Engaging Underrepresented High School Students in an Urban Environmental and Geoscience Place-Based Curriculum

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ABSTRACT

High school students in a large urban area, undergraduate students, and geoscience faculty at a local college used a place-based pedagogical approach to engage in real geoscience problem-based inquiry in a local urban park. The overarching goals of this project were to learn the potential of place-based geoscience research experiences to: influence students' science identities and increase participation of urban youth in science. Student researchers participating in the activity ($N = 22$) completed Likert-scale pre- and post-surveys, which were analyzed using paired t-tests. Student journal reflections were analyzed. Survey and journal reflection results showed that students' science identities were enhanced and student interest in learning science outdoors increased through participation in the program. The evaluation of the project outcomes add to the body of knowledge describing how outdoor settings and place-based pedagogies can be used to increase urban students' interest in science, and demonstrates how students working with scientists who conduct research in students' communities can be a source of motivation for studying sciences and identity development. © *2014 National Association of Geoscience Teachers*. [DOI: 10.5408/12-400.1]

Key words: place-based education, outdoors education, identity, motivation, underrepresented youth

INTRODUCTION

There is an ongoing effort in the United States to encourage and support students from underrepresented groups in pursuit of the STEM fields especially in the physical sciences (National Science Foundation, 2006). Science education research points to the disconnect between school science and students' day-to-day lived experiences as a reason for a lack of interest in science (Lemke 2001, Roth and Tobin, 2007). Underrepresented and immigrant students are often at greater risk of losing interest in science as there is the added cultural and linguistic disconnect between school, school science, and their lifeworlds (Basu and Barton, 2007; Rahm 2007). Even after controlling for academic achievement and student background, the most predictive factor in students dropping out of high school and ultimately out of the STEM pipeline is the lack of student engagement with real world problems and solutions in the coursework being taught in their high schools (Connell et al., 1995; Rumberger, 2004). Edelson and colleagues (2006) note that, for learning experiences to lead to usable knowledge, students must recognize the usefulness of the knowledge or skill in their lives and future goals. In our work designing STEM education programs and courses, we have learned that underrepresented students are driven by goals that focus on their home, family, community, and career, an observation that is also supported by current research (Powell et al., 2009; Adams, 2012).

The report, "Preparing the Next Generation of STEM Innovators" recommends that all students should have opportunities to "experience inquiry-based learning, peer collaboration, open-ended, real-world problem solving, hands-on training, and interactions with practicing scientists and other experts" (National Science Board, 2010, p. 16). Environmental education is more likely to be effective if placed in the context of the community as it leverages that with which people are familiar and care about (Andrews, 2009). This article describes a project and corresponding assessment with the central goal of engaging underrepresented youth in environmental science studies. We begin with a brief presentation of the design process of the project, discuss the results of the implementation, and conclude with implications for place-based environmental science for underrepresented youth.

Pedagogy of Place

Place-based education, as a "community-based effort to reconnect the process of education, enculturation, and human development to the well-being of community life" (Gruenewald and Smith, 2008, p. xvi), is an ideal pedagogical tool to engage students in the deep learning of science. This is more critical for underrepresented and immigrant families that are unfamiliar with American education norms, where schools are commonly perceived as being "*in* communities, but not *of* the communities" (Bouillion and Gomez, 2001, p. 878). Place-based education affords the attenuation of borders between the schools and community. In addition, as standardized education is becoming more of the norm, a pedagogy of place-based education allows for the localization of standards; that is, a means of making standards and assessments more meaningful and place-relevant for students. For example, the New York State Earth Science Regents curriculum outlines learning standards for the whole state although it has geologically and ecologically

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distinct regions. Place-based education encourages educators to look to local resources to engage students in learning about geoscience content and concepts as relevant to the place where they live and go to school.

Sociocultural View of Learning

Recent science education research has pointed to identity development as an indicator of positive performance in STEM-related pursuits (Olitsky, 2007; Rahm, 2007; Tobin, 2007; Luehmann, 2009; Adams and Gupta, 2010). While there are numerous theoretical frameworks that describe identity development, the one that guided our project aligns with an "identity-in-participation" framework that recognizes that identity development is shaped in activity and in relation to others (Hull and Greeno, 2006; Adams and Gupta, 2010). Stetsenko (2008) extends this to the process of learning by describing learning as "profoundly social and collaborative," not only in respect to the people engaged in social activity, but also in respect to the places that the activity happens (Adams and Gupta, 2013). Stetsenko (2008) cites, "learning then appears as the pathways to creating one's identity by finding one's place amongst other people and, ultimately finding a way to contribute to the continuous flow of social practices" (p. 17). Thus, we believe that developing opportunities that allow youth to contribute to the "social practices" of science while learning the culture of scientific research provides the space for them to build identities around science with the corresponding skills and dispositions that could contribute to successful pursuit of the discipline.

Cultural lenses shape students' perception of new knowledge and skills; if a lesson is perceived by a student as empowering them to shape their life, community, and world, they are more likely to accept the information and welcome related information and skills (Bouillion and Gomez, 2001). In their study of urban underrepresented youth, Basu and Barton (2007) noted that students considered science useful when it could be applied to everyday priorities, made their lives easier, increased control of their lives, solved personal or social problems, or validated their leisure or pop culture activities such as sport or music. Furthermore, Basu and Barton (2007) concluded that underrepresented youth developed sustained interest in science when it connected to their vision of their future, and was in line with their perception of the purpose of science. In this program, we present a model in which student input was central to the design of the science-learning activities under the premise that incorporating their interests would lead to increased engagement and motivation to participate, which, in turn, would influence their science identity development.

CONTEXT

This project, funded by a National Science Foundation (NSF) Opportunities for Enhancing Diversity in the Geosciences (OEDG) Planning Grant had the overarching goal of identifying program elements that would engage and motivate underrepresented students to study environmental science. The focus of the project was Prospect Park, a 585-acre park located in the center of Brooklyn, New York. This Olmstead and Vaux designed park is the site of family outings and recreational activities for many of the participating students, including sports practice, music concerts, and cultural events. The overarching question that motivated this project was: In what ways does collaborative community planning and engagement in field work in a local park influence science identity and increase youth engagement in science in underrepresented students? We predicted that outdoor field work in the local park would enhance student science identity and increase youth engagement in science. The OEDG Planning Grant allowed us to assess the immediate impact of the project described below on student science identity and engagement, but lasting impacts were not assessed.

It is important to note that the project involved students from the Brooklyn Academy of Science and Environment (BASE HS), a New York City public high school that has close, formal ties with Prospect Park and the Brooklyn Botanic Garden. In addition, many of the students live near the park, which is one of the few natural environments they have experience with in their highly urbanized community. With sense of place defined as a "living ecological relationship between a person and a place" (Lim and Barton, 2006) we know that most of the students have a relationship with the park outside of school; therefore we describe this project as a place-based (versus a disconnected) outdoor experience. Furthermore, since identity development is central to our understanding of underrepresented students' relationships to science, our identity-in-participation framework allows us to situate place as an active agent in the students' science activity and recognize the role of place in shaping identities (Adams, 2013). Thus, the activity in the park that is a familiar place to students in the study takes on a different meaning than similar activities in the classroom or in another, unfamiliar park.

Project Design

A one-week research experience program was collaboratively designed by a committee of teachers and two high school seniors from the BASE, faculty from Brooklyn College, and staff from the Prospect Park Alliance, including natural resource or landscape managers. The participation of the landscape managers ensured that the research performed by the students was relevant to current issues in the park. The team met twice for day-long planning meetings on weekends in the spring and fall to discuss the goals of the project and ways to integrate the natural resource management needs of the park. The BASE students worked with their teachers to survey their peers and identify an initial list of topics and activities that would interest them in environmental science. They then brought their findings into the committee meetings to be incorporated into the program. The collaborating students' survey of their peers found that they were interested in studying the "creepy crawly nature of living things." As such, research topics were intentionally selected to include an authentic link between biology and the geosciences, with an emphasis on the effects of the physical environment on organisms.

The program was offered during New York City Public School system's spring break in April, 2010. It was a 5-day program that met for 6 hours a day. Students were recruited from BASE through a competitive application process. After careful review of applications by a committee of two Brooklyn College faculty and two BASE teachers, 22 students were selected from over 50 applicants. Students were selected based on teacher recommendations and a personal statement of interest. We focused on students interested in college and the STEM disciplines, and who were likely to commit to fully participate during the week-long experience. Thus, a limitation of our findings is that this was not a random sample of students. However, the students that were selected were typical of the socioeconomic and racial status of all students in the school, and all were from groups underrepresented in the geosciences. We intentionally selected students to provide a balance across grades 9 through 12. Participants included 16 girls and 6 boys, comprising 5 ninth graders, 7 tenth graders, 6 eleventh graders, and 4 twelfth graders. The majority (77%) identified as Black, Caribbean, or African American, with 13.6% identifying as Latino, and 9% as "other." Sixty-three percent identified English as their first language, with Creole/Kreyól (13.6%), Spanish (9.1%), and "other" (13.6%). Students were told that a part of the project was learning about their interests and engagement in studying place-based environmental science. They were placed in the role of student researchers and received a stipend for their participation in the program.

Survey items served as the primary data source for evaluating the project outcomes and objectives with journal entries used as secondary data sources. The survey was a nine-point Likert-scale pre- and post-survey (Appendix A). Pre-surveys were distributed with information packets and parental permission slips and returned before the first day of the program. Post-surveys were administered on the final day of the program. The means of the pre- and post-survey results for each question were compared using descriptive statistics and paired *t*-tests. In this case, Likert-scale scores were treated as interval data, which qualifies for a parametric technique such as a *t*-test (Norman, 2010; Fraenkel et al., 2012). An assumption was made that the data are interval. The *t*-test for correlated means, which is a parametric test of statistical significance, was used to determine whether there was a statistically significant difference between the means of the pre- and post-surveys. Additional data sources included field journals and focus groups; however, focus group data are not presented here. Students were provided with field journals to record their notes, methods, procedures, field and lab observations, and their responses to the reflective journaling questions posed by the education researchers. Reflective journaling topics were posed daily and included questions such as:

- What did you find most interesting about your experiences today? What did you most/least enjoy about today?
- Do you enjoy working in a team of researchers? Why or why not?
- When did you feel like a scientist today?

Students' responses to the reflective journaling questions were coded for themes including science identity, outdoor science learning, and working with college students and faculty. Students also participated in digitally recorded daily focus groups, in which they reflected on their experiences and findings. Additional data sources included student PowerPoint presentations, the researchers' field notes, and videotapes of students engaged in research activities in the park for later analysis.

Research Experience Program

Two issues of concern in the park were posed to students on the first day of the program by the representatives from the park's Landscape Management office: soil compaction from people walking on the grass and forming their own paths (called desire lines) and seasonal algae blooms in Prospect Park Lake. Students and the college faculty worked together to develop the following three research questions based on these two issues: (1) What is the effect of soil compaction on earthworm abundance?, (2) Are the lake sediments a source of phosphorus, which might be helping to fuel the algae and cyanobacteria blooms?, and (3) Is oxygen consumption by the lake sediments an important driver of anoxia? Students were asked to develop a plan to research these issues, perform the research activities, and make recommendations for management and/or further research based on their findings. Landscape managers requested that students present their findings at the end of the week. The science faculty member framed the inquiry as students being a part of a research project team in which he is the lead scientist. He described the structure of a research lab and the role that the students would play within the lab structure. Student researchers worked in teams, with each team lead by an undergraduate student. Once the questions were posed, they followed a guided inquiry approach, in which possible methods were suggested and demonstrated by the lead scientist. The themes for student research and measurements are discussed briefly below. Table I summarizes the students' research activities.

Soil Compaction

The first research theme was the human impacts on soil properties and earthworm abundance. Soil compaction from foot traffic is a continual problem for landscape managers because there are so many people who use the park each year that often ignore marked paths and access barriers such as fences. Earthworms play an important role of decomposition in the soil, mixing soil layers, and aerating the soil. The number of earthworms present would be an indication of the level of soil compaction. Students were asked to collect data on differences in soil compaction and earthworm abundance between impacted and nonimpacted areas in the park.

Algae Blooms

The second theme was the drivers of algae blooms in Prospect Park Lake. The lake suffers from advanced eutrophication that results in intense algae and cyanobacteria blooms every year. As a consequence, the lake experiences prolonged periods of bottom anoxia that can negatively impact the aquatic ecosystem. The cyanobacteria blooms are potentially toxic and can impact the health of park visitors and their pets. Students were asked to investigate if phosphorus fluxes from the lake sediments might be helping to fuel the algae and cyanobacteria blooms, and if oxygen consumption by the lake sediments was an important driver of anoxia. The results could assist the landscape managers in taking corrective action for the eutrophication problem.

Research Teams

A hierarchical research team structure was implemented to add authenticity to the research experience. The students

TABLE I: Student research activities for the week-long research experience.

Research Themes	Measurements and Experiments Conducted by Student Teams to Address Theme		
Theme 1	Soil horizons	Soil compaction	Worm population abundance
Human impacts on soil properties and earthworm abundance.	Students collected soil samples using a soil borer and compared composition of soil in forested area of park with compacted soil areas.	Students determined the rate of water infiltration as a measure of soil compaction.	Students used a mustard solution to drive earthworms to the surface within a quadrat where they could be counted and described.
Theme 2	Water quality testing	Bottom sediment oxygen demand and phosphorous levels	Plankton tow
The relationship between lake sediments, algae and anoxia.	Water quality testing: Dissolved oxygen, pH, temperature, and turbidity were measured in the lake using handheld multiparameter meters.	Students used a boat and a grab sampler to collect lake sediment. Students measured oxygen consumption by Winkler titrations and phosphorus changes using colorimetric kits.	Students collected plankton samples using a plankton net, and observed and identified zooplankton and phytoplankton using microscopes.

were organized into four teams of research assistants with 12th grade students serving as team leaders. An undergraduate Earth and Environmental Science major from Brooklyn College was placed with each team to serve as both a junior scientist and near-peer mentor. Two science faculty from Brooklyn College assumed the roles of lead scientist and senior scientist to oversee the activities of the research teams. The undergraduate students included an African Caribbean female and a Hispanic female, a Hispanic male, and a Caucasian male. The lead scientist was a Caucasian male and the senior scientist was a Caucasian female.

The student research teams each completed several complex tasks and experiments related to the major themes (Table I). They worked closely with the faculty members and undergraduate students to complete measurements and observations using sound scientific practices. Students were each provided with a Jim-Gem® field notebook to document their research activities. Each day the teams met with the lead scientist to discuss their progress, results, and analysis in context of the research questions. Each team worked with their near-peer mentors to construct a PowerPoint presentation of their findings, which was presented to representatives from the Landscape Management department (Table II). The presentations also included student recommendations for management actions and future research that were based on their findings.

RESULTS

Here we present and discuss the results from three survey questions that showed statistically significant positive changes from the pre- to post-survey iterations. These results are of particular interest since they relate to the learning and engagement outcomes and objectives of the project. The limitations of these results must be considered, since this was not a random sample or a norm-referenced survey. The post-surveys were conducted after the week-long experience to determine immediate impacts of the program. The lasting impacts from the program were not measured as it was beyond the scope of the OEDG Planning Grant. The preliminary findings from the survey data were paired with student journal reflections. This triangulation of data allowed us to assess the impact of our place-based curriculum on students' science identities and student engagement in science.

Being a Scientist: Identity in Participation

There was a statistically significant increase from the pre- to post-survey for the construct "I consider myself a scientist" (6.9 ± 1.5 to 7.6 ± 1.2; tcalc = 3.26, df = 21, a = 0.05). Assumptions were not verified because the pre- and post-surveys were from the same students. We assumed that students would answer to the same degree of accuracy both times they took the survey. This result indicates that students were more likely to self-identify as scientists following the week-long research experience.

Student journal responses were analyzed to look for instances when students felt like scientists during the week-long program. Each day of the program students wrote written reflections in their journals to the question "When did I feel like a scientist today?" The following examples showed up in multiple journal entries to this question. They felt like scientists when: they were touching equipment, worms, and soil; completing the chemical testing for dissolved oxygen; mixing the mustard solution for the worm experiment; going on the boat to collect samples; using microscopes to view plankton; discussing in groups; sharing data; and presenting their findings. One student noted,

> *"I felt like a scientist today when I learned more about titration. Also, I felt like a scientist when I was note-taking and collecting data about the different experiments and projects."*

Students felt agency over being able to take their own notes and do independent data collection. This enabled them to assume the identity of a scientist during the week-long program and therefore "feel" like a scientist and experience the embodied notion of participation in the culture of practicing science.

Students also expressed that they enjoyed being with people who appreciated the knowledge of science. Several students shared that when they learned methods and were able to show other research teams how to perform the procedure they felt like experts:

Table II: Student findings and recommendations.

Research Theme	Major Findings Presented to Landscape Management	Recommendations Presented to Landscape Management
Human impacts on soil properties and earthworm abundance	Water infiltration rates are slower in more compact soil. Water infiltration rates are inaccurate when soil is already saturated from rain. Some areas of the park have more compact soil than others. Soil horizons show differences depending on location. There is thinner top layer of soil in areas of compaction. There is a relationship between the soil compaction and the type and size of earthworms found. Earthworms are important for soil aeration. Lower earthworm abundances were found in more compact soils.	Increase signage in the park about the importance of staying on marked paths to avoid compaction. Fence off areas of high compaction for periods of time to allow regrowth of plants. Continued surveying of earthworm abundance in various locations throughout the park is necessary to monitor this important population in the ecosystem.
The relationship between lake sediments, algae, and anoxia	There are higher than normal levels of phosphorous in the lake sediments. There is low oxygen demand in the lake sediments indicating that there is not much organic matter in the sediments. A variety of plankton are found in Prospect Park Lake.	Dredge portions of the lake to remove excessive phosphorous deposits and continue monitoring nutrient levels. Take plankton samples at different times of year and different times of day for a more complete understanding of types of plankton present in the lake.

"I felt like a scientist when I was directing the show in Prospect Park today. I was like an expert in the worm sampling test so I was showing the other group what was supposed to be done."

This authentic science context enabled this student to assume the role of an "expert" and experience science leadership by explaining research procedures to others.

Students also cited presenting their findings to an audience of peers and landscape managers as a "feel like a scientist" moment. One student describes this experience:

"While I was presenting my data I felt a little nervous at first. However, as I got more into it I realized that I've done research in Prospect Park and now I'm presenting my data and my findings. I felt more confident and like a scientist who is sharing their findings."

This student had the realization that they did the research and they were therefore knowledgeable about the work they were presenting. This was a source of empowerment and put them in the role of a professional scientist in this instance. This same student also described how presenting the research was a valuable part of the experience: "I felt like a scientist today when I presented my data, it made me feel like the research was more important." Representatives from the Landscape Management Department reported they were impressed with students' presentations, and that students' findings confirmed some of the ongoing research on the issues in the park. This supports existing literature that describes students as being more engaged in science learning when they recognize the usefulness of the knowledge or skill (Edelson et al., 2006). Students were not merely doing science activities but were engaged in science by forming questions, searching for answers to their questions, participating as a member of a research team, and presenting their findings.

Connecting Students to the Science Community

For the survey construct, "I think high school students are able to work with college professors and researchers on science projects," there was a significant increase from the pre- to post-surveys (7.7 ± 1.5 to 8.5 ± 0.7; tcalc = 2.61, df = 21, a = 0.05). Students participated in the role of research scientists alongside undergraduate students and college professors on teams, which supported the notion that this experience would increase student engagement in science. The social interactions that occurred in this collaborative, place-based setting allowed students to view themselves as authentic members of a science research team. This was confirmed in the responses to the corresponding journal reflection question, "What did you think of working with undergraduates and scientists from the local college?" Student journal responses repeatedly included positive reactions to working as a team with college faculty and students because undergraduate students were knowledgeable about the procedures and explained what college was like. One student expressed in the journal:

"Working with the undergraduates is pretty cool. Being able to talk to them and to listen to them talk about their hands-on experiences is awesome. It's good to know that these students get to travel and investigate about the Earth."

This same student also wrote, "Collaborating with professors and students was really cool because they educate you more about what it's like being a college student in terms of maturity." Another student responded in the journal, "I felt like I was one step closer to college. It was fun to hear the undergrads situations and stories . . . I felt good, like I was really in college doing research." Working on collaborative teams enabled students to contribute to the practices of the science community. The Brooklyn College Earth and Environmental Science faculty member framed the experience of him as the lead scientist on his project, working with the students in teams, as similar to what would happen in a college research setting. Throughout the week, students always had access to the lead scientist and were able to ask him questions or discuss their experiences at anytime. Students were immersed in the social experience of being scientists and were able to make meaningful contributions to the research process.

Place-Based Science Education

Finally, for the construct, ''I would rather learn about science in the park than in the classroom,'' there was also a significant increase from the pre- to post-survey (7.6 ± 1.4 to 8.5 ± 0.8; tcalc = 3.35, df = 21, a = 0.05). This result suggests that students' preference for learning outdoors increased as a result of participating in the program, despite, or perhaps because of, the rigorous and demanding nature of the activity. This supports the body of knowledge suggesting that outdoor science education may raise students' level of enthusiasm for learning science (Smith, 2007) and suggests that students' engagement in science would increase as a result of the program.

The corresponding journal question was, ''What did you like and dislike about collecting data in the local urban park?'' to which many of the students responded that they enjoyed collecting their own samples outside:

> *''In general, I liked collecting data outside of Prospect Park because it gives me hands-on experience and I really get to connect with the environment. It's better than people bringing data to you and you have to give the results.''*

This collaborative, place-based research setting allowed students to experience hands-on science and a certain degree of agency in collecting their own data. One student described it as feeling ''free'' and another student described the experience, ''I liked being outdoors going to different sites and not just seeing them as a place to look at but as a place to research and be able to get potentially important data from them.'' Several students noted having a better understanding of the data because they collected it themselves, for example:

> *''When you collect data yourself it makes things much more understandable and that is what this research experience did for me.''*

However, there were aspects of being outdoors that students disliked. For example, most students disliked working outside in the rain and some disliked the long walks. In spite of this, the students stayed engaged throughout the week, and motivated to get the data needed to address the research questions about the issues in the park. This supports the literature that shows students are more interested in science when they can see the usefulness of the topic to their lives and community (Basu and Barton, 2007).

We chose to discuss the three constructs above because they were found to be statistically significant and best aligned with our overarching questions. The results point to the positive impacts of place-based, authentic science-learning experiences for underrepresented students. They are not only opportunities for students to engage in hands-on science learning, but also the chance for students to engage in social interactions with peers, near-peers and mentors in a scientific context; in other words, the opportunity for students to learn and engage in the culture of science in a familiar out-of-school context. This provides positive science identity-building experiences for students and a chance for them to get an initial idea about what it would be like to study science at the college level.

DISCUSSION AND CONCLUSIONS

We assessed how students' science identities were immediately influenced through participation in a week-long geoscience research experience with college students and faculty. The key findings support that the program would enhance students' science identities and increase youth engagement in science. Results show that students' science identities were positively impacted and the outdoor place-based experience influenced their ideas of what it is like to be a scientist. Students reported many instances of ''feeling like a scientist'' throughout their week-long experience and felt that they were valuable contributing members of the scientific community.

The second project outcome we evaluated was how a place-based, environmental geoscience curriculum could increase the engagement of underrepresented urban youth in science. The guided inquiry experience was planned specifically for Prospect Park to address geoscience and environmental issues using input from other students, landscape managers, and college faculty. Since most students were familiar with the park, they were able to use their experiential knowledge to help address the scientific research questions, such as knowing areas of high foot traffic and having seen differences in the color of the lake throughout the year. Major findings here support the efforts of place-based science education to engage students in meaningful science research in their community park. Students positively responded to collecting their own data in the field. Students felt and acted like experts, demonstrating an embodiment of practicing science, supporting that this outdoor learning experience would enhance development of science-related identities and increase student engagement in science. It is clear from this project that students were more engaged in geoscience learning when researching and providing solutions for an actual problem in Prospect Park.

Several limitations to the survey and student group should be noted. First, the Likert-scale survey was a nine-point scale and although statistically significant, the difference in the pre- and post-surveys is small. Second, the long-term effects of the program on students' science identities and interests were not measured. Third, this evaluation did not focus on individual students and their changes, but on the collective group of students. Further research could look at changes in students who had a major shift in their survey responses. Fourth, the students who were recruited to participate in the study already had science identities, as the pre-survey indicated. While it would have been more transformative to recruit and note the change in students who had little to no science identity, we were encouraged by the positive trend in our results. Despite the limitations the preliminary findings are encouraging for science teaching and learning. Place-based projects, like the one described here, provide opportunities for high school students to connect with university science communities who are engaged in local environmental research. Students who are given the opportunity to interact meaningfully with undergraduate and faculty science researchers, and to contribute to authentic science communities of practice, may experience positive enhancement of their self-identification as scientists. In agreement with the National Science Board (2010) recommendations, this project provided the opportunities that would prepare students to enter the STEM fields. Students responded positively to doing hands-on research with peers and scientists to solve a real and visible problem in their local park.

As a science-themed high school, students at BASE High School are encouraged to participate in other science programs. Some of these include the Young Naturalists extracurricular club for 9th graders where they study the ecology of Prospect Park. Students could conduct conservation projects during a summer month in the Nature Conservancy's LEAF Internship or work in the Garden Apprentice Program at Brooklyn Botanic Garden where they prepare to be educators at the garden for the general public. Students have opportunities to be paired with mentors and participate in scientific research at the American Museum of Natural History and the Science Research class at BASE. From these programs they enter their projects in regional science fairs. Although this project did not determine if students were motivated to pursue these opportunities as a result from participating in the week-long program, opportunities like these could be supportive in students' development of a positive science identity.

A growing body of work suggests that place-based pedagogy can play an important role in the science curricula of urban schools (Adams, 2012; Lim, Tan, and Barton, 2013). If localities develop curriculum to support the interests and needs of the communities in which they are situated, not only will communities benefit but, so will students, as their interest in science is enhanced through relevant, real world application rather than mere test preparation (Smith, 2007). It is important for teachers and school administrators to recognize the importance of relating science learning to physical contexts in which students have their lived experiences, such as what was done in this project, in order to increase student interest, especially among urban and underrepresented students.

This project is a model for high schools, colleges, and organizations to work together to offer relevant science learning experiences. Partnerships are key in developing engaging place-based science learning experiences for underrepresented students (Bouillion and Gomez, 2001; Adams, 2012). Community-based partners could offer the context for the real-world issues that students could address, while university faculty could offer the scientific and educational expertise to work collaboratively with schools to plan and facilitate research activities. It is also important to include students in the planning process, as they will provide feedback about what kinds of activities and questions would engage their peers. Partnerships take time to build but can be rewarding, and with strong partnerships there are great possibilities for developing place-based curricula and inspiring the next generation of STEM professionals.

As place-based education increases in popularity, teachers, researchers, and community partners will need (a) methods of inquiry into teaching and learning science connected to place, and (b) frameworks on which to design curricula and student-learning experiences that are based on and relevant to the local environment. This is of special importance in urban contexts, where there is often a misconception of the lack of viable green spaces available to engage in meaningful environmental studies. This project describes a method for teachers to develop critical place-based pedagogies in urban schools. This project also indicates that the local urban environment provides ample opportunities for developing scientific questions and stimulating interest in the geosciences and allows students to make the connections between geoscience concepts and their local environment. Extending this knowledge base is important for those who are engaged in research and teaching and learning in a variety of contexts, both in and out of the formal classroom.

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APPENDIX A

High School Student Interest Survey

ID Code: ________

Thank you for your participation completing this survey. This survey will take about 20 minutes to complete. The information you provide will remain anonymous (you will be assigned a number for an ID code instead of writing your name on the survey).

-Please record your ID code on the informational letter from __________at the top of this paper. Please ask if you don't know your ID code or write your name on this paper.

-The purposes of this survey are to: determine students' interests in science and the environment, and improve science learning experiences for high school students.

-Please return the completed survey to ____________________ High School by May 6th, 2011. Thank you for your time.

Directions #1-27: Circle the number of the response that best reflects your feelings about the following statements.

Directions #28-32: Please circle or write your response.

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
1. I care about the environment.	1 2	3 4	5	6 7	8 9
2. I would rather learn about science in the park than in the classroom at school.	1 2	3 4	5	6 7	8 9
3. I am interested in studying land formations and earthquakes.	1 2	3 4	5	6 7	8 9
4. I want to one day study science as a career.	1 2	3 4	5	6 7	8 9
5. I have taken a science class that is/was held outside.	1 2	3 4	5	6 7	8 9
6. I learn from completing lab experiments.	1 2	3 4	5	6 7	8 9
7. It upsets me when people litter.	1 2	3 4	5	6 7	8 9
8. I plan to go to college.	1 2	3 4	5	6 7	8 9

9. I consider myself a scientist.	1	2	3	4	5	6	7	8	9
10. It is my responsibility to take care of the environment.	1	2	3	4	5	6	7	8	9
11. I enjoy going to outdoor parks during nice weather.	1	2	3	4	5	6	7	8	9
12. I like science more when it is studying about an area where I live.	1	2	3	4	5	6	7	8	9
13. I value natural spaces, like parks.	1	2	3	4	5	6	7	8	9
14. I would like to present a science project at a science fair.	1	2	3	4	5	6	7	8	9
15. I would like to study life sciences (for example biology) more than geosciences (for example earth science).	1	2	3	4	5	6	7	8	9
16. I think high school students are able to work with college professors and researchers on science projects.	1	2	3	4	5	6	7	8	9
17. I like doing hands on activities (labs) in science.	1	2	3	4	5	6	7	8	9
18. I enjoy learning outdoors.	1	2	3	4	5	6	7	8	9
19. I have taken a science class that studies earth processes such as earthquakes and seasons.	1	2	3	4	5	6	7	8	9
20. I like learning about how people impact the environment.	1	2	3	4	5	6	7	8	9
21. I am considering majoring in science in college.	1	2	3	4	5	6	7	8	9

22. I understand science better when it is related to my life.	1	2	3	4	5	6	7	8	9
23. I am interested in studying global climate change.	1	2	3	4	5	6	7	8	9
24. I enjoy my high school science classes.	1	2	3	4	5	6	7	8	9
25. If I had the opportunity I would do a science project that would help my community.	1	2	3	4	5	6	7	8	9
26. I would rather identify animals and plants than identify rocks and minerals.	1	2	3	4	5	6	7	8	9
27. I like spending time outdoors.	1	2	3	4	5	6	7	8	9

Continued on back.

28. Please circle your gender: Male Female

29. Please circle your grade: 9 10 11 12

30. Please circle the ethnicity you most identify with:

African American Caribbean American Black

Latino/Latina White Asian

Other if not listed above: ________

31. What is the first language you speak at home? ____________

32. What are your parents' highest levels of education and/ professional training?

Mother: _______________

Father: _______________

33. What is your definition of geoscience?

____

____

34. Describe one topic or research question a geoscientist might study.

35. Describe the benefits and drawbacks of working with college students and professors on science projects.

Please record your ID code on the informational letter from ____________ at the beginning of the survey. If you don't know your ID code, please record your name.

Please return the completed survey to _________________ High School by May 6, 2011.

Thank you for your time and participation in this survey.