous activity (27%).
- The area which showed the greatest difference in use with respect to gender were the tennis courts which afforded play for older boys (grades 4 and 5) interested in soccer.
- Other than being on open asphalt, the girls were spread evenly among the fixed play equipment, the greened area and the open playing field.

<u>Behaviour Setting</u>

- On the treed, concrete steps (Area 1), there was a cluster of activity (V, M) on raised areas defined by trees and ledges. It was mostly rule-bound play involving boys. There was some dispersed activity near trees (mix of S, M, V).
- Around the fixed play equipment (Area 2), there was a cluster of activity around each piece of play equipment, mostly M, V with a mix of boys and girls.
- In the greened area (Area 3), there was a cluster of activity in the open sandy area (mostly M, some V), another cluster on the stones of amphitheatre (mix of V and S), another cluster in the centre of the amphitheatre (mix of M, V, S), clusters at the trees and rocks by the baseball field (mostly S as this is where the children sat to watch baseball), clusters around particular trees (mostly S) and activity dispersed among the bushes (M and V).
- On the open playing field (Area 4) activity was very dispersed. It was mostly V, M, with some S, some rule-bound, and a mix of boys and girls. There were clusters of activity in the sand pit and at the long jump pit, mostly M and mostly boys, with some girls. The baseball field was used twice at lunch for intramural baseball.
- On the treed, grassy berm (Area 5), there was a concentration of S activity at the picnic tables and under trees, with some M activity. Groups of children tended to use this area primarily to sit and talk.

- On the southern portion of the open asphalt (Area 6a), there was a lot of unpatterned, dispersed activity (mix of V, S and M). There was a cluster of activity near the fence (mostly M, V), a cluster on the edge of asphalt near the grassy berm (mostly S), and two more clusters of V and M (with some S) near one of the entrances to the school.
- On the northern portion of the open asphalt (Area 6b), there was a lot of dispersed activity (a mix of levels but predominantly M) involving boys and girls. There were clusters of activity where the space is defined by the soccer net (mix of V, M, S, including some rule-bound) and by the side of the school, where there are trees (mostly S).
- The tennis courts (Area 7) were used mostly by boys engaged in V and M rule-bound activity (with some S). This space is defined by nets and fences.

5. Micro-Observations

5.1 Purpose and description of method

The purpose of the micro-observations was to assess the potential of this method allow for a finer scale of analysis by taking into account factors such as age, ethnicity and ability. Ten students (five boys and five girls) were randomly chosen from a grade-four class to participate in the micro-observations. Each was observed for five 10-minute periods while playing on the school ground during morning, lunch or afternoon recesses.[6] Because these same students wore the accelerometers and participated in the guided walks, mapping and interview activities, we were able to correlate the data from the direct observations with the data gathered by the other methods.

5.2 Protocol for micro-observations

The following protocol was developed to guide the researchers and should be adapted for future studies:

> Each of the 10 participants are assigned a number in advance (on day 1).
>
> Researcher must know whom each of the 10 participants is, in order to conduct micro-observations.
>
> Researcher must not let the 10 participants know whom they are observing at any time, nor that they are focusing on only 1 individual at a time.
>
> Researcher meets the students before class starts on each day, and ties a bright band or scarf on the arms of the 10 participants so that they are easier to spot and follow during the micro-observations on the school ground. As with the accelerometers, these arm markers are gathered up at the end of each day, to be redistributed the next morning with the accelerometers.
>
> Each day the researcher meets the class outside the classroom before recess and after lunch so that s/he can proceed to the school grounds with the students in order to conduct the micro-observations. Researcher follows particular students on each day, according to a predetermined schedule. If on any day a student is absent, then the researcher chooses a different individual to follow and makes the necessary changes to the subsequent scheduled observations.
>
> At one-minute intervals, the researcher observes for 30 seconds and records for 30 seconds on the data collection sheet. Each observation period lasts for 10 minutes. Each observation notes: the time, the target area, the level of activity, the social interaction, the group size and the activity behaviour.

It is important for the field researchers to keep close track of which students have been observed when. For this purpose, the researchers developed a micro-observation record sheet, which can be used as a template for future studies:

[6] Note that the school board's research ethics review committee asked us not to observe individual students before or after school.

Table 2: Micro-Observation Record Sheet

STUDENT #1

Observation Session #	Date	Start Time	Finish Time	Notes
1	April 11	10:16	10:25	
2	April 13	14:20	14:29	
3	April 19	10:13	10:22	
4	April 24	12:19	12:28	
5	April 24	10:11	10:20	

***A similar table would be needed for each student.**

5.3 Strengths and weaknesses of the method

Strengths:

- allows researchers to make sense of accelerometer data
- allows inclusion of variables of age, ethnicity and ability
- when correlated with data from interviews, maps and guided walks, it can tie motivation to observed behaviour
- it is a way of validating qualitative data gathered through mapping, guided walks and interviews
- can support interpretation of the SOPLAY patterns (especially if different grade levels are included)

Weaknesses:

- requires a lot of time on the part of the field researcher (one student observed at a time)

5.4 General comments and recommendations for future research

In a larger scale study, the micro-observation technique is needed in order to understand the influence of such variables as age, ethnicity and ability (e.g., it should involve students from a range of grade levels in order to investigate age as a variable). Like the macro-scans, it should be conducted throughout the year in order to reflect seasonal variations in the use of school grounds.

5.5 Interesting findings

Table 3. Micro-observation results
The total number and percentage of micro-observations and the percentage of boys and girls engaged in Sedentary, Moderate and Vigorous intensity of physical activity.

GIRLS

Target Area	Total # of observations	Percentage of Observations	% Girls engaged in each intensity of PA		
			S	M	V
Treed concrete steps	11	5	64	36	0
Fixed play equipment	65	28	32	35	33
Greened area	20	9	21	79	0
Open playing field	8	3	50	13	38
Treed grassy berm	0	0	0	0	0
Open asphalt	62	27	68	23	10
Tennis courts	64	28	11	33	56
All target areas	230	100	37	33	30

*Note: Observations at one-minute intervals

BOYS

Target Area	Total # of observations	Percentage of Observations	% Boys engaged in each intensity of PA		
			S	W	V
Treed concrete steps	6	2	33	33	33
Fixed play equipment	0	0	0	0	0
Greened area	31	12	32	35	32
Open playing field	4	2	25	50	25
Treed grassy berm	14	5	57	29	14
Open asphalt	43	17	14	58	28
Tennis courts	162	63	4	38	58
All target areas	260	100	13	40	47

*Note: Observations at one-minute intervals

- The open asphalt covers about three times the area of the tennis courts, and yet was used about the same amount of time by the five girls observed, and about four times less frequently by the boys (43 minutes compared to 162 minutes). Even though both areas are hard-topped areas, the tennis courts are well defined by fencing and nets. The tennis court area was of particular importance to the grade four boys who regarded it as their territory.
- The open playing field covers an area about three times the size of the greened area, and yet was used less than half as much by the five girls (8 minutes

compared to 20 minutes), and even less by the boys (4 minutes compared to 31 minutes). Even though both are soft (natural) surfaces, the greened area is well defined by trees, shrubs and rocks.

- **On the greened area, most of the girls time was spent in M activity (79%), whereas for the boys, their activity was evenly split among S (32%), M (35%) and V (32%) activity.**
- Unlike the macro-scan results, the highest level of M activity for the boys occurred on the open asphalt (58%).

6. Mapping

6.1 Purpose and description of method

The purpose of the mapping activity was to provide an opportunity for students to describe and explain their play behaviours on the school ground. It is critical for children's health advocates to understand children's perspectives if they hope to design and develop environments that are conducive to active play.

Although we originally intended to involve only the core ten students in the mapping activity, at the request of the principal and the teacher, we involved the whole class. However, the data presented here were gathered only from students who submitted informed consent forms: 15 students including six boys and nine girls.

6.2 Mapping protocol

The following protocol was developed to guide the researchers and should be adapted for future studies:

> Equipment needed: a map for each child in the class; an overhead of the map; an overhead machine
>
> The researcher schedules the mapping activity with the teacher.
>
> The researcher distributes the maps to the students, and with the aid of an overhead, helps students understand the map, and ensure that they can orient themselves. (e.g., using a friendly quiz approach, ask the students to find particular places on the map, and then confirm with the overhead).
>
> The researcher then asks the students to indicate on the map where they like to play and what they like to do at each spot, using drawings and words.
>
> Then, in order to explore seasonal differences, the researcher asks the students to put a sticker (e.g. a sun) beside activities that they like to do when it's warm out (late spring, summer, early fall). Next, the researcher asks the students whether there are other activities that they like to do during the cold weather: if they aren't marked on the map yet, students will mark them on the map and put a sticker (e.g. a mitten) beside them. Finally, the researchers asks the students to put mitten and sun stickers beside activities they engage in all year round.
>
> The researcher then discusses the responses with the students, exploring what activities occur where, and the reasons why. If time permits, and as an opportunity to enhance the students' understanding of the purpose of the research, the researcher also engages students in a discussion about how the design of the school yard seems to influence their play behaviours.
>
> The researcher asks the students to put their names on their maps and collects all the maps. After leaving the classroom, the researcher records in writing the information and insights gathered through the discussions.

6.3 Strengths and weaknesses of the method

Strengths:

- allows students to explain, in a visual format, how they use the playground and for what types of activities
- provides a general picture of each student's activities
- provides a visual cue for discussions during interviews
- allows researchers to investigate play across all seasons
- students really enjoyed producing the maps
- potentially provides excellent visuals for presentations
- an excellent way to involve the entire class in the research (without requiring additional time for data collection)

Weaknesses:

- would be difficult to use with younger children (spatial representation on maps would be difficult)
- provides insights into play activity in particular target areas, but does not get at the influence of individual design elements on play (this limitation can be potentially overcome if mapping is combined with interviews)
- Some areas allow for more description than others (e.g., lots of different activities described on the greened area; however, very few ways to describe play on manufactured play equipment)
- On some maps more activities are mentioned in writing than on others; this may indicate that some children are more comfortable with writing (and may not reflect only the level or types of activity)

6.4 General comments and recommendations for future research

In a larger scale study, qualitative methods which represent the perspectives of children are important. Whether the mapping method is needed is not clear, as it offers many of the same advantages as the guided walks, but would be difficult to use with younger children. From a budgetary perspective, the mapping exercise involves less time on the part of the research team and requires no expensive equipment such as disposable cameras.

6.5 Interesting findings

The analysis of the maps consisted of counting each type of activity represented on the students' maps, associating these with the target areas used in the SOPLAY macro-observations, and totalling the number of times mentioned (by all the students, by all the girls, by all the boys). The maps of 15 students (6 boys, 9 girls) who had written consent from their parents to participate were used for the analysis.

*Note that on many student maps, a maze was drawn in Area 6 (open asphalt). This maze is an important 'green' design element in the open asphalt, where it was dug out and then planted with a variety of plants. It was out of bounds at the time of the study (April), however, to allow the plants to emerge from their winter dormancy and grow tall enough not to be accidentally trampled. For this reason it was not included as a separate target area.

Table 4. Findings from mapping exercise

Target area	# of times target area mentioned	# + % of students	# + % of girls	# + % of boys	Most frequently mentioned activities	# of activities mentioned
Area 2 fixed play equipment	16	11 = 73%	7 = 77%	4 = 66%	1.equipment 2.grounders 3.tag	4
Area 3 greened area	22	14 = 93%	9 = 100%	5 = 83%	1.rock jumping 2.tag 2.swing 2.sit	12
Area 4 open playing field	22	13 = 87%	8 = 89%	5 = 83%	1.snow soccer 2.soccer 3.snow forts	9
Area 5 Treed grassy berm	13	8 = 53%	7 = 77%	1 = 17%	1.talking 2.sliding 2.pretend play	9
Area 6 open asphalt	23	12 = 80%	7 = 77%	5 = 83%	1.four square 2.kickball 2.racing 2.walk + talk	13
Maze	11	11 = 73%	7 = 77%	4 = 67%	1.tag 2.hide and seek 2.manhunt 2.run	4
Area 7 tennis courts	24	12 = 80%	6 = 67%	6 = 100%	1.soccer 2.octopus	7

- Compared to girls, boys show a stronger preference for two areas: the open asphalt and the tennis courts. Note the distinct gender preference (more than 15%) by boys for the tennis courts.
- Compared to boys, **a higher percentage of girls mentioned the areas with natural elements (greened area, open playing field, treed grassy berm, maze)** and the fixed play equipment. Note the distinct gender preference (more than 15%) by girls for the greened area and the grassy berm (which has picnic tables).
- **The area mentioned by the highest percentage of students (93%) is the greened area.**
- The area mentioned by the lowest number of students is the treed, grassy berm (only 1 boy).

- The greened area is mentioned about as many times and by about as many students as the playing field, the open asphalt and the tennis courts.
- **The areas that support the greatest number of different activities are the greened area** (12) and the open asphalt (13).
- The maze (which is very small) and the fixed play equipment support the fewest number of different activities.
- The tennis courts are mentioned most often (24), but support relatively few different kinds of activities (7) and these are dominated by competitive, rule-bound games (soccer, octopus).
- The treed, grassy berm is mentioned very seldom, but, given its small size, it supports a relatively high number of different activities (9). These are dominated by open-ended play.

7. Guided Walks and Photographs

7.1 Purpose and description of method

The purpose of the guided walks was to provide another opportunity for students to describe and explain their play behaviours on the school ground. Accompanied by the data collectors, 15 students, either singly or in small groups, led 'tours' (ten tours in total) of the school ground to show the data collectors where they liked to play and to explain what they did there and why. Students used disposable cameras to photograph these places. The photographs were then used as a basis for discussion during the interviews. During the guided walks, the data collectors noted the places visited and took note of students' comments.

7.2 Protocol for guided walks

The following protocol was developed to guide the researchers and should be adapted for future studies:

> Equipment needed: a disposable camera; a clipboard with paper and pencil; a map of the school ground with the target areas indicated.
>
> The guided walks are conducted with participating students individually.[7]
>
> The researcher prearranges with the teacher times that are convenient to take the children out of class. At the scheduled times, the researcher meets the student in the classroom, and then they proceed to the playground.
>
> The researcher explains the purpose of the activity to the child, and the procedures: e.g. "I would like to know more about where you play on the school ground, and what you do in different spots on the school ground. So I'd like you to be my tour guide. I'm going to give you this camera, and I'd like you to take pictures of the places where you like to play. At the same time I'd like you to tell me how often you play there, what you do there, and why you like to play there. Do you understand what I mean?"
>
> After confirming that the child understands the task, the researcher gives the camera to the child, and follows the child around the school ground. The researcher takes notes during the tour, prompting the child when necessary, and recording: i. where the child plays; ii. what the child does in each spot; iii. why the child likes to play there and engage in particular activities (see Table 5).
>
> Once the guided walk is completed, the researcher collects the camera, and accompanies the child back to the classroom.
>
> The researcher then labels the camera.

[7] We decided to try walks guided both by students individually and students in small groups, to see whether this influenced discussions and students' readiness to share their perspectives. The data collectors felt that both methods worked equally well. The difference between the two approaches is most apparent in terms of analysis: i.e. separating out what each individual student said in order to look at factors such as ethnicity, gender and ability. From this perspective, guided walks with single students are more straightforward and thus preferable. Also, single guided walks make it possible to correlate the data gathered with data gathered by other methods (e.g. direct observation).

Table 5. Data collection sheet for guided walks

Data collector: _____

Date: _____ Time: _____

Participant: _____

Camera # _____

Description of Area (How do you refer to this area?)	**Target Area #**	**Description / Activities /Notes** - **What do you do here?** - **Why do you like this spot?**	**Photos Taken? (#)**

7.3 Strengths and weaknesses of the method

Strengths:

- during the walks, the features of the playground serve as a cue/prompt to discuss play activities (unlike mapping)
- data are not limited by what is actually happening at the present moment (as in direct observation): students often describe what takes place in other seasons, or even in other years. These are dimensions of play that can be captured by direct observation only if the study covers more than one season or year. For example, the guided walks allowed us to explore the use of the 'maze' located in the open asphalt which was off limits during the study, and for which the micro-observations and macro-scans consequently produced no data.
- would work well with students of all ages, including younger students who may not be adept at map-making or writing
- guided walks consistently produced more descriptive data than the maps

Weaknesses:

- recall of student may be of questionable accuracy
- photographs are difficult to interpret on their own – need to be discussed in the context of a follow-up interview

7.4 General comments and recommendations for future research

This is a good method for a larger scale study. It is preferable to mapping in that guided walks yield richer results and are more adaptable to different ages. If interviews were conducted at the same time, there would be no need to take photographs (helping to reduce costs).

7.5 Interesting findings

The findings presented here represent the data gathered from the guided walks considered separately from the interviews (*though the photographs were used as a basis for discussion in the interviews and influence the findings discussed in section 8 below as well). That analysis began with a count of the number of times that features of a particular target area were mentioned in the notes of the data collectors (excluding references to play activities in other years). Note that, as with the maps, the maze was mentioned by a number of students.

Area 1 (Treed concrete steps):	12 mentions by 7 groups
Area 2 (Fixed play equipment):	21 mentions by 9 groups
Area 3 (Greened area):	49 mentions by 10 groups
Area 4 (Open playing field):	10 mentions by 4 groups
Area 5 (Treed grassy berm):	19 mentions by 9 groups
Area 6 (Open Asphalt):	18 mentions by 8 groups
Maze:	12 mentions by 7 groups
Area 7 (Tennis courts):	22 mentions by 9 groups

- **The only area mentioned by all groups is the greened area**, Area 3. **This area had more than twice as many mentions as any other**. When asked whether their approach to the guided walks may have influenced this finding, data collector Amy Ouchterlony responded: "I think the number of mentions has to do with the kinds of stories and information that can be shared about the specific areas. I don't feel that I probed much during the guided walks - there is just more to talk about in Target Area 3! There is a wider variety of elements and places to play - there are lots of small corners and nooks to show during a tour. Whereas, in the open asphalt area or field, one simple mention

often will suffice - "we play soccer there" just about does it! It could also be that the field wasn't mentioned too much because it was muddy and off limits some days during the study - it may not have been fresh in the minds of the students - although we were definitely asking them to consider all seasons."

- Area 4, the playing field, was mentioned by only 4 groups and only 10 times. This is a big part of the school ground (about three times the size of the greened area) – and yet not a focus for play during free time, according to the guided walk data.

- Activities at the sedentary level were seldom mentioned (14 times out of 163 mentions – see below). This is very different from what was actually observed during the micro-observations. Places that have seating (especially Areas 1 and 5) were most often mentioned for sedentary activities.

The next step in the analysis was to consider the types of activities mentioned for each target area and to group them according to whether they suggested Sedentary, Moderate or Vigorous activity.

Sedentary types of activities: 14 out of 163 mentions: essentially sitting and talking. From highest to lowest number of mentions in each Target Area:

Area 1 (Treed, concrete): 4
Area 5 (Treed, grassy berm): 4
Area 6 (Open asphalt): 3
Area 3 (Greened area): 2
Area 2 (Fixed play equipment): 1
Area 4 (Open playing field): 0
Area 7 (Tennis courts): 0

Compared to the macro-scans, these results similarly indicate that Areas 1 and 5 invited the most Sedentary activity, and that the tennis courts invited the least S activity.

Moderate types of activities: 67 out of 163 mentions: 22 exploratory moderate (of which 19 are associated with natural elements); 20 rule-bound moderate (all in areas where play can be spatially defined by features); 10 pretend play moderate (6 associated with natural elements); 6 creative play moderate (all associated with natural elements); 6 manufactured equipment moderate (of which 4 are on ropes in the food garden); plus 2 others. **Note the predominance of open-ended play (exploratory, pretend, creative) at the Moderate level.** The findings below suggest that **most of this open-ended play is associated with areas where there are natural elements such as trees** (not the open playing field).

From highest to lowest number of mentions in each Target Area:

Area 3 (Greened area): 32
Area 5 (Treed, grassy berm): 8
Area 1 (Treed, concrete steps): 7
Area 6 (Open asphalt): 7

Area 2 (Fixed play equipment): 5
Area 4 (Open playing field): 4
Area 7 (Tennis courts): 4

Compared to the macro-scans, these results similarly indicate that the greened area invites a high level of Moderate activity.

Vigorous types of activities: 82 out of 163 mentions (over half of activities mentioned during the guided walks involve vigorous levels of activity): 59 rule-bound vigorous (which includes baseball, jumping, team sports, tag etc.); 12 running (which includes biking, jumping, sliding, racing, running); 11 manufactured equipment vigorous. **Note that the greened area (Area 3) was mentioned more often for Vigorous types of activities than the open asphalt (Area 6) and the open playing field (Area 4). However, this result is not supported by the macro-scans.**

From highest to lowest number of mentions in each Target Area:
Area 7 (Tennis courts): 18
Area 2 (Fixed play equipment): 15
Area 3 (Greened area): 15
Maze: 11
Area 6 (Open asphalt): 9
Area 5 (Treed, grassy berm): 7
Area 4 (Open playing field): 6
Area 1 (Treed, concrete steps): 1

Compared to the macro-scans, these results indicate that the tennis courts and the fixed play equipment invite Vigorous activity.

8. Interviews

8.1 Purpose and description of method

The purpose of the interviews was to corroborate the data gathered through the mapping activity, guided walks and micro-observations, and to further explore the children's perceptions of where they play, what activities they engage in, and why. The data collectors conducted the interviews singly and in groups, based on the same groupings used for the guided walks.

8.2 Protocol and schedule for interviews

Equipment needed: a recording device and cassettes; a clipboard with paper and pencil; a summary of data collected regarding the child to be interviewed (micro-observations, map, photos and notes from the guided walks).

The researcher numbers all the photographs to be discussed during the interviews.

The researcher prearranges with the teacher times that are convenient to take the children out of class. At the scheduled times, the teacher meets the student in the classroom, and then they proceed to a quiet area to conduct the interview.

The researcher explains the procedure to the student and obtains verbal consent for recording the interview. The researcher clearly identifies on tape the student at the outset of the interview. During the interview the researcher identifies, by number, which photos are being discussed.

Once the interview is completed, the researcher accompanies the child back to the classroom.

The researcher labels each cassette with the child's number and records any comments about the interview process (ethical issues, technical difficulties, etc.), to bring to the attention of the lead researcher.

Questions to guide the interviews:

1. [explain procedure to student] What we are going to do this morning is an interview. Do you know what an interview is? [clarify if necessary] I would like to record our conversation on this tape recorder. Is that OK with you? [confirm consent]. What we're going to do is talk about the map that you drew and the pictures that you took when you took me on a tour of the school ground. I have some questions I'd like to ask you about these, and about what I've seen while I've been watching you and the other kids playing on the school ground during the past couple if weeks. OK? any questions? [answer questions]
   [turn on tape recorder and identify student, date]
2. On this map, you've shown me the places you like to play and what you like to do in those places. I wonder if you could go over it with me so that I'm sure I've understood correctly. [clarify which spots, which activities, student's motivation] Is there anything you'd like to change? Anything you've missed?

3. Here are the pictures that you took of the play ground when you took me on the tour. I wonder if you could go over them with me so that I'm sure I've understood correctly. [clarify which spots, which activities, student's motivation]
4. While I was out on the playground watching you and the other kids, I noticed … [use this opportunity to corroborate, clarify and otherwise explore the information that the child has supplied].
5. The child may wish to hear what s/he sounds like on the tape recorder. If so, play back a short section of the recording and answer any questions.

8.3 Strengths and weaknesses of the method

Strengths:

- can explore motivation, enhance interpretation, and probe data from other methods
- interview transcripts provide text to include in reports and papers, providing a voice for students

Weaknesses:

- when interviews are conducted in groups, it can be difficult to identify which child is speaking
- experienced technical difficulties (4 interviews were inaudible), so need to check equipment prior to use

8.4 General comments and recommendations for future research

In future studies, some form of an interview with the children involved in the micro-observations is needed. The children's insights are key to interpretation. In a larger study it would be interesting to do a gender analysis of the interviews. To help reduce costs, the interviews could be merged with the guided walks, using a tape recorder. This would eliminate the need for photographs and possibly maps.

8.5 Interesting findings

Unfortunately, the cassettes from four of the interviews were inaudible. The findings presented below are therefore based on only six interviews involving 13 students:

Interview 1: 1 boy, 2 girls
Interview 6: 2 girls
Interview 7: 1 girl
Interview 8: 2 boys, 1 girl
Interview 9: 2 girls
Interview 10: 2 girls

The four interviews that we weren't able to hear/use involved three boys in individual interviews and three girls in a group interview.

A number of themes emerged regarding design features that students appreciated for a variety of reasons, providing insight into why children are choosing particular places to play:

1. Students liked places that they could call their own, for themselves, their friends and/or their age group (interviews 1, 2, 6, 7, 10). This preference emerged in comments about:

-the tennis courts (Area 7) which are very much considered to be the territory of this grade four class and a couple of other classes
-the older kids claiming the soccer area
-trying to find a space not too crowded
-four-square areas tending to be for grades four and five
-special places for different grades

2. Students liked well-defined spaces - spaces defined for example, by trees, tree stumps, rocks, lines, the wall, nets, fences (interviews 1, 6, 7, 8).

3. Natural elements appeared to inspire pretend play (interviews 6, 9, 10). For example, the greened area (Area 3) seemed to spark the imagination, and have stories associated with it: during play, rocks were lava, a cauldron and beds; knots in trees were keyholes; a tree stump was a plate; a bush was the queen's chair; a grove of trees was a house; the rock amphitheatre was a tent; and tall plants in the maze were like a jungle.

4. Students liked places to hide (interviews 1, 6, 8). Good hiding spots mentioned were the berm in Area 5, the tall plants in the maze, and the amphitheatre in Area 3.

5. Students in one interview (interview 6) appreciated design elements that challenged their ability: being able to navigate rocks when they're slippery or wobbly and having rocks spread out so that they're a challenge to jump from.

6. Students like places to socialize and to talk with friends (interviews 1, 7, 10).

7. Students in two interviews (interviews 6, 9) indicated a preference for places that could be shaped, either physically or imaginatively. This preference emerged in comments about:
-kids making an area their own: moving the rocks around to suit jumping games around the tree
-the importance of natural elements, especially in Area 3 (rocks, stones, leaves, mint, flowers, berries), and even on the tennis courts (branches, leaves) and the playing field (snow, sand, leaves – snow for snow forts and snowmen, sand for sand castles, leaves for leaf forts)
-things that kids can do something with (pick, squish, pretend to cook, build, hide, dig,)
-their personal involvement, or the involvement of people they know in creating the gardens

8. Students in interview 6 liked places to climb.

9. Students in interview 8 liked places to slide (the stairs in Area 2 and the berm in Area 5).

Other points of interest that emerged during the interviews:

1. appeal of rule-bound games for the boys (soccer, snow soccer, ball hockey) and of jumping and hiding (interview 8)

2. appeal of more open-ended play (dance, tree-hugging, sliding, running, swinging, jumping) and the social aspect of play (being with friends, sitting, talking) for one girl (interview 8)

3. different games invented (e.g., re. food, family) (interview 9)

4. use of the school ground after school hours (interview 6)

9. Accelerometers

9.1 Purpose and description of method

The purpose of using accelerometers was to become familiar with the technology and test its potential application in exploring the relationship between school ground design and physical activity. While originally the researchers hoped to be able to combine the use of accelerometers with Geographical Position System (GPS) technology, the literature indicated that the GPS technology could not be used at such a fine scale in the way intended. As a result, the use of the accelerometers was limited, because it had to be coupled with direct observation (so that intensity of activity could be correlated with the location of activity).

The accelerometers used were GT1M Actigraphs rented from the Actigraph company in Fort Walton Beach, Florida at a cost of $US 65 per unit.

The researchers all read the Actigraph manual to familiarize themselves with the technology. One of the lead researchers practiced with two of the units prior to the field study, and then reviewed how to use them (how to charge the units, how to initialize them, how to set the epochs, how to download the data) with the data collectors.

The units were charged and set to begin collecting data at 9:00 a.m on the morning of the first day of the field study. The epochs were set at 10 seconds. The units were numbered 1 – 10 to ensure that the same student would always be wearing the same unit.

The ten students who participated in the micro-observations were the same students to wear the accelerometers. On the first day of the pilot study information was gathered from each student regarding their ethnicity, age, weight and height (see Table 6). Each student was fitted with an accelerometer and asked to wear it around their waist all the time while at school for the duration of the study. Every morning, before class, the students met with the data collectors outside the classroom to put on their accelerometers. Every day, at the end of class, they met with the data collectors to return them.

Table 6. Participant Information Sheet

Name:
Participant Number:
Age:
Height: Weight:
Ethnicity : Caucasian __ African Canadian __ Aboriginal __ Asian __ Latino/Hispanic __ Other _____

Activity counts were collected from the accelerometers at 10 second 'epochs.' When the data was downloaded as a '.dat' file, and then converted to an '.xls' file, the 10 second epochs were added together to provide activity counts for 60 second intervals. By matching the activity counts with the information gained through the micro-observations, it was possible to explore the relationship between the activity counts and the student's location (i.e., target area), level of intensity of play (using SOPLAY categories), group size, social interaction, and activity.

9.2 Strengths and weaknesses of the method

The researchers experienced a number of problems with the accelerometers, one of which may have compromised the validity of the data gathered. The first problem encountered was that two of the units lost their charge at the end of the first day (whereas they were supposed to retain their charge for several days). The researchers informed Actigraph of the problem, and replacement units were sent immediately so that no days of data collection were lost.

The second problem, more serious, was discovered at the analysis stage of the study, after the data collection: the Actigraph software purchased and used for the study was faulty and did not correctly download the data from the units. Upon discovering the problem, the researchers contacted Actigraph, and sent the downloaded files to the company to recover the data. Actigraph provided new software to be used in future studies. However, this new software could not be used by the researchers or Evergreen staff to recover the data from the pilot study. Actigraph therefore took responsibility for recovering the data, and after several weeks, the company sent the recovered files to the researchers who then proceeded with the data analysis.

It is difficult to assess the strengths and weaknesses of the method, given the problems encountered. Fortunately, however, one of the lead researchers will be conducting a second 'twin' pilot study in Australia, which will result, hopefully, in a clearer understanding of the potential use of accelerometers for this line of research. At this point, our assessment of the strengths and weaknesses of the method are as follows:

Strengths:

- the ability to measure the intensity of activity
- the potential to correlate intensity of activity with location of activity (by combining with direct observation)
- the potential to correlate measurements of the intensity of physical activity with other factors such as age, gender, geographic location, ethnicity, ability, etc.

Weaknesses:

- the relatively high cost of the equipment and of the labour involved in analysing the data
- the potential difficulty of correlating the intensity levels used in the SOPLAY method with the intensity readings on the accelerometers (please see next section)
- the usefulness of only a small portion of the data generated (i.e. only that gathered in conjunction with direct observation)

9.3 General comments and recommendations for future research

It is unclear whether accelerometers should be used in future studies, given that to make sense of the accelerometer data vis-à-vis design elements requires coupling the use of the accelerometers with direct observation (in order to know where the activity is occurring). This entails using only a very small segment of the accelerometry data (in this case, 50 minutes per student). It would be important to ask for advice from an accelerometry expert to determine whether there is any value or merit in using such a small segment of the data, especially considering the costs involved.

Further, the pilot study results indicate a problematic discrepancy between the categories for levels of intensity used in SOPLAY and the data derived from the accelerometers. Our mean intensity counts for each level, using the accelerometer data, were:

Sedentary: 1216 counts/minute
Moderate: 2039 counts/minute
Vigorous: 2722 counts/minute

These means fall far below the cut-off points recommended in the literature (See Table 7). Granted, there is no agreed-upon cut-off point for children in the literature. Still, we would need to seek an expert explanation and advice on the implications of this discrepancy before using this method in further research.

Table 7. Accelerometer Activity Count Cut-off's used in the literature

Author	Age group	Moderate intensity cut points (counts/minute)	Vigorous intensity cut points (counts/minute)
Puyau et al. (2002)	6-16	>3200	<8200
Eston et al. (1998)	8.2-10.8	>500	<4000
Puyae et al. (2004)	7-18	>1500	<6500

9.4 Interesting findings

1. There is a general increasing trend of activity count as a function of group size. When boys were playing in pairs, there was a noticeable decrease in accelerometer count, but otherwise an increasing trend. For girls, the activity count increased as a function of group size.

2. On the open asphalt, the boys were more active than girls (mean count of 1905 vs. 957).

3. The boys spent more time than the girls on the tennis courts (159 minutes vs. 64 minutes), but the mean intensity count for the girls on the tennis courts was higher (3102 counts vs. 2895 counts).

10. Logistical Information

10.1 Letters and informed consent forms

For the information letters and informed consent forms for principals and parents/guardians, see Appendices 1 – 3.

10.2 Preparation and training for data collectors

macro-observation: i. view SOPLAY video, practice and discuss; ii. practice in the field with tally counters and data entry sheets and arrive at agreement on the meaning of the intensity levels (S, M, V) among data collectors; iii. review approach to data entry into Excel file.

micro-observation: i. review data entry sheets and codes; ii. review approach to data entry into Excel file; practice in the field to ensure consistency of approach among data collectors.

mapping: i. review protocol.

guided walks: review protocol.

interviews: i. review interview schedule and use of recording devices; ii. review means of organizing and submitting data (e.g. labelling tapes with student numbers; matching tapes with photos or maps).

accelerometers: i. read instruction manual for accelerometers; ii. practice charging and initializing units and downloading data prior to first day of data collection; iii. review means of organizing data files on computer; iv. review approach to gathering information about student participants (height, weight, etc.).

10.2 Daily organization

Because a variety of methods would be used in future studies, it is important to carefully coordinate research activities and to keep a record of what takes place. To this end, data collectors should fill out on a daily basis a timetable for the day's events See Table 8).

Table 8. Sample Daily Timetable for Researchers

Date:_____ Day of Observation: 1 2 3 4 5 6 7 8 9 10

TIME	ACTIVITY
Before School	
8:30	
8:45 – 10:00	
10:05	
10:10 – 10:25	

10:30 – 12:00	
12:05	
12:20	
12:30	
12:45 – 2:10	
2:15 – 2:30	
2:30 – 3:25	
3:25	
3:40	
4:00	
End of Day	
Notes	

10.4 The first day: introducing student participants to the study

In addition to the written information that is sent home to parents/guardians, the researchers and data collectors must verbally inform the student research participants about the purpose and nature of the study. The following topics should be covered:

1. Who the researchers and data collectors are.
2. Purpose of the study: to explore the ways that the design of the school ground influences play. (If possible, link discussion to the history of the school ground greening project, and what students know about it.)
3. What is research? What is meant by "research"? examples? Why do people engage in research? What makes research reliable (multiple methods, consistency, …)? The rights and responsibilities of a research participant (right to withdraw, right to anonymity; responsibility to participate to the best of one's ability, to NOT tamper with the equipment, the results etc…)
4. Methods to be used in study: what methods will be used, equipment, etc. Could ask student s to speculate about what they think researchers will find (hypothesis).

11. Conclusion and Summary of Recommendations

The literature review and pilot study have provided invaluable insights into potential methods for future research. In general, the pilot study underlined the importance of collecting data across a range of age groups and across the entire school year in order to capture the range of play patterns and to understand how they are influenced by age and seasonal differences. To fully appreciate the influence of greening on physical activity, future research should include schools with greened and non-greened school grounds (ideally, paired schools in the same neighbourhoods).

Specific recommendations regarding each method are as follows:

1. **Macro-observation:** In future studies, a macro-observation technique is needed. Ideally the SOPLAY and Behaviour setting methods could be combined to offer a method that is simple enough to analyse the play behaviours of large numbers (hundreds) of students and sophisticated enough to produce data that can support design recommendations.
2. **Micro-observation**: In a larger scale study, the micro-observation technique is needed to understand the influence of such variables as age, ethnicity and ability (e.g., it should involve students from a range of grade levels in order to investigate age as a variable). Like the macro-scans, the micro-observations should be conducted throughout the year in order to reflect seasonal variations in the use of school grounds.
3. **Mapping**: In a larger scale study, qualitative methods which represent the perspectives of children are important. Whether the mapping method is needed is not clear, as it offers many of the same advantages as the guided walks, but would be difficult to use with younger children. From a budgetary perspective, the mapping exercise involves less time on the part of the research team and requires no expensive equipment such as disposable cameras.
4. **Guided Walks**: This is a good method for a larger scale study. It is preferable to mapping in that guided walks yield richer results and are more adaptable to different ages. If interviews were conducted at the same time, there would be no need to take photographs (helping to reduce costs).
5. **Interviews**: In future studies, some form of an interview with the children involved in the micro-observations is needed. The children's insights are key to interpretation. In a larger study it would be interesting to analyse the interview data with respect to such factors as gender, age, ethnicity and ability. To help reduce costs, the interviews could be merged with the guided walks, using a tape recorder. This would eliminate the need for photographs and possibly maps.
6. **Accelerometers:** It is unclear whether accelerometers should be used in future studies, given that to make sense of the accelerometer data vis-à-vis design elements requires coupling the use of the accelerometers with direct observation (in order to know where the activity is occurring). This entails using only a very small segment of the accelerometry data (in this case, 50 minutes per student). It would be important to ask for advice from an accelerometry expert to determine whether there is any value or merit in using such a small segment of the data, especially considering the costs involved. Further, the pilot study results indicate a problematic discrepancy between the categories for levels of intensity used in SOPLAY and the data derived from the accelerometers. This discrepancy would need to be addressed.

Appendices

Appendix 1: Sample information sheet and consent form for parents

INFORMATION SHEET FOR PARENTS

PROJECT TITLE: *Active by Design: Investigating the Impact of Green School Grounds on Physical Activity*

March 29, 2007

Dear Parent/Guardian,

I would like to invite your child's participation in a study to investigate the relationship between school ground design and children's physical activity. The school ground is an important social and physical environment where Canadian children spend, on average, about 25% of their school day engaged in free play. When designed to promote physical activity and health, the school ground is a public resource that stands to benefit, on a regular and ongoing basis, children and youth.

This research will be coordinated and led by me, Dr. Anne Bell, Project Manager of Research for the Learning Grounds Program of the charitable organization, Evergreen. I can be reached at abell@evergreen.ca or (416) 767-3684. Aspects of the research will be supported by two graduate students at the Ontario Institute for Studies in Education at the University of Toronto, Erin Walsh and Amy Ouchterlony.

The purpose of this pilot study is to identify, test and refine appropriate research methods to investigate the influence of school ground design on children's physical activity and related health benefits. We will trial selected research methods and assess their appropriateness in monitoring and measuring the quality and quantity of children's physical activity on school grounds. The study will involve your child's entire class in one activity (mapping) and only 5 girls and 5 boys in other activities. It will take place over a period of 11 – 12 school days in April and will require a total of about 2 – 4 hours of each child's time. Only children who return the attached parental consent form will participate. From among the students who return the consent forms, your child's teacher, will help me to select 10 who will participate in certain activities (accelerometry, guided walks, interviews).

The study has been funded with a grant from the Centre for Urban Health Initiatives and approved by the External Research Review Committee of the Toronto District School Board.

The research methods for the study are:

1. Direct observation of physical activity to ascertain where children are playing on the school ground and what activities they are engaged in and what relationship their activities have to the designed landscape

2. Mapping, guided walks and interviews with child participants to understand their perspectives on school ground play (e.g., reasons for their play choices, motivating factors, desires and dislikes)

3. The use of accelerometers to measure intensity and timing of physical activity on the school ground

There are no foreseeable risks associated with participation in this study. All data collected during this research will be stored in a secure location, and only the researchers involved in this project will have access to it. All participants and the name of the school will be known by the researchers but will not be identified or identifiable in the research output. Pseudonyms will be assigned in the data analysis and report writing phase of this study.

Participation in this study is entirely voluntary. If your child participates in this study, he or she can: (i) decline to answer any question; (ii) withdraw at any time without effect or explanation; and (iii) withdraw any data he or she has supplied to date.

If you have any concerns of an ethical nature or complaints about the manner in which the project is conducted, you may contact Sally Erling, Chair of the External Research Review Committee for the Toronto District School Board, 1 Civic Centre Court, Etobicoke, ON, M9C 2B3.

Thank you for taking the time to read the information sheet. I do hope that you will be willing to consider letting your child participate in the study.

Yours truly,

Dr. Anne Bell
Program Manager of Research
Learning Grounds Program, Evergreen
abell@evergreen.ca
(416) 767-3684

CONSENT FORM for PARENTS/ GUARDIANS

PROJECT TITLE: *Active by Design: Investigating the Impact of Green School Grounds on Physical Activity*

1. I have read and understood the 'Information Sheet' for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves:

   a. **Direct observation of physical activity**: to ascertain where children are playing on the school ground and what activities they are engaged in and what relationship their activities have to the designed landscape

   b. **Mapping, guided walks and interviews with child participants***:* to understand their perspectives on school ground play (e.g., reasons for their play choices, motivating factors, desires and dislikes)

   c. **The use of accelerometers:** to measure the intensity and timing of physical activity on the school ground.

4. I understand that participation involves no foreseeable risks.
5. I understand that all research data will be securely stored by and accessible only to the researchers.
6. I agree that research data gathered from my child may be published provided that the name of my child and school will not be identified.
7. I understand that the researchers will maintain the school's and participants' identity confidential and that any information supplied to the researcher(s) will be used only for the purposes of the research.
8. I agree to let my child participate in this investigation and understand that my child may withdraw at any time without any effect. If I so wish, I may request that any data my child has supplied to date be withdrawn from the research.

Name of child:

Name of parent/guardian:

Signature: Date:

You will be informed directly if your child is one of the 10 students selected to participate in direct observation, guided walks or interviews. I will send home to you, through your child's teacher, a letter of confirmation.

Name of principal investigator: Anne Bell

Signature of principal investigator: Date:

Appendix 2: Sample information sheet and consent form for principals

INFORMATION SHEET FOR PRINCIPALS

PROJECT TITLE:

Active by Design: Investigating the Impact of Green School Grounds on Physical Activity

1/11/2007

Dear Principal,

I would like to invite your school's participation in a study to investigate the relationship between school ground design and children's physical activity. The school ground is an important social and physical environment where Canadian children spend, on average, about 25% of their school day engaged in free play. When designed to promote physical activity and health, the school ground is a public resource that stands to benefit, on a regular and ongoing basis, children and youth. Thus, from a population health perspective, the school ground represents a promising site for intervention.

This research will be coordinated and led by me, Dr. Anne Bell, Project Manager of Research for the Learning Grounds Program of the charitable organization, Evergreen. I can be reached at abell@evergreen.ca or (416) 767-3684. Aspects of the research will be supported by two graduate students at the Ontario Institute for Studies in Education at the University of Toronto, Erin Walsh and Amy Ouchterlony.

The purpose of this pilot study is to identify, test and refine appropriate research methods for a future, in-depth study investigating the influence of school ground design on children's physical activity and related health benefits. The investigators will trial selected research methods and assess their appropriateness in monitoring and measuring the quality and quantity of children's physical activity on school grounds. The study will directly involve 5 girls and 5 boys from one class over a period of 2 – 3 weeks in April and will require a total of about 2 – 3 hours of each student's time. In addition, the researchers will be observing general patterns of play on the school ground. The study has been funded with a grant from the Centre for Urban Health Initiatives and approved by the External Research Review Committee of the Toronto District School Board.

If you agree to participate in the study, we will investigate a range of methods to explore individual and collective factors that influence active play on the school ground. The proposed methods are:

1. Direct observation of physical activity: to ascertain where children are playing on the school ground and what activities they are engaged in and what relationship their activities have to the designed landscape

2. Mapping, guided walks and interviews with child participants: to understand their perspectives on school ground play (e.g., reasons for their play choices, motivating factors, desires and dislikes)

3. The use of accelerometers and GPS technology: to measure the location, intensity and timing of physical activity on the school ground

The student selection process will involve the following steps:

1. In consultation with you, I will confirm with a teacher his/her willingness to have his/her class involved in the study.
2. The teacher will send home consent forms with each student in the class.
3. From those consent forms that are returned, the teacher will be asked to help the researchers to select student participants based on gender (5 boys and 5 girls) and on a purposeful selection of students who exhibit a range of play behaviours.

There are no foreseeable risks associated with participation in this study. All data collected during this research will be stored in a secure location, and only the researchers involved in this project will have access to it. All participants and the name of the school will be known by the researchers but will not be identified or identifiable in the research output. Pseudonyms will be assigned in the data analysis and report writing phase of this study.

Participation in this study is entirely voluntary. Participants who decide to take part in the study can: (i) decline to answer any question; (ii) withdraw at any time without effect or explanation; and (iii) should they wish, also withdraw any data they have supplied to date. The parents/guardians of participants will be provided with an information sheet describing the study and will be required to sign a consent form prior to the participation of their child.

If you have any concerns of an ethical nature or complaints about the manner in which the project is conducted, you may contact Sally Earling, Chair of the External Research Review Committee for the Toronto District School Board, 1 Civic Centre Court, Etobicoke, ON, M9C 2B3.

Thank you for taking the time to read the information sheet. I do hope that your school will be willing to participate in the study.

Yours truly,

Dr. Anne Bell
Program Manager of Research
Learning Grounds Program, Evergreen
abell@evergreen.ca
(416) 767-3684

PROJECT TITLE:

Active by Design: Investigating the Impact of Green School Grounds on Physical Activity

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1. I have read and understood the 'Information Sheet' for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves:

   d. **Direct observation of physical activity**: to ascertain where children are playing on the school ground and what activities they are engaged in and what relationship their activities have to the designed landscape

   e. **Mapping, guided walks and interviews with child participants***:* to understand their perspectives on school ground play (e.g., reasons for their play choices, motivating factors, desires and dislikes

   f. The use of accelerometers and GPS technology: to measure the location, intensity and timing of physical activity on the school ground.

4. I understand that participation involves no foreseeable risks.
5. I understand that all research data will be securely stored by and accessible only to the researchers.
6. Any questions that I have asked have been answered to my satisfaction.
7. I agree that research data gathered from the study participants may be published provided that the name of our school will not be identified.
8. I understand that the researchers will maintain the school and participants' identity confidential and that any information supplied to the researcher(s) will be used only for the purposes of the research.
9. I agree for my school to participate in this investigation and understand that we may withdraw at any time without any effect, and if I so wish, may request that any data I have supplied to date be withdrawn from the research.

Name of Principal: _____

Signature: _____ Date: _____

Name of investigator _____

Signature of investigator _____ Date _____

Appendix 3: Sample confirmation of participation note to parents

CONFIRMATION FOR PARENTS:
Participation in Evergreen study on physical activity and school grounds

April 10, 2007

Dear Parent/Guardian,

This is to confirm that your child, _____, has been selected to participate in Evergreen's study on physical activity and school ground design. Your child is one of 10 children that were selected through a random selection process. As explained in the parental consent form that you signed last week, your child will be involved in accelerometry, guided walks and interviews, in addition to other activities that will involve his/her entire class.

Thank you very much for letting your child participate in this study. As explained on the consent form, participation in this study is entirely voluntary, and your child may withdraw from this study at any time.

If you have any questions or concerns, please don't hesitate to contact me.

Yours truly,

Dr. Anne Bell
Project Manager of Research
Learning Grounds Program
Evergreen
abell@evergreen.ca
(416) 767-3684

Appendix 4. Relevant literature: micro-observations and technology

MICRO-OBSERVATIONS

Article	Location	# of kids	Age/year group of kids	# of days	# observations	# schools	Categories of Play	Categories of School Grounds	Reliability/ Validity	Data Collection Techniques
(Malone & Tranter, 2003)	Canberra Melbourne Australia	10 students/ school -teachers were asked to pick children who had a range of play behaviours	Year 3 and 4 (8-10 yrs old)	Each child was observed for one day (over the recess and lunch periods)	5 observations during recess; 10 at lunch; each occurring at 2 minute intervals -total of approximately 1000 observations	5	*Social Interaction* -solitary play, parallel play, associated play, cooperative play, two people, small group, large group *Categories of Play* -Physical/motor (3) -social(4) development -cognitive development	-Traditional -Designer -Adventure -Creative/ Comprehensive	-	-systematic observation and mapping during recess and lunch -individual interviews -child/peer observations -analysis of drawings
(Hands & Parker, 2006)	Australia	24 (8 from each school) -4 boys & 4 girls from each school -teacher asked to choose 4 children perceived as 'high' active and 4 as 'low' active	5-6 yrs old	5 days	-monitored for 30 minutes over 5 consecutive days during free play (based on study by Gretebeck and Montoye 1992 that said that is a good length of time to track habitual patterns) -had 8 observers (one/child) -coded with CARS	3	CARS method Scale of 1 (stationary with no movement) to 5 (translocation – fast, very intense movement)			

					every 10 seconds					
(Trost, R.Pate, Freedson, Sallis, & Taylor, 2000)		245 (127 girls, 118 boys)	3-5 yrs old		-researcher observed child for 15 s followed by 15 s recording -participants were observed for 1 hour on 3 separate days		5 point likert scale (1=stationary/ motionless to 5 = fast movement) -also got location, structure or context of behaviour, type of activity, interactors, frequency of prompts from interactors		-interobserver agreement (p. 835)	
(Moore, 1986)	Milwaukee	-many	2.5-6 yrs old	-data collected over a period of a month (but unclear how many times each centre observed?)	-2 trained observers -20 minutes, 5 min break, another 20 minutes and so on (for a total of 2.5 hr observational period) -each observation lasted 10 seconds, with 1 minute and 50 seconds for recording -after each 2 minutes, a new randomly selected observation cell was observed	14	-see table of categories of behaviour (p. 219)	-this study looked at 'cells' or behaviour setting areas in day care centres that are 'well defined' 'moderately defined' and 'poorly defined'	-lots of stuff about inter-rater reliability	
(Boulton, 1999)	UK	89 children 45 girls; 44 boys	8-12 yrs	-?	-Scan sampling -participants observed in a random order -on each scan, one child = target of obs -observe for 60 seconds then record	2	-this study was looking at bullying	-not relevant	Inter observer reliability studies done (p. 946)	

					observations (who with, what doing) -Mean number scans across all participants = 56.8					
(Brown & Burger, 1984)		72 children (12 at each playground)	3.5 yr olds and 4.5 yr olds Boys and girls		-time sampling method -record behaviour every 5 seconds for a two minute period -collected over a 5 week period -average minutes each subject observed = 27.7	6	-social, language, and motor (see table p. 614)	Contemporary vs. less contemporary playground design -19 item rating scale (p. 611)		
(Weinstein & Pinciotti, 1988)	New Jersey	-entire school population (N=400 kids)	Kinder to grade 3	-10 days data collection -During each recess period, 3 observers circulate through yard; note # boys/girls engaged in each category of behaviour and their location -each observer could get 2-3 maps/recess period	Pre-post study (after changes made to playground) -observe 2 weeks before and 2 weeks after construction -5 separate recess periods/day (separate recesses for different aged kids)	1	20 categories of *activities* and *social* behaviour (p. 353) -organized games; uninvolved behaviour; active play; talking; rough housing; transition; pretend play; quiet play; aggression (p. 360)	-playground rating dimension ("does the playground embody the design principle?" Scale of 1-3)	-inter observer reliability trials done repeatedly throughout	
(Susa & Benedict, 1994)	?	38 girls 42 boys (randomly selected as they came to play at public playgrounds)	4-11 years old	-not relevant	-observed child for 15 minutes -observations recorded by minute intervals (45 seconds observing; 15 seconds of behavioural	2 playgrounds	Categories of *pretend* play (p. 568)	Traditional playground vs. Contemporary playground (see picture; page 565)		-Observation and then child interviews

					descriptions)					
(Faber-Taylor, Wiley, Kuo, & Sullivan, 1998)	Chicago	377 groups observed; of these, 114 contained children (N=262 children)	-Categories of ages = Baby, children, teen, adult, elderly	Probably 4	-observed on 4 separate occasions (between 3:30-5:00 on weekdays; between 12:00-3 pm on weekends) -data collected based on what seen at time of arrival at site	64	Pretend play (sociodramatic; fantasy; physical pretend; object centred); rule bound conventions; rule bound creative; functional; constructive; exploratory (p. 12-13)	64 public urban housing spaces (27 low veg; 37 high veg) -a team of 5 researchers assessed space on 5 point Likert scale (p. 9)	-p. 12 (both recorders observed 1 site at start of day; inter-rater reliability 97%)	-observing location, activity, and access to adults
(Barbour, 1999)	Texas	8 (4 boys, 4 girls)	Grade 2 (low or high levels of motor skill) -based on Bruininksy-Oseretsky Test of Motor Proficiency (p. 81)	?	-each child observed for at least ten- 30 minute recess periods -notations made of time elapsed in intervals of 2-5 minutes -entire study = 83 observations that are 27 minutes each	2	-Micro analysis -Macro analysis -Development of a model *p. 82 (categories are presented)	2 contrasting playgrounds (p. 79) as a function of design	-to observer-inter observer agreement (p. 81) -trained grad student to collect half data on each subject *see page 83	-audible conversation recorded; anecdotes about peers; field notes expanded -interviewed children (8 in study and their peers) (N=38 interviews)
(Kirkby, 1989)		PHASE 1 LOCATION 26 (13 boys; 13 girls) PHASE 2 BEHAVIOR	4 yrs 8 months	5 play sessions	Children's play was sampled at 1 minute intervals for duration of play period (20-25 minutes) during 5 play sessions Sampled at 1 minute	1	Dramatic (domestic and adventure) Other non-verbal Other verbal p. 9	Divided into 17 areas (of these, 2 were natural refuges; 1 was built refuge)		

		53 children (29 girls; 24 boys)	4 yrs 2 months		intervals for duration of play period during 5 minute sessions					

Barbour, A. C. (1999). The impact of playground design on the play behaviours of children with differing levels of physical competence. *Early Childhood Research Quarterly, 14*(1), 75-98.

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Weinstein, C. S., & Pinciotti, P. (1988). Changing a schoolyard: Intentions, design decisions, and behavioural outcomes. *Environment and Behaviour, 20*(3), 345-371.

TECHNOLOGY

Article	Location	# of kids	Age/year group of kids	# of days # observations	# schools	Data Collection Techniques	Notes
(Elgethun, Fenske, Yost, & Palcisko, 2003)	Seattle	11 children	2-8 yrs old	-1 day, 7-11 hrs -they were just trialling the methods for this study, so whilst a short period of time, it was enough to determine resolution of data collected	n/a	**GPS unit** They identify 10 features deemed essential for GPS units that track children's movements (p.116) -logged movement every 5 seconds (see batteries etc. p. 116 -units integrated into cotton bib overalls	-resolution was 2-3 m outdoors and 4-5 m indoors
(Santos, Guerra, Ribeiro, Duarte, & Mota, 2003)	Portugal	157 children (64 boys, 93 girls)	8-15 yrs old	-3 consecutive days (Tuesday-Thursday) -worn on average 14 hrs/day	?	**Accelerometers** Actigraph (Model 7164, MTI Health services, FL, USA) -Uniaxial accelerometer -Epoch length of time was 1 minute	
(Hands & Parker, 2006)	Australia	24 (8 from each school) -4 boys & 4 girls from each school -teacher asked to choose 4 children perceived as 'high' active	5-6 yrs old	-monitored for 30 minutes over 5 consecutive days during free play (based on study by Gretebeck and Montoye 1992 that said that is a good length of time to track habitual patterns) -had 8 observers (one/child)	3 pre primary centres	**Accelerometers** Actigraph (Model 7164, MTI Health services, FL, USA) -Uniaxial accelerometer -Epoch length of time was 10 seconds **Pedometers** Yamax Digiwalker SW-200, MLS 2000	? Pedometers seem to be a better correlation (but it was a limited level of analysis with the accelerometer)

		and 4 as 'low' active				**Direct Observation** Using CARS system, done every 10 seconds to correspond with accelerometer (scale of 1 to 5 based on activity) **Video**	
(Boldemann et al., 2006)	Sweden	197 children	4-6 yrs old	12 school days	11 pre-schools with varying degrees of shade provided	**Pedometer** -also had some device to measure the sun	-interesting categorization of the 11 playgrounds (p.302)
(Trost, R.Pate, Freedson, Sallis, & Taylor, 2000)	Amherst, Mass, USA	381 students (189 boys; 192 girls)	Across a range from grade 1-12	Wore for 7 days during all waking hours	9	-CSA 7164 uniaxial **accelerometers** -Epoch length was 60 seconds	-key finding is that 7 days is a good monitoring protocol
(Ridgers, Stratton, & Fairclough, 2005)	UK	116 boys 112 girls (10 children/ school)	5-10 yrs old	1-3 recess breaks in 1 school day (they wore the accelerometers all day, but were able to isolate data for 3 recess periods) -Average length of data collection time over recess = 85 minutes	23 schools randomly selected	Actigraph (Model 7164, MTI Health services, FL, USA) -Uniaxial **accelerometer** -Epoch length of time was 5 seconds	-very limited length of time? -good engagement with daily physical activity recommendations -included independent variables of age and gender
(Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003)	Columbia, SC	245 (127 girls, 118 boys)	3-5 yrs old	-ranged from 1-11 days (depending on a number of factors) (p.836) -wore it from 0.4 – 7.8 hrs/day -for this study, minimum inclusion was 3 days monitoring activity	9 pre-schools	Real time **acceleromtery** (MTI/CSA 7164 Acceleromoter) -15 second sampling interval on accelerometer	-compared overweight and non-overweight kids Need BMI

NOTE

Accelerometers (Ridgers, Stratton, & Fairclough, 2005):

- Measure vertical acceleration of human motion
- The detected accelerations are filtered, converted to a numerical value, and subsequently summed over a specific time interval or *epoch* set prior to the start of data collection
- The recorded counts for each epoch represent the intensity of the activity undertaken during that time period
- At the end of each epoch, the summed value is stored in the memory and the accelerometer is automatically reset to zero
- Length of time interval (see article by Nilsson et al. 2002 as cited in Ridgers 2005)
- Activity count thresholds are used to determine the amount of time the children engaged in physical activity at moderate, high, and very high intensities (see Nilsson ref) (163-479, 480-789, >790 counts/5 seconds respectively)
- Data is downloaded using a reader interface unit connected to a computer and analysed using the ActiSoftware Version 3.2 (MTI Health Services)
- Small, lightweight

Pedometers

- Measure 'steps' taken (unable to comment on intensity)

Boldemann, C., Blennow, M., Dal, H., Martensson, F., Raustorp, A., Yuen, K., et al. (2006). Impact of preschool environment upon children's physical activity and sun exposure. *Preventive Medicine, 42*, 301-308.

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Trost, S. G., Sirard, J. R., Dowda, M., Pfeiffer, K. A., & Pate, R. R. (2003). Physical activity in overweight and nonoverweight preschool children. *International Journal Obesity, 27*, 834-839.

Appendix 5. Relevant literature: green school grounds and physical activity

Canadian children, physical activity and the overweight/obesity crisis

Over half of Canadian children and youth aged five to 17 are not active enough for optimal growth and development (Public Health Agency of Canada, no date). One in three children is overweight, and one in ten is obese, numbers that have risen dramatically over the last two decades (Active Healthy Kids Canada, 2005; Canadian Institute for Health Information, 2004; Raine, 2004). This disturbing situation was brought to wide public attention with the 2005 release of *Dropping the Ball: Canada's Report Card On Physical Activity for Children and Youth* (Active Healthy Kids Canada, 2005), a nation-wide study on physical activity opportunities and behaviours among Canadian children. As suggested by the title, a troubling picture emerged from the study, with an overall grade of "D" assigned, based on a variety of indicators.

The effects of this health crisis are serious, with more and more Canadian children suffering from problems associated with increased childhood obesity, Type 2 Diabetes, and other chronic diseases. In addition, obese children tend to have an increased risk of becoming overweight in adulthood, with higher morbidity and mortality rates (Public Health Agency of Canada, no date). The direct and indirect costs to the Canadian health care system stand to be considerable (Heart and Stroke Foundation of Canada, 2005), with the cost of obesity in Canada estimated at $1.8 billion in 1997 (Birmingham, Muller, Palepu, Spinelli, & Anis, 1999), and the annual economic burden of physical inactivity estimated at $5.3 billion (The Secretariat for the Intersectoral Healthy Living Network, F/P/T Healthy Living Task Group, & F/P/T Advisory Committee on Population Health and Health Security, 2005).

While the problems associated with overweight and obesity are serious across all of Canada, certain factors, such as socio-economic status, education, gender, ethnicity and geographic location, are directly linked to obesity in young Canadians (Oliver & Hayes, 2005; Raine, 2004; Shields, 2004). In fact, children from families with low incomes are 1.5 times as likely to be obese as their counterparts from higher income families (Canadian Institute for Health Information, 2004). In households where no members have more than a high school diploma, children are more likely to be overweight or obese than in households where members have a post-secondary education (Shields, 2004). Boys and girls have their own unique challenges, with more boys being overweight than girls (31 % compared to 23 %), and yet girls reporting less daily physical activity than boys (10-15 % differential) (Action for Healthy Kids, 2004). Youth of Aboriginal origin (off-reserve) have a higher than average overweight/obesity rate (Shields, 2004). Overweight and obesity rates for young people tend to be highest in the Atlantic provinces (Shields, 2004).

Responding to the crisis

The reasons for the growing number of obese children in Canada are complex, yet readily understood. Stated most simply, children in Canada are sitting more, moving less and eating too much unhealthy food. Numerous environmental and societal factors have been identified as determinants of these unhealthy behaviours. These include:

- insufficient "walkability" and "playability" of neighbourhoods, insofar as they encourage car use and discourage walking, cycling and active forms of leisure
- increased "screen time" (television, computers)
- unequal access to participation in organized and unorganized sport/community programs (function of gender, socio-economic status)
- reduction in daily physical education classes and lack of teachers trained as health and physical education specialists
- lack of access to healthy food choices (function of the built environment, the school environment, the family environment, socio-economic status)
- shifts in food consumption patterns, especially the increase in consumption of snacks, soft drinks and fast foods
- marketing/advertising that promotes the consumption of unhealthy food

In response to these diverse and pervasive influences, it is generally agreed that health promotion strategies must be integrated and complementary, and must work at the individual, community, environment and policy levels (The Secretariat for the Intersectoral Healthy Living Network et al., 2005). In other words, health experts and advocates have moved beyond the historical focus on individual behaviours, recognizing that interventions must influence the environments within which choices about nutrition and physical activity are made (Raine, 2004). Accordingly, a range of environment-based strategies is recommended, involving sectors and settings not directly linked to the health promotion field. Schools are one such setting.

Schools and school grounds as sites of intervention

As the World Health Organization suggests, the prevention of overweight and obesity "should begin early in life, and should involve the development and maintenance of lifelong healthy eating and physical activity patterns" (World Health Organization, 1998, p. 240). Seen in this light, schools are an obvious setting for establishing healthy habits and promoting change (Active Healthy Kids Canada, 2005; Canadian Institute for Health Information, 2006). In fact, many schools in Canada have taken up the overweight/obesity challenge with strategies that typically include increasing the amount of physical education offered, providing healthier food choices in the cafeteria and encouraging walking and cycling to and from school.

While a healthy school environment is a recognized component of coordinated school health programs (Canadian Institute for Health Information, 2006), school grounds are seldom directly mentioned within strategies intended to influence children's eating or activity behaviours. This is despite the significant amount of time that children spend there on a daily basis. Indeed, at the schools participating in this study, children are spending, on average, about 110 minutes a day on the school ground. This amounts to about 25 % of their school day and includes:

- 15 minutes before school (range: 1-45 minutes)
- 17 minutes during morning recess (range: 5-25 minutes)
- 37 minutes during lunch (range: 5-90 minutes)
- 17 minutes during afternoon recess (range: 5-45 minutes)
- 23 minutes after school (range: 1-120 minutes)

When one considers that children attend school about 200 days per year, there can be little doubt that school grounds represent an environment worthy of attention in school-based health-promotion initiatives.

Most school grounds consist of open expanses of turf and asphalt, features which offer valuable opportunities for active play in rule-bound games like basketball, tag, baseball and four-square. But many children are not interested or able to play in such vigorous, rule-bound activities (Dyment, 2005), and are therefore relegated to the sidelines.

Moreover, the vigorous level of activity provided by competitive, rule-bound games is not in itself adequate to respond to the overweight/obesity crisis. Canada's *Physical Activity Guide for Youth* recommends, for example, an increase in moderate activity as well as vigorous activity (Canadian Institute for Health Information, 2006). Moderate levels of physical activity, such as those achieved through cycling and walking, can reduce the risk of obesity (Frank & Niece, 2005). Recent studies suggest that various forms of leisure activity, such as dance and art, may also be of benefit (Tremblay & Willms, 2003) and point to the importance of increasing the range of enjoyable, non-competitive physical activities for children (Kumanyika, Jeffrey, Morabia, Ritenbaugh, & Antipatas, 2002).

If school grounds are to realize their potential to address overweight and obesity, they must offer opportunities for forms of active play that appeal more broadly to children of varying interests and abilities. This is where green school grounds stand to make an important contribution. By their very design they create new opportunities for more children to engage in active play.

Green school grounds

School ground greening is a growing international movement that focuses primarily on the design, use and culture of school grounds, with a view to improving the quality of children's play and learning experiences. Schools around the world have embraced the notion of greening and are transforming hard, barren expanses of turf and asphalt into places that include a diversity of natural and built elements, such as shelters, rock amphitheatres, trees, shrubs, wildflower meadows, ponds, grassy berms and food gardens. School ground greening is particularly prominent in Canada, Australia, the United Kingdom, the United States, Scandinavia, New Zealand and South Africa.

Researchers across a range of disciplines (e.g., education, psychology, sociology, architecture) have noted the impacts of these spaces (Dyment, 2005a) . Some have discussed health benefits, especially the immediate physical ones such as protection from ultraviolet radiation (Greenwood, Soulos, & Thomas, 1998). Other recognized health issues on school grounds revolve around the elimination of pesticides (Daniel, 1991) and the potential of food gardens in helping students to understand food production and healthy food choices (Canaris, 1995; Morris, Briggs, & Zidenberg-Cherr, 2002). The social, mental and physical dimensions of health have also been alluded to by researchers investigating the relationship between the type, quality and diversity of play spaces and the type, quality, and diversity of play behaviours (Barbour, 1999; Malone & Tranter, 2003b).

Relatively little is known about the relationship between children's environments and children's physical activity, since studies investigating the built environment/physical activity relationship have focused primarily on the health and experience of adults. Studies are now emerging, however, that explore the relationship between neighbourhood design and children's physical activity. They examine factors such as residential density, street connectivity, land use mix and access to facilities (Holt et al., 2006; Spence et al., 2006). Within the context of this emerging body of research, investigations of the relationship between green school ground design and the promotion of physical activity represent a new and potentially significant area of investigation (Bell & Dyment, 2006; Boldemann et al., 2006). Evergreen's national study, entitled *Grounds for Action*, was leading-edge in its exploration of the school ground as an everyday neighbourhood environment with the potential to affect children's physical activity. The study clearly indicated that school ground greening could enhance children's physical activity at school by diversifying play opportunities and inviting more children to engage in moderate and light levels of activity. Further research is needed, however, to corroborate these preliminary findings.

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