USING MUSEUM RESOURCES TO ENRICH URBAN SCIENCE EDUCATION: TEACHER AGENCY, IDENTITY TRANSFORMATION, AND CREOLIZED SCIENCES

by

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Abstract

CULTURAL HYBRIDIZATION AND SCIENCE TEACHING AND LEARNING: A STUDY OF TEACHER AGENCY, IDENTITY TRANSFORMATION AND LEARNING TO INTEGRATE MUSEUM RESOURCES IN URBAN PUBLIC SCHOOLS

by

Jennifer D. Adams

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This dissertation is a critical ethnography that documented my experience with a group of seven teachers re/producing a leadership identity and building a culture around using museum-based resources to teach science. These teachers were participants in the Urban Advantage initiative—a New York City-wide partnership for science education. The initiative aimed to create a sustainable practice of middle school students and teachers using the City's museums, zoos and botanical gardens to teach science and complete an independent science investigation called the 8th grade Exit Project. The seven teachers formed the core of a group called the Urban Advantage Lead Teachers with the goal creating enactment structures for teachers to effectively use museum resources to teach science. Out of this group one emerged as my case study. I visited her school and examined how she transformed the structure of her school and classroom to include object/inquiry-based science. As a facilitator of the group, I was a participant/observer and my data sources included fieldnotes, individual|collective created artifacts, photographs, videotapes and audiotapes.

In their experience of learning in different fields, visiting each other's classrooms, and enacting science and teaching culture in different fields, the Lead Teachers participated in a diaspora of science education. As their science teaching identities were transformed with the adoption of the new schema and resources, they re/produced a creolized culture and identity of classroom science and museum science teaching and learning. Bring a part of the Lead Teacher group provided a structure for the hybridization and creolization of science as it afforded the opportunities to build solidarity and share positive emotional energy around using the resources of the museum to teach and learn science.

Dedication

To my nieces Brianna and Ariel, nephew Jacob,
mother Peggy and late father Prince

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Chapter 1

Connecting Science Rich Cultural Institutions To Urban Science Teaching And Learning

> The museum is not a conservative but a progressive educational force, that it has a teaching quality or value peculiar to itself, that the museum succeeds if it teaches, fails partially if it merely amuses or interests people and fails entirely if it simply mystifies. (Osborne, 1927, p. 246)

The Science Expo

I arrived for work at the Museum early, as I usually do when there is a big event. The students were expected to arrive with their science projects in two hours, and we had a few last-minute things to do. As my colleague and I walked around the room, placing numbers on the tables, we discussed the registration.

"I think we have about 89 projects registered. Maybe we should spread out the numbers so the room looks full," Anne suggested. We planned for 160 projects—two projects per 8th grade teacher—but less than half of the teachers had registered. This was the first City-Wide Expo for Urban Advantage, and we wanted the room be full of students and their projects—or at least to have the illusion of being full.

"We should spread the numbers out and adjust as the projects start coming in. With these sorts of things, you never know how many people will actually show up." Anne and I finished numbering the tables and returned to the registration table in anticipation of the crowd to come.

A student showed up with her mother and asked for her teacher, "My teacher is supposed to have my project." But her teacher had not arrived yet; the eager 8th grader and her parent were the first to arrive. Anne gave the student a presenter's medal, "Please wear this around the Museum so they will know you are with the Expo. Go see some of the exhibits and come back in a little while and your teacher should be here." The student

took the medal in her hand and read the little circle. She smiled, immediately hung the medal around her neck and ran off with her mother.

We waited—though we felt like it was the calm before the storm, we still worried about the numbers of students and projects that would show up. We learned from previous events with schools that the number of reservations was no indication of the number of people who would ultimately attend. We ordered 500 medals and kept the date neutral so that we could use the leftovers the following year. While we waited we sorted the medals into manageable bundles of twenty-five.

The second person to arrive, a teacher from Staten Island, came with his project. "My student is not able to make it and I am sorry, but I cannot stay." We showed the teacher to his table; he set up his student's project and departed. Amidst the sea of white tables stood one lonely project about the geology of Staten Island. We continued to wait.

The trickle of projects became a steady flow and eventually a flood as more and more teachers and students arrived with their projects. Within this river of activity, the Urban Advantage Lead Teachers came in with their progeny. They came eager to help their students set up and to support other students and teachers within their designated areas—the room was divided into the City's instructional regions. We gave each Lead Teacher a large button that read "Urban Advantage Lead Teacher" so the other teachers and students would recognize them and ask for any needed assistance in setting up.

Eventually the room was filled beyond our expectations with the student projects. Our initial fears of having a sparse room was overtaken with the opposite issue of having to squeeze three or more projects onto tables designated for two. Students with their projects continued to fill the room, along with their families and their schoolmates who

came to support them. Sixth- and seventh-grade teachers brought their students "so they could see what is expected of them next year," one teacher told me.

The Hall of Ocean Life became a seaside carnival of activity around science. The rides were replaced with a diverse range of science projects and demonstrations. The games were the cultural partners' (museums, zoos and botanical gardens) tables where students could do activities, from petting a live porcupine to playing with magnets. Even the salt-water taffy was replaced with bagged lunches to keep the students properly fueled for an afternoon of presenting. The prizes were the presenter's medals, as there was not one student who was deserving of the medal who did not make sure that she received one.

Ranging from disaster relief to parakeet behavior to water quality, there was a diversity of science projects represented. Each was unique, but showed evidence of consistency with the Urban Advantage community. They displayed the process of science investigation as practiced by the science-rich cultural institutions and codified by the new assessment rubric. Some students presented extensions of science investigations begun by their teachers during professional development; for example, there was a group of young ladies who did an experiment with hydroponics, which their teacher had researched. The students proudly stood by and explained their project to visitors while stealing time to see what other students had done.

"This is a great day for science education in New York City," the Director of Science remarked as she addressed the audience. The excitement in the room was so intense that it was difficult to get the participants settled to listen to the customary welcome speeches. It was a festive atmosphere as the students ran back and forth

between the projects and the Museum's exhibition halls celebrating science. They were the experts as they described their science research to the public. They were at the center of science at the cultural institution and the community of science in the city. Many of the presenters were neatly dressed in their school uniforms. Since this was a Saturday, their attire and attendance were signs of pride in their connection to an event that was school related; they signified that this was an important event. The postures and gestures that the students assumed at their displays were those of confident, seasoned professionals presenting at an adult professional conference—well, they were 8th grade science professionals.

The student scientists had worked hard on their projects—coming up with a question and a hypothesis, designing a research plan and conducting the research, interpreting data and determining conclusions—and this event was an opportunity for them to demonstrate to the City what they had done. "They were proud of themselves and their work," a teacher wrote in an email to me describing her students and other students that she saw—the medals were symbolic of their work.

At this culminating event of the second year of Urban Advantage, the medals that the students wore around their necks were symbolic capital associated with their participation in science and the status they gained as presenters in the Science Expo. Every student made sure that he or she had a medal and, if it happened to break (as a couple of them did), they made sure that it was promptly replaced. Some of the co-presenters were unable to attend the Expo but their colleagues made sure they received their medals. Although the medals were small objects, in Urban Advantage they became

identity markers for the students—signs of their connections to science. The medals marked them as student scientists.

For the Urban Advantage teachers and Lead Teachers, the Expo was a time for them to reflect on what they learned during the year and how it was represented in their students' products. At the Expo, the Lead Teachers were able to see the citywide impact of their work as liaisons between the schools and the cultural institutions and their revision of the assessment rubric for the student projects. For the teachers, Lead Teachers, students, and the cultural partners, participation in this culminating event demonstrated the centrality of all participants in the practice of science in New York City and shaped their identities as people who are committed to quality science education in New York City.

What is Urban Advantage?

The Urban Advantage Middle School initiative is a collaboration of seven science-rich cultural institutions, including the American Museum of Natural History, the Brooklyn Botanic Garden, the New York Botanical Garden, the New York Hall of Science, the Queens Botanical Garden, the Staten Island Zoo and the Wildlife Conservation Society/Bronx Zoo, and the New York Department of Education. The goal of Urban Advantage is to educate middle school teachers in the use of cultural institutions to facilitate scientific inquiry for project-based assessments with students. Funded by the New York City Council, Urban Advantage began in 2004 in an effort to build better bonds between the schools and the science-rich institutions to make up for the inadequate science resources and facilities in the City's schools (AMNH Proposal, 2004, p. 23).

Middle schools were targeted because 8th grade students are required to complete an independent investigation called the Exit Project. In addition, they must pass the 8th grade science assessment that covers the three major content areas—life, Earth, and Physical science -- covered in the 6-8th grade science curriculum. In the assessment-driven climate of science education in New York City, the focus of Urban Advantage was to help students complete the Exit Project and pass the 8th grade assessment exams. Urban Advantage aimed to help teachers and students reach those goals by providing professional education for teachers and access to the cultural institutions for their students. In addition, the initiative provided science resources to the classroom. This was so the culture of science inquiry and investigation could be extended to the classroom and teachers could create a sustainable practice of integrating use of the institutions into their teaching practices.

Why was an Initiative like Urban Advantage Needed?

Teaching Science in New York City

Currently New York City is experiencing a crisis in science education. According to a Campaign for Fiscal Equity (2003) memo, 30% of the city's 7-12 science teachers are uncertified. In addition, in 2002 46% of the middle school Earth science teachers were not certified in this content area (AMNH Proposal, 2004). These shortages of qualified science teachers are more pronounced in the lowest performing schools and the poorest communities (AMNH Proposal, 2004). Again, shortages of qualified science teachers are most severe in the lowest performing schools and the poorest communities. In a report on teacher quality and student achievement, Linda Darling-Hammond (2000) reviewed numerous studies that clearly indicated a positive correlation between teacher quality and

student achievement—teacher quality referring to the training, licensure and overall teacher effectiveness. In one such study, data analyzed from the National Educational Longitudinal Studies of 1988 showed that the students of fully certified teachers scored higher on standardized subject-area tests than the students of teachers who are not certified in the subject area. She also noted that African American students were twice as likely to be assigned to ineffective/uncertified teachers (Darling-Hammond, 2000). As New York City is lacking in credentialed science teachers, this deficit presents already disadvantaged and underrepresented students with a barrier of access to a high-quality science education. In 2003, only 54% of eighth graders passed the State science test (The New York City Council, 2004). Furthermore, science teaching in New York City is strained by outdated or non-existent lab equipment and inadequate lab facilities.

The dismal 2004 *Lost in Space: Science Education in New York City Public Schools* report by The Council of the City of New York cited a number of problems adversely affecting science education, including too few qualified science teachers, secondary schools doing a poor job of teaching science, insufficient science facilities in the school, science education not being a high-profile, high priority issue, and outside resources not being used effectively. With minimal opportunities for science professional development and minimal support for science and science education, science in the City has become a reflection of the issues that reflect the deficits that already exist in lower income urban areas—a picture of struggling schools, struggling teachers, and struggling students.

Snapshot of Obstacles to Quality Science

As a manager of science professional development at the American Museum of Natural History, I have had the opportunity to attend meetings of various groups of the City's science teachers, administrators and regional instructional specialists (RIS). I attended one such meeting in May 2005. There, I heard about the current issues the RISs were facing in trying to implement quality science education in their schools.

Experienced science teachers were described as "hot commodities" but once they are trained in New York City, they leave for the suburbs (who are more than eager to "snatch" them up) for higher pay and working conditions conducive to higher quality science education (including access to well-equipped labs, smaller class sizes and a budget for resources). This continuous exodus leaves New York City with a dearth of qualified and experienced science teachers. Another issue that arose was the lack of accountability relating to the absence of a uniform curriculum across the city, especially in elementary and middle school science, and reduced creativity in enacting the existing curriculum. This ultimately affects many students, especially those who may transfer from one school to another. Students transferring between schools could easily fall behind in science due to lack of a citywide science curriculum; they may miss science topics or may attend a school where science is not even taught.

Each RIS had to support as many as 150 schools. This limited professional development opportunities for teachers and caused insufficient curriculum support. Other problems needing resolution included insufficient money for materials—especially for the consumable items that many science activities require; a system for ordering materials that is neither user-friendly nor cost-effective; and insufficient class time dedicated to

science. While the city was beginning to recognize that science education had been ignored for a number of years, in favor of math and literacy, and keeping in mind the No Child Left Behind mandate of state assessments in science by the 2007-2008 school year, it will require the hard work and dedication of the city's science educators to make a difference in the quality of science education in the city.

Teacher Quality

Highly qualified teacher is a specific term defined by No Child Left Behind (U.S. Department of Education, 2003). The No Child Left Behind Act of 2001 is a policy implemented by the Bush Administration, which is "designed to improve student achievement and change the culture of American schools" (U.S. Department of Education, 2003). One of the major goals of this Act is to have all classrooms taught by "highly qualified teachers" by the end of the 2005-06 school year. According to NCLB, a highly qualified teacher must have: a bachelor's degree, full state certification and licensure as defined by the state, and demonstrated competency, as defined by the state in each core subject he or she teaches. In New York State, to be qualified to teach elementary science (K-6), a teacher needs only 6 credit hours (only two courses!) in science. Some of these "qualified" teachers end up teaching middle schools (grades 6-8), often without the laboratory experience necessary for a sound secondary science curriculum. This raises questions about what it means to be a highly qualified science teacher.

According to Darling-Hammond (2000), there are certain characteristics that relate to the effectiveness of a teacher. These characteristics include general academic ability and intelligence—namely teachers' verbal ability, subject matter knowledge,

continued professional training, years of teaching experience, and teacher behavior and practices. For example, one study found that course work in science education was significantly positively correlated with student achievement, more so than simply the number of passed credits in science (Darling-Hammond, 2000). In addition, teachers with more science education were more likely to use practices associated with higher-order thinking and problem solving and to include laboratory techniques and scientific discussion in the classroom than those with less science education training (Darling-Hammond, 2000). An analysis of NAEP data showed that teachers who had more professional training were more likely to use teaching practices associated with higher reading achievement on the NAEP exams (Darling-Hammond, 2000). This suggests that teachers who receive on-site professional education in using informal institutions will be more likely to use these institutions in their teaching practice.

Why Cultural Institutions as Sites of Teacher Education?

The National Science Education Standards (NSES)(National Research Council, 1996) recognize that "good science programs require access to the world beyond the classroom," (p. 202) with the word programs implying that the beyond-the-classroom experiences would be more valuable if they were goal oriented and linked to learning and performance standards and the classroom curriculum. Connecting museum visits to topics that are presented in the classroom could allow teachers to build deeper understandings of topics and facilitate experiences that access a wider range of learners1(Cox, Marsh, Kisiel

[1] Currently there is a debate in the museum education field about the role of museums in formal education—does the museum learning experience stand alone or should museums be more responsive to the needs of schools? I tend to side with the latter point of view but major players in museum education, like Hein (2001), tend to stress the former.

& Melber, 2003). Cultural institutions provide settings for rich beyond-the-classroom experiences for teacher and student learning. With access to an array of science-rich cultural institutions within the City's five boroughs, urban science teaching and learning would benefit from a collaborative program with those institutions with the goal of using them to do science investigations.

Falk and Dierking, (2000) in their contextual model of learning, highlighted four realms that interact when one learns in an informal setting—the physical, social, and personal contexts, and time across a lifespan. This comprehensive view of informal learning includes sociocultural aspects where there are different interconnecting events to comprehend. In order to form a picture of the nature of learning in a museum, conversations, interactions, physical space, as well as what happens within the individual must be considered. It is the interactions—that of the object and learner, between learners, and of the learner and the space—that make the learning experience. Additionally, learners in museums bring a host of personal experiences that influences how and what they learn from the objects on display. Using the example of a diorama, each viewer may focus on one part of the diorama—one may hone in on the plants because she is a gardener, while another may scrutinize the background scenery because he likes art. Hein and Alexander (1998) and other museum researchers often use constructivist and discovery learning theories when describing the nature of learning in a museum. Both of these pedagogies place the learner at the center and emphasize the importance of social interaction, experience and meaning making in the learning process.

Informal settings such as natural history museums, zoos, and botanical gardens have a variety of objects on public display that have the potential to complement many of the NSES standards (Cox, Marsh, Kisiel & Melber, 2003). For example, the NSES Professional Development Standard B calls for learning experiences for teachers to "occur in a variety of places where effective science teaching can be illustrated and modeled, permitting teachers to struggle with real situations and expand their knowledge and skills in appropriate contexts." (National Research Council, 1996, p. 62). With access to authentic scientific objects, and displays of scientific phenomena, science-rich cultural institutions have the potential to provide valuable learning experiences and professional education for science teachers. In a 2001 study of teachers in a museum-based course, Dhingra, Miele, Macdonald, and Powell (2001) reported that teachers experienced a positive difference between learning in a college classroom and learning in a museum. Teachers described the learning experience as being experiential and engaging. The researchers noted that this could translate into creating more of an interactive learning experience for their students (Dhingra, et al., 2001).

For example, at the American Museum of Natural History (AMNH), teachers learn science from viewing objects in the exhibition halls and investigating objects in the classroom. Workshop facilitators, who could be scientists, museum educators or classroom educators, who incorporate the museum's resources into their curriculum model take advantage of the museums' resources to model good science teaching. For example, a facilitator could use a diorama in the Milstein Hall of Ocean Life to discuss ocean ecosystems while at the same time modeling the use of the diorama as a teaching

resource. For the workshop participants, this affords the learning of science content (such as animal and plant adaptations) and effective use of the museum's resources.

To strengthen teachers' content knowledge, workshops are designed and co-taught by museum educators and scientists who discuss the process of research. From the scientists, teachers are expected to learn about real-life applications of the inquiry process and gain scientific reasoning behind why certain objects are displayed in exhibits and what science has learned from observing similar objects in the field and in the lab. From teachers, scientists can learn about science teaching standards and how to present their work in a way that it can be accessible in the classroom. This partnership affords an appreciation of the work of science and supports the National Research Council's idea of involving the public in the work of science—science as a human endeavor (Melba & Abraham, 2002).

Researching Museum-based Learning

Investigating learning in informal contexts can benefit from a researcher using a bricolage of theoretical lenses to discern the nature of learning in this milieu (Kincheloe, 2001). The Board of the National Association of Research in Science Teaching (NARST), the Museum Learning Collaborative (2002), and Falk and Dierking (2002) have all emphasized the importance of researching the sociocultural underpinnings of informal learning. Researchers of the Museum Learning Collaborative made a formal call to undertake a sociocultural approach to studying the process of learning in museums since it "emphasizes the interplay between individuals and mediators" (p. 4).

In 1999 NARST established an Informal Science Education Ad Hoc committee with the purposes of defining the research area and articulating the issues relevant to

research in informal settings (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003). A central understanding of the committee is the longitudinal nature of learning, "…much of what people come to know about the world, including the world of science content and process, derives from real-world experiences within a diversity of appropriate physical and social contexts, motivated by an intrinsic desire to learn" (p. 109). One of the issues that the committee outlined in relation to researching out-of-school learning is *exploring the social and cultural mediating factors in the learning experience.* They cite, "Out-of-school learning is strongly socioculturally mediated, so research designs need to offer opportunities to explore social and cultural mediating factors including the role of conversations, social learning networks, cultural dimensions, and the use of groups as well as individuals as the unit of analysis" (p. 115).

While most of the research around learning in museums has focused on individuals and family groups learning in informal settings, less has focused on school groups as units of analysis and even less has focused on teacher education in these learning environments. This study is salient in that it focused on a teacher education program that was enacted in a museum setting and how it played out in the professional lives of participating teachers.

This study is an ethnography of teachers learning to use museum-based resources to teach science. Viewing teaching and learning to teach as cultural practice, this study examined the experience of a group of teachers as they transformed their identities as science teachers to include out-of-classroom experiences in their teaching toolkits and created displays by re/producing the museum-based culture of objects and display in the classroom. Using critical ethnography as my lens and methodology, I aimed to reveal the

social and cultural issues around using new resources to teach science and re/produce a leadership identity in science education within the structure of schools and the Urban Advantage initiative.

The year of this study was the first year of the Urban Advantage Lead Teachers. It was also my first time facilitating a cadre of Lead Teachers around the use of museum resources to teach science. As I discovered through my research, facilitating leadership was more than simply teaching a course about using the museum. It was a process of adapting new cultural practices and building a science teaching identity around the use of new resources. As I was a participant in the group, I too was learning a new culture and building an identity around the ways in which my agency was expanded by the provision of new resources. The new resources for me were using the sociocultural lens to examine the experiences of the Lead Teachers. This framework enabled me to view learning as a social process rather than a solely cognitive process of storing and retrieving information. As the following chapters describe, the sociocultural framework enabled me to describe the Lead Teachers' experiences in terms of the agency|structure dialectic. It also enabled me to see learning to use new resources and learning in new fields as a process of hybridization—taking on new cultures and identities—to create a creolized culture and/or a creolized identity. The sociocultural lens also made me aware that my interpretations were dependent on my own web of reality (Kincheloe, 2001) and subject to radical doubt (Roth, 2005). My own web of reality also influenced the methodological choices that I made, the questions that I asked, and how those questions changed as I learned about teachers learning in a museum.

Although I outline research questions in this and subsequent chapters, I wanted my research to be emergent, so I expected my questions to change as I changed and as the Lead Teacher individual│collective changed. I found that although my questions in each chapter were similar, they were responsive to different contexts so the answers were different but theoretically related. As I became more informed about teachers learning to teach and sophisticated in using my sociocultural theoretical lens, my constructions about teachers learning to teach changed. In addition, my constructions about museums as resources in relation to classroom teaching and learning changed. For example, for a teacher, my primary and transformative lesson is not necessarily a resource to improve the quality and amount of inquiry teaching and learning. The lesson *becomes* a resource when a teacher is able to enact a culture of teaching with objects and resources. Furthermore, a museum *becomes* a teaching resource when the museum culture changes to allow the enactment of classroom practices—such as being able to connect its resources and practices to the curriculum and practices of the classroom.

Urban Advantage: The Study

Purpose of the Study

When teachers teach and learn to teach, they re/produce their identities as being certain kinds of teachers depending on a variety of factors, including the resources to which they have access and know how to use and the kind of teaching they enact in the classroom. When teachers enact inquiry-based teaching it becomes a part of the structure for science teaching and learning in the classroom field and thus a resource for all participants, namely the students in the field (Tobin, 2005). In Urban Advantage, teachers were taught how to use the resources of the cultural institutions to teach science. They were also

taught how to extend the resources and pedagogy of teaching with objects to the classroom. Using a sociocultural theoretical framework around agency |structure, identity, and communities of practice, this study examined the experience of teachers learning to teach using the resources of the science-rich cultural institutions. I wanted to find out what teachers learned from their participation in Urban Advantage. I began with the following four questions:

1. How did the Urban Advantage Lead Teachers construct a community of practice around integrating the resources of a museum into their teaching practice?
2. In what ways did the culture that Lead Teachers learn in Urban Advantage get re/produced in their classroom?
3. How did Violet (a teacher featured in a case study described in chapter 5 and 6) use her agency from participating in the Urban Advantage Lead Teacher group to transform the science teaching and learning structure in her school?
4. In what ways did participation in Urban Advantage enable the Lead Teachers to re/produce their identities as object/inquiry-based teachers?

Context and Stakeholders

The American Museum of Natural History (AMNH) had the primary role of administering the Urban Advantage initiative. The New York City Council funded the initiative. The money allocated for Urban Advantage covered all aspects of the program including teachers' stipends, vouchers, and resources for the classroom. The Museum managed the budget and the collaborative efforts of the cultural partners, which included coordination of the professional development content and schedule. I was a part of the

central management team at AMNH and my primary role was the management of schools and teachers, which included teacher recruitment and retention and facilitating the Lead Teacher group.

My research was situated mainly at the AMNH, but included experiences of teachers at the other institutions due to the shared nature of the initiative. The Urban Advantage initiative was comprised of several stakeholder groups who were central to the success of the project. Although my research focused on the experiences of the Lead Teachers during their second year in Urban Advantage, here I describe the different stakeholder groups in order to contextualize the position of the Lead Teachers. My research examined how the Lead Teachers formed identities in the context of negotiating their roles within these different groups.

Department of Education

There are three administrative levels for science in the New York City Department of Education. The Director of Science is responsible for science teaching and learning citywide. She and her staff of curriculum specialists are responsible for guiding and managing science-based initiatives and curriculum throughout the City. The New York City Department of Education is currently divided into 11 instructional regions and each region has a Regional Instructional Specialist (RIS) in science to facilitate science instruction and support science initiatives. The role of the RIS is to administer the implementation of science instruction—this includes mentoring, providing professional development and assisting with the implementation of science curricula and initiatives at the regional level. At the school level there is an administrator of science—this could be the principal, an assistant principal or a lead teacher assigned to support science

instruction at the school level. The school-based administrators were key in providing support for teachers in the initiative and responsible for creating school policy around Exit Projects and making science curricular decisions.

The Exit Projects

The Exit Projects provided students with the opportunity to engage in an independent investigation and demonstrate their science process skills. For these investigations, students were required to come up with an investigable question and design and complete their project, including the collection and analysis of data. Students were encouraged to work do the Exit Projects in small groups, however there were still some teachers and students that opted to do them individually. There were four different types of science investigations—controlled experiment, fieldwork, design, or secondary research—as defined by the Department of Education that a student could do to fulfill the Exit Project requirement. Students and teachers used a specially designed assessment rubric to assess their ongoing research and final project. A primary goal of the Urban Advantage initiative was to have teachers and students use the resources of the cultural institutions to implement the Exit Projects.

The Cultural Partners

The Urban Advantage initiative has seven cultural partners: the American Museum of Natural History, the Wildlife Conservation Society (The Bronx Zoo), the New York Botanical Garden, the New York Hall of Science, the Brooklyn Botanic Garden, the Staten Island Zoo, and the Queens Botanical Garden. There is at least one cultural institution in each of the five boroughs. Within the scope of the initiative, the first four are considered the larger institutions, based on size and number of student visitors during

the previous year, and the second four are the smaller institutions, based on the same criteria. Each of these institutions had one or two staff members and educators who were involved in the planning and implementation of Urban Advantage in their institution. These educators also worked with the Urban Advantage Lead Teachers in facilitating the teachers' workshops.

Teachers and Schools

Middle school science teachers in New York City were recruited from the public schools to participate during the first year of Urban Advantage. These teachers represented the 11 regions—10 instructional regions and District 75 (special education) -- of the New York City Department of Education. The Regional Instructional Specialists in science (RISs) were responsible for selecting 7th and 8th grade teachers and schools in each of their regions to participate in Urban Advantage, based on the following criteria:

1. Middle performing schools according to math and science assessments and economic demographics,
2. Teachers with at least 3 years of teaching experience,
3. Teachers who are familiar with the Exit Projects or project-based assessment,
4. Schools that could provide a team of two teachers,
5. Schools with administration supportive for the initiative.

These criteria were chosen to ensure a certain degree of success with the project. We felt that experienced teachers, middle performing schools and schools with some experience in doing Exit Projects would allow us to concentrate on fostering the cultural institution partnerships in conjunction with this collaboration with the benefit of having teachers familiar with authentic assessments who could provide experience-based

feedback. However, in order to reach the first-year goals of having at least 30 participating schools, schools and teachers that fell outside of the above criteria entered the program. For example, there were a number of first-year teachers and several small schools who were only able to enroll one teacher in the initiative. Some schools were recruited by the cultural partners rather than going through the RIS.

The second year recruitment saw an exponential increase in the number of teachers and schools, from 30 schools and 59 teachers to 111 and 195 respectively. While we tried to stick to the original criteria for selecting participating schools, due to meeting numerical goals of new schools and teachers, schools and teachers who fell outside of the criteria were once again recruited.

Students

In the first year, Urban Advantage impacted over 5,000 7th and 8th grade students. During the second year the number rose to over 18,000. Each student received family vouchers that allowed up to four people to visit three of the participating cultural institutions for free. The vouchers were intended to enable families to visit the Urban Advantage partners and engage in learning science together. The students also received classroom resources to continue their science investigations in the classroom and complete their Exit Projects. These resources where chosen and ordered by the teacher and included items, such as magnifying glasses, tri-fold boards, resource books, and science objects such as fossils.

The Study Participants

The participants in this study were the Urban Advantage Lead Teachers. From the first group of Urban Advantage teachers, 17 became Urban Advantage Lead Teachers during year 2. However 7 of them were more consistent participants (attending most of the

meetings and assessment revision sessions) and therefore were included as data resources for this study. All Lead Teachers received a stipend of $3,500 for 80 hours of work and they received no additional compensation for participation in this study. The core of the Lead Teacher group comprised the following teachers, listed with their pseudonyms, borough they teach in, and type of cultural institution they were partnered with:

- Violet (my case study) —Brooklyn, natural history museum.
- Jake—Queens, zoo.
- Pamela—Bronx, botanical garden.
- Mike— Manhattan, botanical garden.
- Collette—Queens, science and technology museum.
- Elena—Manhattan, botanical garden.
- Andrea—Bronx, zoo.

The Lead Teachers completed the 50 hours of professional development during the first year of Urban Advantage and volunteered to serve as Lead Teachers during the second year of the initiative. These teachers were chosen as Lead Teachers for three initial reasons: (1) they participated in focus group sessions that discussed "what worked and what would I change about UA for the second year?" (2) Urban Advantage partners who got to know them during the extended workshops at the seven institutions recommended them; and (3) they had good attendance, active participation in the workshops, and participated in student borough fairs where they presented projects done by their students. For the teachers who participated in the focus groups, their responses to the questions had no bearing on whether or not they were chosen to be a Lead Teacher. I made the assumption that their participation in the group (for which they received no pay) indicated a level of commitment to Urban Advantage.

As manager of schools and teachers in Urban Advantage, it was my role to facilitate the Lead Teacher group. This included planning and organizing the monthly

meetings, coordinating the collaborations between the Lead Teachers and the partner institutions, providing opportunities for additional teacher training, and initializing the assessment and curriculum revision discussions. Although I often assumed a leadership role in the group, it was my objective to rotate the leadership role whenever possible to allow individual teachers to assume leadership of certain aspects of the Lead Teachers' activities. For example, Mike and Jake facilitated the rubric revision process. Through participation in the Lead Teachers' group as a manager, I was able to gather a comprehensive first-person view of the impact of the learning experiences for the Lead Teachers.

During the second year, the Lead Teachers participated in monthly meetings, planned and facilitated professional development in the cultural institutions, participated in ancillary meetings around curriculum and assessment and enacted various Urban Advantage related roles within their schools and instructional regions, such as the recruitment and support of science teachers in their schools and facilitating workshops related to Exit Project implementation in their regions. I aimed for the monthly meetings to be an open forum where the Lead Teachers had the chance to talk about the issues relating to teaching and learning in museums as well as continue in their own professional education in using the informal sources to teach and learn science. As this was the first year of the Lead Teacher group, role definition was a central discussion of the monthly meetings. These meetings also provided teachers the opportunity to share their experiences as Lead Teachers and provide each other support, suggestions and feedback on their work in the cultural institutions and in their classrooms around Exit Project implementation.

Violet: My Case Study

In June 2005, Violet and her assistant principal attended the year-end celebratory event for Urban Advantage teachers and administrators. It was an opportunity for schools to network and share their experiences from the first year of Urban Advantage. We also gave each school a banner that read, "This is an Urban Advantage School." Some teachers stood up and spoke at the gathering about the impact that Urban Advantage had on their students and their schools. Violet spoke about the wonderful resources for the classroom and field trips to the museum and the botanical garden. She talked about how her students were able to learn science content from seeing the space show and how the science films, such as *Volcanoes of the Deep,* that were given to her were used to reinforce what they learned from the fieldtrips in the classroom. I knew that she was from my neighborhood middle school, but at that time I did not know that she would emerge as my case study.

My first interactions with Violet were during the Lead Teacher training during the summer of 2005. She was a quiet but strong presence in the room. In reviewing videotapes of the sessions, I noticed that she would watch first and then engage in the activity as opposed to immediate immersion in the task at hand. In one instance while teachers were learning how to assemble and use the dissecting microscope, Violet was careful to watch the instructor's every move before she attempted to manipulate the microscope, even though others at her table were already trying to use theirs. She was thoughtful in her actions and took ample notes as she interacted with the museum educators and scientists during those first sessions. When we gave the teachers a simple magnifying glass to study geology and ecosystems in Central Park, Violet made frequent

use of her magnifying glass to get a better look at everything, from insects to the minerals in the exposed bedrock. She reminded me of a middle school student whose curiosity has been piqued and now could not stop investigating everything. I have noticed that she was the same way with her students -- thoughtful about observing and knowing them first, in order to make science accessible for them.

Violet is originally from British Guyana and has taught for "many years" (as she disclosed) in Guyana and the British Virgin Islands before coming to New York. She has been at Central Brooklyn Middle School for as long as the school has been a part of Urban Advantage—two years going on three. She recalled her first days teaching there, "No one gave me a curriculum. They gave me the green [Exit Project] book and said 'this is what we follow'." Urban Advantage provided Violet with resources and guidelines to work with and "renewed the sense of curiosity about nature that [she] had as a child."

When we needed to recruit more teachers for Urban Advantage, Violet asked me to visit her school. She thought that if I came—as a representative of the Museum— to talk to them about adding more teachers, it would make a stronger impact on her school administrators. I was very interested in visiting her school because it was a school in the community I grew up in. The school had a bad reputation (with the urban ills of overcrowding, disinterested teachers, and delinquent students) so I was surprised to see them as one of the Urban Advantage schools and wanted to see if the school had changed since its days of infamy. It was my idea that such a school—a "bad" school—would not be invited to participate in Urban Advantage; that it would not have been on the radar of the RIS to select such a school. After visiting her school, I decided to use her as my case study because a) of the location of the school in the community where I grew up, b) I

share a common (Caribbean) ancestry with Violet and many of her students, c) I was intrigued by a school that appeared very different from what I remembered. I was interested in the potential of her role as a Lead Teacher and my role as an outside resource in transforming the science education structure of the school.

Teacher Education

The first year Urban Advantage teachers received a total of 50 hours of education (workshops, lectures and hands-on activities) on using the cultural institutions to do science investigations for the Exit Projects. Teacher education took place in the classrooms, and indoor and outdoor spaces of the collaborating institutions. During the workshops, the teachers had access to specialized tools and resources of the institutions as well as the expertise of the staff members involved in the sessions. The first 20 hours involved a visit to each partner institution and a briefing on the nature of the science investigations that happen in those institutions and the content that the professional development would cover. For example, the Bronx Zoo demonstrated techniques to study animal behavior. For the second 20 hours, participants were asked to choose an institution for in-depth study, and they chose based on content and convenience to their schools (for purposes of field trips). For the last 10 hours, participants chose two different institutions (5 hours each) for additional education and to become familiar with different resources and learning spaces.

The professional development structure changed during the second year, to better coordinate the resources of the cultural institutions with the needs of the classroom. The first 12-hour cycle happened over two Saturdays, and was designed to give all new Urban Advantage teachers a common experience. Teachers attended workshops on asking

investigable questions, looking at student work with the guiding question of "what makes a good science project?" observing objects and exhibits, and keeping a science notebook. (The museum educators, Lead Teachers, Department of Education Central Staff and institution scientists codified these skills during the summer of 2005 after identifying the skills common to practicing science and looking at student projects.) During the second 24-hour cycle, the teachers attended the cultural institution of their choice where they completed their own science investigations while learning the content and pedagogy of the cultural institution and how to facilitate science investigations with their students. For the third cycle, teachers chose a second institution and participated in 12 hours of additional education that focused on learning about the resources of the institution. The fourth and final cycle was dedicated to classroom implementation and preparation for the City-wide Expo.

Timeframe

This is a longitudinal study that began in the fall of 2004 and continued through June 2006. As described above, teachers participated in a total of 50 hours of training on the weekends at the cultural institution of their choice. The Lead Teacher community began in June 2005 with two focus group sessions lasting for two hours each. The Lead Teacher support sessions officially began during August 2005 with two full-day meetings and continued with 2-hour after school monthly meetings throughout the year. In addition, some of the Lead Teachers participated in additional meetings that focused on revising the assessment rubric. As some of the Lead Teachers participated in Museum programs during the summer of 2006, I was able to inadvertently gain additional insights and data for my research.

Violet was my case study and I began to visit her school in October 2005. She arranged for me to attend her double period class on Wednesdays when the students worked on their Exit Projects. I initially visited once a week, but due to schedule changes within her school and scheduling conflicts with my work, the visits ended up being bi-monthly until late March and three more visits occurred in late April and May 2006. When I was present in her class I served as an additional resource for her students' work on their Exit Projects, as I discuss in chapters 5 and 6. I attended two professional development sessions that Violet facilitated for the science teachers in her school and observed Violet as she taught her students and teachers (during the Urban Advantage workshops) in the Museum.

Methodological Considerations

This dissertation is a manuscript-style document; hence the theoretical framework and methodology are embedded within the individual chapters. Each chapter is written so that it is complete in its own right and can pass peer review for specific journals that cater to particular audiences. This section provides an overview of the collection and analysis of the data resources used in the study.

Data Sources

In order to study how culture was enacted and re/produced I collected data in the different fields where the Lead Teachers participated. Beginning with the focus groups, I audiotaped the conversations of the teachers as they reflected on their first year of Urban Advantage and discussed how the program could be changed to better meet the needs of the classroom. I videotaped the first two August meetings of the Lead Teachers.

During the monthly Lead Teacher meetings, I took fieldnotes, participated in discussions and took photographs of the classrooms that we visited. I videotaped the meetings where they worked on revision of the Exit Project rubric. I used my fieldnotes and videotape data to do meso analysis to see where teachers accessed and appropriated the museum's resources and looked for evidence of museum teaching habitus in their teaching practice with colleagues. I listened to their discourse during the sessions for evidence of their expanded agency in how they discuss science, teach science, and do science investigations in the museum and other cultural institutions with their students.

I looked at the rubric revision process as an artifact to see how the museum field has informed and transformed their notions of science teaching and learning. I examined student projects for evidence of transference of the museum pedagogy and ways of doing investigations to the classroom, as I believe that the student work displays teacher influence. In addition, I conducted both formal and informal interviews that asked questions that were specifically directed at their expanded and enacted agency and resource appropriation in the classroom. Through this discursive interaction I learned about their transforming identities as learning unfolded. I reviewed samples of the Lead Teachers' student Exit Projects for evidence of the teachers' expanded agency in the classroom.

Analysis and Interpretation

In this study, teaching and learning are framed as forms of culture (Sewell, 1992), so I expected to observe patterns of thin coherence and contradictions in my investigations of social life in the various fields involved in my study. I endeavored to understand both the coherences and contradictions to them. I used multiple data resources to explore each of

my research questions and identified, as preliminary conclusions, the patterns (that is coherences) and associated contradictions that emerged from all the data.

The examination of the data was ongoing during the research process. In examinations of my notes, audiotapes, and artifacts, I looked for evidence of identity transformation and affordances of science content knowledge and uses of the cultural institutions in the teaching and learning of science. I presented my findings to the participants for member checking where the teachers either confirmed or denied my interpretations or provided alternative views. The feedback from participants was used as an additional data resource. I strived for reciprocity in my study—I provided feedback to the Lead Teachers about educating their peers on using the informal institutions to teach science and they informed me about how the institutions could be used more effectively for teachers and students. Through this reciprocity, I learned about the agency that the Lead Teachers experienced (or did not) in their roles and how their identities as science teachers were transformed through their expanded agency.

My position as a participant/observer enabled me to gather both a first-person view and a third-person view of the Lead Teacher community formation and identity re/production. This afforded me the iterative process of going between my lived experience as a facilitator and my interpretive experience as a researcher. It also allowed me to provide feedback and suggestions to the Lead Teachers based on my own experiences as an educator both in the classroom and in the museum setting. Additionally, it allowed me to do an auto/ethnographic reflection on my own experiences as a classroom teacher, learning to teach with new resources, and as a museum educator,

learning to transfer and transform my classroom teaching pedagogy to teach others how to use the resources.

Uses of Authenticity or Validity Criteria

As discussed in previous sections, the learning that takes place in a museum is socially constructed and mediated. It seems only natural that inquiry into learning in a museum would use methodologies that are naturalistic and socially constructed. In order to ensure that my research was an accurate reflection of the teachers' experiences, my research design included multiple data sources and data collected primarily from my research and secondarily from the program evaluator. The focus groups and Lead Teacher check-ins enabled peer debriefing and member checking.

The questions that I outlined in this chapter are different from the research questions that I initially set out to study. This was consistent with the desire for my research to be emergent (Tobin, Elmesky, & Seiler, 2005). In chapter 7, I describe how my constructions changed and evolved, as did my research questions, the roles of the research participants, and the data that I collected and decided to analyze. Due to the critical and emergent nature of my research, I aimed to adhere to criteria geared towards naturalistic inquiry to ensure the trustworthiness and validity of my research.

Ontological authenticity. As a stakeholder in this project, I expected my constructions of teachers' learning in museums to change as a result of doing this research. With ongoing evaluation of the data, I practiced reflexivity: first in my role as teacher educator I asked myself if the Lead Teachers were learning what we wanted them to learn and second, in my role as researcher, I asked if what I am seeing/interpreting is a true reflection of what is actually happening. I documented my changing constructions as

I became distant from my initial predispositions. For example, we (the Lead Teachers and I) realized that they needed to learn skills and techniques for teaching and mentoring adults. It will become a part of the Lead Teacher education during the third year of the program, when the current Lead Teachers will be integrated with the new Lead Teachers. I also looked for the Lead Teachers changing constructions, especially in their identities as Lead Teachers and peer leaders. As the study progressed, the Lead Teachers began to identify and enact their leadership roles in Urban Advantage, such as participating in the partner meetings and co-facilitating professional development with the museum educators.

Educative authenticity. As a part of Urban Advantage, I participated in regular meetings with the cultural partners and science education leaders and administrators from the Department of Education. I updated these stakeholders about what I was learning from my interactions with the Lead Teachers. I engaged in discussions (within the context of ongoing discussions about the program) about my findings and learned from their perspectives on my perspective.

Catalytic authenticity. In this project I served as the liaison between the teachers and the decision-making others. Although there were policy-related constraints to some issues that arose as a result of my study, I used my position to inform the policy-makers about the issues that came up during my discussions with the Lead Teachers. My reflexivity, peer debriefing and dialogue of my research with the leadership team afforded (lead teachers, institutions, Department of Education) adjustment in the project (where feasible) to make it more effective for teachers and students.

Tactical authenticity. Tactical authenticity (Guba & Lincoln, 1989) was evident as the institutions adjusted to meet the needs of the teachers and schools and teachers adjusted their teaching to facilitate learning in the institution. I also reported to the partners and the Lead Teacher what I learned as a researcher/participant in the Lead Teacher group. For example I stressed the importance of maintaining a learning community with the Lead Teachers when I learned that it was important in identity re/production and inquiry-based teaching enactment. In this process, I also identified where schools and teachers were at a disadvantage with respect to other participating schools, and policy that could be enacted to equalize the opportunities. To the extent possible I will use what I have learned from the study to make it possible for disadvantaged schools, classes and individuals to overcome their disadvantages. For instance, some schools were disadvantaged due to their distance from the cultural institutions and the impracticality of using public transportation to access the institutions. Consequently, since AMNH was responsible for the budget, it allocated monies for busses to facilitate field trips for these schools.

Overview of the Dissertation

In **chapter one**, I describe the culminating event of Urban Advantage to introduce the context of the study. I review and discuss the current status of science teacher education and present a rationale for using informal settings as sites for science teacher education. I continue with an overview of the structure of the New York City Department of Education in the context of policy decisions around Urban Advantage and teacher selection. I present theoretical and methodological considerations for studying learning in

museums and learning to use museum resources to teach in the classroom. I then describe the Urban Advantage program and the purpose of the present study.

In **chapter two,** I provide a historical context for science education in the American Museum of Natural History. I examine the Museum's role in the creation of a science ideology and discuss the implications for teaching students and teachers, especially those who are marginalized with respect to the dominant (Western) culture. I also discuss how certain museum education practices are historically constituted, but practices like "original observation" contradicts the "single objective truth" as is the ideology of science as practiced in the Museum. I compare the education programs of the founding decades of the Museum to the present partnerships with schools and science-rich cultural institutions.

In **chapter three,** I theorize learning to teach science in a museum with a discussion of the agency|structure and central|peripheral dialectics, as well as identity and forming a community of practice. Describing the experiences of the Urban Advantage Lead Teachers, I explain how they shaped their identities as peer leaders and inquiry-based science teachers around knowledge of using museum-based resources to teach and learn science. I look at how their community enabled the resources of the museums, available to the entire Urban Advantage community, to enact inquiry-based science teaching and learning.

Chapter four uses the object/inquiry-based classroom as both a real space and a metaphor for how the Urban Advantage Lead Teachers re/produced identities around being object/inquiry-based teachers. The classrooms that they created reflected their hybridized identities that occurred as a result of their interactions with museum-based

resources and pedagogy. I discuss how they transformed their classroom spaces and teaching practice to include the visual pedagogy of the museums.

In **chapter five**, I discuss how Violet used the agency that she developed from learning in the museum and her participation in the Lead Teacher group to transform the structure for science teaching and learning in her high-needs middle school. I discuss how she had to acquire and set up a space for science as well as carve out the space within the context of the literacy and math mandates.

In **chapter six,** I use auto/ethnography and auto/biography as a method of understanding issues of ethnic identity and intracultural science teaching. Using Roth's (2006) theoretical constructs of creolization, hybridization and diasporic identities I examine my experience as a Caribbean-American teacher of Caribbean-American students vis-à-vis researching Violet who is also a Caribbean-American teacher of Caribbean-American students.

In my concluding **chapter seven**, I revisit my original research questions and discuss the implications of teachers learning to use museum-based resources to teach, and creating communities of practice and identities around the enactment of science teaching and learning. I argue about the role informal institutions can play in continuing teacher education.

Chapter 2

The Historical Context of Science and Education at the American Museum of Natural History

> You have little idea in walking through these halls what labor they have involved, what sacrifices men have made and are making for them today in all parts of the world, how much the workers in this Museum are imbued with what may be called the spirit of the institution—the desire to extend the call and vision of nature (Osborne 1927, p. 271).

Race and Historical Displays in the Museum

I work in a great Museum and I enjoy my daily interactions with objects of science, human culture and history. I also realize the value of the Museum as a science teaching and learning resource for teachers and schools, however I do feel a personal feeling of oppression when I look at some of the ways that people of African descent are depicted, described and interpreted in the Museum. While I realize that these objects are a reflection of an historical era, these objects are nonetheless present and have to be dealt with for the value of what they represent to people who see them, especially people like me who may interpret them in oppressive ways.

To describe this oppression, I can begin with the statue at the main entrance to the museum. Adorning the entrance of the Museum is a statue of Theodore Roosevelt on horseback in oxidized bronze (see figure 2.1). An African and a Native American man flank him, both on foot. Proudly mounted on his horse, his back is slightly turned towards the African, who is wearing almost nothing but a downcast gaze toward Central Park. The Native American chief—wears a grand headdress and is draped in a blanket, he too gazes into the park. Roosevelt's position on the horse indicates the awareness of the

African's existence, but a desire to ignore his presence; ignoring the significant contributions that African peoples have made to this country and to the knowledge that is contained within the building behind his statue.

When I enter the Roosevelt Memorial Hall and look at the murals painted on the walls up to the high ceilings, I am confronted by murals that depict great scenes of great European men on horses and foot collecting animal, mineral and vegetable treasures in order to display the wealth of the worlds and peoples that they have conquered in this great building. These murals represent the greatness of Western civilization with stories of great white men—science and culture—told, interpreted and displayed from their point of view (Levin, 2002). While many find this hall inviting because of the expanse and natural light, I am also disconcerted by the depiction of people of color in subordination to the white explorers on horseback. I often wonder if students and teachers of color see themselves in subordination on these walls too? I also wonder if some students and teachers see the history they have learned about

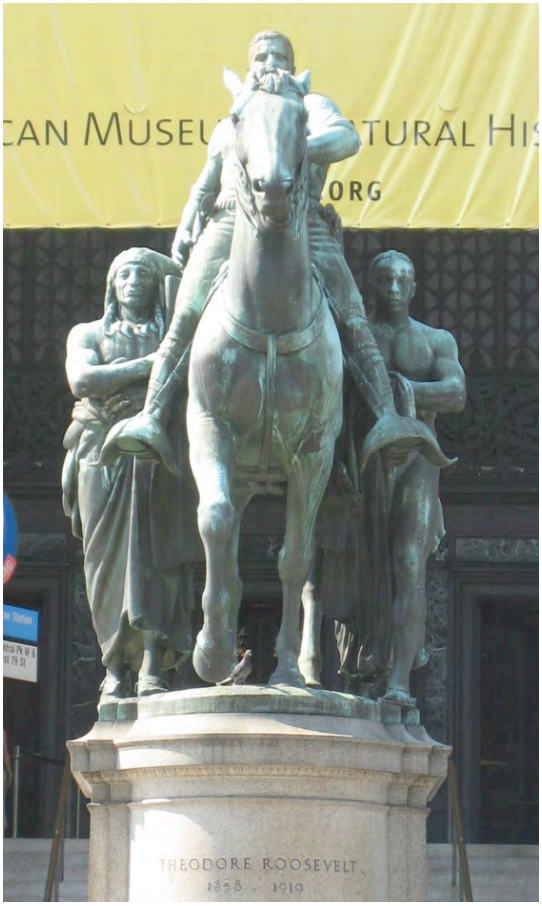

Figure 2.1. Theodore Roosevelt statue.

themselves in school reinforced on this great wall. Sometimes when I look at the statue and mural, I feel a sense of pain in the wealth and culture that was stolen from many peoples and appropriated for the advancement of the Western cause. Perhaps some people sense this same discomfort when visiting the museum on their own. In my "web of reality" the meaning that I construct from the statue and from these murals is that to the colonial Western mind, the "other" cultures seem only to be as great as the exotica that they produce (Kincheloe, 2001).

The American Museum of Natural History, a New York City and American treasure, contains a wealth of cultural and scientific knowledge both in the halls and behind the scenes. But, like many great things of our nation, there is some darkness in its past. When classes visit the classic diorama halls, we (museum educators and explainers) are quick to point out that the stuffed animals displayed were from a time when it was okay to kill and collect animals for sport. Theodore Roosevelt was known for his fondness of hunting. We explain that while random collecting is no longer practiced, we were able to gain a wealth of knowledge about the diversity of life on Earth from this past practice. The newer Hall of Biodiversity displays the range of this wealth—the Spectrum of Life wall exhibits representative specimens from each phylum of life on Earth. Individual items, which number in the hundreds of thousands, are stored as a part of the Museum's collection in their respective scientific departments. While some people are still upset by the collecting practices of the past, many are comforted in knowing that this does not happen (at least to the extent that it did back then or back in the day) in the present climate of conservation and preservation. People do not take these halls personally.

While the murals and cultural halls also contain a wealth of information about the past and important lessons for us to learn today, people take these halls personally. The Theodore Roosevelt statue offends me. Intellectually I understand that the statue and murals that depict people of African descent (and other people of color) in subordinate roles are historically constituted—they represent the ideology of the era of imperialism/colonial and racial superiority. However, for me as a person of African descent, this history is embodied and therefore seeing such monuments evokes within me a visceral feeling of oppression and pain, as if I am the individual that is on display—I cannot help but feel personally affronted when I see the culture of the main branch of my ancestry displayed and interpreted in such undignified ways. We can explain the past of the scientific halls in ways that are acceptable to folks today. How can we explain the cultural halls and murals in a way that is acceptable, if not liberating to folks today? This is necessary if we are going to continue to dialogue about using this Museum and other great museums around the city as an important part of urban teaching and learning.

Historiography

In my practice as a museum educator in science, I often use the Museum's resources to support science teaching and learning and until recently, I rarely accessed the cultural artifacts in my practice. However the cultural and historical artifacts—like the mural, statue, and interpretations of the ethnographic collections—are present and a part of the Museum's structure and therefore have implications for any teaching and learning that happens in the Museum's space. How people perceive the Museum and such objects has the ability to constrain the science teaching and learning that can occur in the museum. As an example, if a person of African descent enters the museum noticing the statue and

has a similar visceral response to mine, it could affect how she approaches the scientific objects in the Museum, for the museum has now become racialized and perhaps even mistrusted by the viewer. In addition, these racialized objects in an authoritative institution such as the Museum can reinforce the ideology of Western superiority—both in science and culture—shutting down the viewer from the opportunity for expanded agency in science as "the knowledge Western science produced became the benchmark by which the productions of non-Western civilizations are measured (Kincheloe, 2001, p. 475). I have heard of college students who were training to be explainers in one of the Museum's summer internship programs reading some of the text in the Hall of African Peoples and becoming highly offended and angry at the stereotyped interpretations of African culture. Although they continued in the program and became star explainers during that summer, I am sure that this experience affected how they viewed themselves within the Museum.

As an educator, I have had to deal with my own feelings about the legacy of racism both in my personal experiences and how those experiences are replicated in the historical display of people of African descent and their artifacts—I have had to keep a constant vigil against internalizing racism (Brock, 2005). In order for me to understand the Museum as a teaching and learning resource for all students, it is important for me to learn and understand the historical constitution of the Museum as presented in the objects and the halls. As a researcher in using the Museum as a resource for teaching and learning, I have had to reconcile my feelings of race with the history of the institution and conceive new ways of using those very objects as teachable moments to help myself and other people move beyond being defined by others—"when you define your existence

based on the ideals of others, you give them power." (Brock, 2005, p. 39). Unbeknownst to me in my oscillation between the Museum's past and present, I was engaging in historiography, which Villaverde, Heylar, and Kincheloe (2006) describe as a method to "delineate the larger constructs which inform the ways [a researcher] makes sense of the past, present, and future (p.316).

Through historiography, using the power of my individual story in relation to the objects in the Museum as well as the collective endeavor of the Museum to present scientific and cultural knowledge to the public, I have been able to change my culture in relation to accessing and using the Museum's and hopefully influence the culture of students and teachers wishing to do the same (Villaverde, Heylar, & Kincheloe, 2006). A critical examination of the historical context of the Museum can be both informative and transformative. Informative in that it helps us to understand how situations came to exist in a way that informs our actions (Villaverde, Heylar & Kincheloe, 2006) and transformative in that an understanding of these historical structures helps to develop a critical consciousness that is liberating. As hooks (1994) explains, combining the analytical and experiential is a richer way of knowing. In speaking of the critical pedagogies of liberation, by tapping into our personal experiences we can look at/analyze the societal structures that seem to continue the domination politics in such a way that gives us a "purpose and meaning to struggle." (hooks, 1994 p. 89). It can allow us to examine the social, political and economic conditions that are at odds with the individual's will to freedom (Villanueva, 1993).

Borrowing Lemke's (2001) question of "what practices, beliefs, and values constitute the culture of science/science education in a given time and place, and how

does this culture change across historic time?" as a framework, I describe the history of the education programs, the ideology that shaped the pedagogy and content of the programs and how the programs have evolved in response to the changing ideology of education and the needs of the public schools. By comparing and contrasting the education programs from the founding years of the Museum to the present decade, I will demonstrate that some of current practices are constituted in the past, however transformed to accommodate the Museum's present relationship to teachers and schools.

New Resources, Old History

Museums are often thought about in context of their physical structure—the visible and tangible resources as well as the buildings that contain these objects as these structures are often of historical and/or architectural significance. It is the dialectical interactions of objects and ideas, interpretations and ideology, scientists and the public audience. Seeing the Museum through sociocultural lenses, the Museum becomes a field—an arena of the enactment of social life. In this context, the structure of the museum expands to include invisible as well as the visible structures for which museums are renowned.

Using the word "culture" in reference to the museum can have different connotations. It can refer to the ethnological display of cultural artifacts from around the globe, or it can refer to "high culture" and the association with visiting museums with Eurocentric, elite culture (from the history of museums as being places to display collection by and for members of the elite class (Melber & Abraham, 2002)). While both of these definitions have implications for discussing the history of the museum as well as the museum as a resource for teaching and learning today, this chapter uses the sociocultural definition of culture as a system of schema and practices enacted in relation

to power and structure within a given field (Kress, 2005). Culture gets enacted in a field and is responsive to the visible and invisible underlying structures. While the visible structures of a museum are obvious in presence of the building and the object that it contains, the invisible structures have to be described and theorized. Anthropologist Miriam Kahn's (2003) notion of third space could be used to describe the invisible structures in a field; "everything takes place in this lived space, a space that is active and reactive, fluid and dynamic, open and expansive." (p. 308). Kahn (2003) sets up the third space as a dialectic of perceived and conceived space—a space that is at once realized and imagined. She continues to describe the space as "simultaneously past and present, physical and mental, immediate and mediated." These intangible structures shape and enable the activity that takes place in this field, including the teaching and learning that can be enabled or constrained based on one's perceptions of the museum. In this chapter, I will bring to the forefront the past or history that simultaneously is present, as the history of the Museum is always present—both in visible structures, such as the old dioramas and invisible structures like the "spirit of the institution" as I quoted Osborne (1927) at the beginning of this chapter.

Historically, the museum has always been a place for the acquisition of new objects and the production of new scientific knowledge. A defining characteristic of a cultural field is that it is dynamic and changes as new resources and culture gets enacted in the field. Throughout decades of the Museum's existence, it has been a place were people both visitors and scientists, come into contact with new resources. Whether it is seeing a new object, or learning new or different science content through observation and/or research, the Museum has always been a source of science-related interactions

between objects and people. As a cultural field, these interactions lead to the re/production of culture. People also bring culture into the museum that gets enacted in the halls, in the classrooms, and behind-the-scenes in spaces like the scientific labs. This enacted culture subsequently changes the structure of the Museum. A culture that I enact is viewing the Museum as an ideological space—a space that represents the ideas and interpretations from a culturally specific point of view being that of Western civilization. This is implicit in an early statement about the role of the Museum—early Museum leaders saw the Museum as having the important social conviction of bringing nature to those who were not able to get out and experience it for themselves, "very few people, even among those who have the means to travel, really see nature in the sense of understanding it, and to the millions within the cities, nature is practically unknown, so we [museum scientists and exhibit developers] are *interpreters"*(emphasis mine). (Osborne, 1927, p. 269). It is curious that this contradicts another statement by Osborne (1927), "the peculiar teaching quality of a museum is that it teaches in the way nature teaches, by speaking to the mind direct and not through the medium of another mind" (p. 281). Osborne omits the role that interpretation plays in "speaking directly to the mind." Perhaps this is because in agreement with the notion of science as being objective, the study of nature as a science is objective and therefore any interpretation of nature is unbiased. However I view interpretation as culturally situated –a selective activity as it is the interpreter who decides what information gets conveyed and the interpreter as a cultural being is not free from an ideological bias. As a public space, the Museum could be a space to begin the discussion about this ideology and as it has done in recent decades

with culture, it can bring to the forefront the notion of having different interpretations and explanations of scientific data and phenomena.

Practices, Beliefs, and Values of Science and Science Education in the Museum

The Early American Museum

Figure 2.2. Peale's museum.
Reprinted from Virginia Center for Digital Literacy, University of Virginia

Charles Wilson Peale, a portrait artist, naturalist and collector, opened the first museum in America in Philadelphia in 1784. In contrast to the museums in Europe of the time, Peale's museum was a "secular temple" where the "most perfect order in the works of a great Creator…" was displayed. Arranging objects in context—stuffed animals posed against painted backgrounds, wax figures dressed in traditional clothing—Peale wanted visitors to leave his museum "happily amused and certainly instructed." Figure 2.2 shows Peale dramatically revealing his temple with a welcoming hand, but daring gaze as if he

is saying to enter at your own risk, which leads me to ask, what would one risk if they should dare to enter?

In keeping with the culture of social efficacy movement of the time, Peale's museum inspired citizens through, "charming models for every social duty…" rendering man "more content in the station where he is placed" (Levin, 2002). This was the very beginning of the American museums' movement into "edutainment" where "how people felt about their museum experience was given equal status to what they learned"(Levin, 2002). According to John Cotton Dana, the founder of The Newark Museum, "a good museum attracts, entertains, arouses curiosity, leads to questionings—and thus promotes learning." (Dana in Peniston, 1999).

Subsequent American public museums were funded by philanthropists, such as Field, Bishop, Peabody, Carnegie and Smithson, several of them including objects from their personal collection in their Museums (Melba & Abraham, 2002). As Melba and Abraham (2002) noted John Smithson's will desired that his "worldly goods be used to 'found at Washington an establishment for the increase and diffusion of knowledge among men'." (p. 46). These public institutions enabled a wider range of people to view objects that were once reserved for the elite class—beginning the democratization of American museums. The American museum was to be an egalitarian place welcoming all classes of people with objects and displays that were somehow connected to their lives. In a natural history museum this meant displaying objects and exhibits that connected the visitor's history to the natural history of life on Earth.

The Tradition of Collecting and Classifying

The early museums evolved from the cabinets of curiosities that were often objects from the private collections of the elite class. Peale, as described above was one such collector. As tools of empirical research, possessions of a diversity of objects raised the social prestige of the owner (Müsch, Rust, & Willmann, 2001). These objects—both science and cultural artifacts—were collected from travels and expeditions around the globe, most of the objects originating from European colonies, such as East Africa and parts of Asia. With these objects from the far corners of the globe, the early museums attempted to produce an overall picture of the world (Müsch, Rust, & Willmann, 2001), and formed heterotopias—combinations of different places as though they were one (Kahn, 1995). Humanistic in thought the cabinets and the subsequent Museums aimed to achieve "a comprehensive encyclopedic archive and repository which will yield a total knowledge" (Kavanagh, 1991, p. 104). In other words these collections would reveal the truth about nature and human existence. These collections and early museums were also meant to spark inquiry by putting people in contact with real objects of science and human culture from around the word.

Kahn (1995) notes, "all museums are exercises in classification and it is precisely from their position as "classifying houses" that museums become institutions of knowledge and technologies of power." (p. 324). As classification is an *interpretation* of characteristics and the creation of categories based on these interpretations, these practices reflect a specific ideology of science that is based on a Western, Eurocentric notion of science. To science and the Museum, classification is a way of knowing. It is a way of naming, describing and categorizing living things as a means of creating a

catalogue of life on Earth. This is also the case for the science of anthropology and the Museum, as classification becomes the means by which human culture is characterized and grouped. This is important to keep in mind in examining the history of the Museum's education activity as the Museum presents a culturally specific way of seeing the world, which often conflicts with other cultures that students and teachers bring into the Museum.

The Founding Decades of the Education Department at AMNH

Western Science Ideology and the Museum

According to Swartz (1997) even science itself—"self-proclaimed highest expression of objectivity"(pp. 117-118)—is produced within the framework of a field, in other words, science is a culturally produced phenomena in a field where the struggle is for control knowledge. According to Spears (personal communication, 7/16/2006) it is by historical accident that the leading practitioners of science are located in the "West," therefore the science that is produced will be ideologically slanted to support the vested interests of Western European dominance (Kincheloe, 2002). Kincheloe (2002) describes science "as a force of domination, not because of its intrinsic truthfulness but because of the social authority (power) that it brings with it." (p. 476).

Villanueva (1993) describes science as a "modern folklore" conscripted into the service of hegemony. Defined, as ideological domination by consent, science, or at least the hegemonic view of science, which is often represented in museums and other institutions that exist in "civil society," is a part of the modern folklore that needs to be exposed. Science is a culture and language is a means of transmitting culture (Falk, 2001). Perhaps we can help our students to create a language that will allow them to

question the Western hegemonic worldview of science. Only by framing the [science] museum experience within the larger context of an individual's life can one begin to truly understand the nature and impact of that experience (Falk, 2001).

I often argue with a friend/colleague of mine who is also a scientist at the Museum about the so-called objectivity of science. I argue that if science is culturally bound, the science that we study and present in the Museum is based on Western culture and ideology and therefore not the only truthful way of describing and explaining the natural world and that there are many different things that could be accepted as fact. She, on the other hand, who is acculturated into the Western ideological science through her training (although she is Latina, but Argentine), believes that there is only one objective truth and science provides that objective truth. She has bought into the perception of the objectivity or neutrality of science—science is science no matter whom it is practiced by (Prakash, 1999, p. 160). To her, as a systematist, it is her job to describe and classify living things; there is only one universe to describe and science is a universal experience. To me the post-colonial, postmodern, creolist thinker, there is one universe, but multiple ways of describing it and therefore *all* of them are true.

Although museums are described as democratic places, they are sites for the creation of a science ideology, and they help to mold much of what we understand about science (Vackimes, 2003). According to anthropologist Sophia Vackimes (2003), "science museums in the United States have remained attached to merely presenting materials as wonders of nature or as technological feats" (p. 8)—leaving out the cultural situatedness of the interpretations (as written in the text and/or communicated by scientists) of these wonders and feats.

The American Museum of Natural History was founded on the ideologies and power of the dominant culture. As the term *founding fathers* suggests, the Museum was patriarchal in its position of power and authority over the knowledge of science and the natural world. In its position of power, it presented a culturally specific way of seeing the world. According to Kincheloe (2002) it is important to understand science as a "social construction, produced in a particular culture in a specific historical era." (p. 472). The Museum as a scientific, cultural and historical institution has been shaped by the dominant ideology on which it was founded. In next section I describe some of the early programs of the American Museum of Natural History's "service to schools."

The Founding Years

The American Museum of Natural History is one of the oldest of its kind in the United States. As with other American museums, the American Museum of Natural History was founded with the "notion of public education clearly in mind (American Association of Museums 1984, p. 55 in Melba & Abraham, 2002). As clearly indicated in the mission statement the American Museum of Natural History aimed to make the education of the public central to its operations.

> The American Museum of Natural History founded April 6th, 1869 for the purpose of establishing in said city a museum library of natural history; of encouraging and developing the study of natural science; of advancing the general knowledge of kindred subjects, and to that end of furnishing popular instruction. (60th Anniversary Endowment Fund, 1930).

The Founders saw the importance of conveying to the public the great work and discoveries of the Museum's scientists and collecting expeditions. One of the founders who continued to make his mark on the development of the Museum's education programs was Albert S. Bickmore. When the Museum opened its doors in 1878, Morris

Ketchum Jesup was the President and Bickmore served as Superintendent of the Museum. A successful administrator, Jesup saw the value of the Museum's content as going beyond a monetary value, and it was his belief in the ideals of science and his desire that "they should be brought within the comprehension of all classes of people." (Osborne, 1911, p. 29)

> The value of what you have already accumulated in your halls rises to a large figure commercially, but it is a difficult task to estimate the money value of what belongs to science and scientific institutions. To their values must be added their ameliorating power, their educational force, and the scope they afford the higher faculties of man to apprehend the wonderful phenomena of Nature, and to master and utilize her great forces. (from an 1884 administrative report in Osborne 1911)

Jesup and the Board of Trustees initiated a series of exchanges that led to the official establishment of the Department of Public Instruction; which was officially constituted in the year 1884. In this Department would be, "all those features of the Museum which are instrumental in articulating the work of the Museum with the public at large and *especially with the educational system of the City"* (emphasis mine) (Osborne, 1911, p. 116). Through the creation of this Department, the vital link between the City schools and the Museum was established.

In 1880, the State Department of Education enthusiastically approved the Museum's proposal to offer a series of lectures to Primary School teachers and principals. Thus, in January 1881, Bickmore began a series of lectures in zoology and natural history; establishing him as the Museum's first public educator. In 1884, grant money from the State Department of Public Instruction was appropriated "to establish and maintain a course of free lectures to the teachers of the common schools of New York City and to the teachers of the common and normal schools throughout the State, who wish to avail themselves of this training." (Quotes from the grant proposal in Osborne

1911). Professor Bickmore was appointed as the Museum's first Curator-in-Chief. The school year of 1884 was greeted with ten lectures on physiology, zoology, and botany in a course of study presented by Professor Bickmore.

The Bickmore Slides—Providing a Resource for Teachers and Schools

Serving as the first curator of the Department of Education, Bickmore is credited with developing a series of lanternslides and lectures on natural history for public school teachers. Inspired by his youth, growing up in the woods of Maine, Bickmore felt that, what he called "the visual method" of education was a vital way of allowing students and teachers who don't have access to nature to be able to see and make observations and connect with the natural world. In 1895, the State issued an act to provide "The Visual Instruction Method" to common schools in the State, accordingly the access to Bickmore's lectures was far reaching. For the lectures and distribution, Bickmore reproduced "lantern slides" from the best photographs taken on the Museum's famed expeditions. Bickmore himself traveled to "remote lands" of the world in order to gather information and take photographs. He also collected negatives from world travelers, "there was not a traveler of note who came to New York, whom he did not seek out and ask for negatives." (Sherwood, 1927, p. 317) Teachers were allowed to pick and borrow from these slides. Professor Bickmore's slides, some of which were "beautifully colored," served as the basis on which the Museum's lanternslide collection was developed. These lanternslides later served as an important piece in the Museum's service to New York City public Schools.

Bickmore served as the curator of the Department of Education until 1904. During his leadership, the Department's service focused on instruction for teachers. This

instruction included evening lectures on natural history, geography, and industry supplemented by the Bickmore slides. He officially retired in 1906 due to failing health, but his special collection of lanternslides known as the "Bickmore Slides" continued to serve thousands of students and teachers.

The Museum Connects to the School Curriculum

During time of the establishment of the Museum's education services, the New York City public schools were under the leadership of Superintendent William H. Maxwell. Described by Cuban (1993) as a pragmatic school reformer, he is credited with establishing a broader and more uniform curriculum in the public schools. He sought to give the City's children as many educational opportunities as possible and was against reformers who compared the education of children to that of manufacturing industrial goods (Ravich, 2000). He expanded the role of the public school by adding afterschool programs and services for kids with disabilities. It is interesting to note that Maxwell also served as the chairman for the Committee of Fifteen where William T. Harris was the head of the subcommittee to deal with correlation of studies—a committee established with the goal of creating a common curriculum for New York City public schools. This Committee championed the cause for a humanist curriculum "constructed around the finest resources of Western Civilization" (Kliebard, 1987, p. 17). Nonetheless, Maxwell's reforms influenced the services provided by the Museum to the public schools, and Maxwell's administration heartily endorsed the Museum's service to public schools and since the City increased its financing of the Museum's operations (after the State withdrew financial support in 1904) the Museum felt that is was "proper…to give its attention, first to the needs of the City's schools…" (Sherwood, 1927, p.317). Spurred on

by a request from the New York City Teacher's Association, the Museum commenced a series of lectures to school children in supplementation of classroom work in geography, history, and natural science.

A nature study curriculum for elementary school was established as part of the City's curriculum reforms. The Museum was able to supplement this curriculum with the oldest, and at the time the most extensive aspect of its service to schools—the circulation of its nature study collection. Wooden cases containing representative specimens of various animals, such as mammals, birds, and insects, and samples of minerals and woods, as well as public health charts and exhibits—were made available on loan to schools. They were designed so that the specimen could easily be removed and handled by students. Also available were Museum-developed mini-dioramas called "habitat group types." One example, "Birds that are Our Friends" presents a group of native birds, including a Screech Owl with a mouse in its beak displayed against a painting of the natural environment and types of trees and plants that would be found in the habitat. The nature study collections were accompanied by literature describing the animals and their relationships to each other and to humans as well as a bibliography of popular books on the subject. These teaching tools were available, free of charge, on loan to schools. This loan program enabled the close contact to occur between the education department and teachers; this led to the Museum's greater understanding of the needs of the City's schools.

The Sherwood Era: Expanding the Museum's Service to Schools

In 1906, George H. Sherwood, began his service as Curator-in-Chief of the Department of Education. Described as a practical teacher who believed that the "training of children

is the most important vocation in the world," (Sherwood, 1927, p. 320) under Sherwood's leadership the Museum developed a comprehensive service to the schools. The scientific departments of the Museum provided the content for the education programs. Sherwood believed that "it is the function of the department of public education to digest this material and to present such portions of it as will be useful to teachers and pupils." Sherwood (1927) distinguished two main branches of the Museum's service to schools; one designated as extramural—services that occurred in places out side of the Museum and included the previously described lantern slide service, the circulating nature study collections to branch libraries and branch schools, both began in 1904 and 1914 respectively. The distribution of films, and lectures in the schools were also included in the extramural services. Special exhibits where made available for loan to public libraries. The primary purpose of these exhibits was "to stimulate children to read good books." (Sherwood, 1927, p. 329). These exhibits included specimens such as animals, artifacts and industrial models that could be used to illustrate books on travel, geography, nature study and a host of other subjects. The intramural branch—services that took place within the Museum, included lectures, a service for blind students, and instructors in the exhibition halls. Of the lantern slide service, Sherwood believed that "the use of the slide in the classroom and assembly simplifies the teacher's task and enables the pupil to absorb information more quickly and permanently" (Sherwood, 1927, p. 327). Sets of slides of curriculum topics were developed and accompanied by lecture manuscripts enabling teachers with limited preparation time to use the slides with minimum effort.

Sherwood found the nature study collections most valuable to teachers and students. He recounted teachers who have found them useful in teaching facts about

nature and doing language work, particularly with teaching English to foreign-born students. He believed that the greater service was "giving city children a glimpse of the great outdoors" (Sherwood, 1924, p. 272). Many of the children at the time rarely left the city and had almost no references to the great outdoors. Sherwood illustrated the urgency of this matter in the following example:

> The class was reading a poem dealing with the "signs of spring," daffodils, frogs, etc. The children did not comprehend the meaning of the phrase [signs of spring]. Finally, the teacher asked how do we know that spring is here. Johnny was the only one who raised his hand. "Well, Johnny, how do you know that Spring was here?" "Because I saw them hanging the swinging doors on the saloons." Certainly the nature study collections from the Museum helped to give Johnny a new conception of spring. (Sherwood 1924, p. 272)

Sherwood (1927) described these exhibits as having the ability to "awaken the spirit of research" and encourage students and their families to visit the Museum and go back to the library for further reading. Sherwood (1927) mentioned that this program formed the basis of cooperation between the libraries and local schools, in other words, this initiative brought the Museum to the community and made it accessible to those students who could not afford to visit the Museum. As a part of its extramural services, the Museum also provided lectures to schools, but due to limited staff, these mainly took place in centrally located schools where kids from surrounding schools could visit and have the benefit of a quality Museum lecture, supplemented by slides and specimens from the education collection, without expenditure of carfare. Again this points to the importance that Sherwood placed on accessibility to the Museum—a very serious matter in many families (p. 329).

In 1926, over 170,000 students and teachers attended lectures at the American Museum of Natural History. As a part of its intramural activities, these lectures provided

a valuable resource "designed to supplement the work of the classroom teacher, not to replace it" as Sherwood mentioned on numerous occasions (e.g. Sherwood, 1923). Using the New York City public school curriculum as a guideline, these lectures were designed for elementary students and dealt with topics primarily in history, geography and natural science. They were illustrated with the lanternslides and corresponded, whenever possible with exhibits at the Museum. Upon questioning the value of the courses, Sherwood found through testimonies from teachers that they were truly valuable. One teacher even asked for the unused lecture programs, which she distributed to her students who took them home. This sparked interest in the parents of the subject matter, one mother expressed that the Museum lectures so inspired her children that they could not stop talking about them and consequently "they all gathered around the table at home to read the story books based on the Museum lectures." (Sherwood, 1927, p. 331). For the high school students, special lectures were given during Regent's Week on biological topics after which the students were sent to the exhibition halls with questionnaires for further study.

Through a special endowment, the Museum dedicated a special branch of its work for the education of blind students in the New York City public schools. Under the guidance of a special Supervisor for the Blind, the Museum's visual education program was adapted to the needs of the students. The students had the opportunity to listen to lectures and touch the specimen from the nature study collection. "The results from this work is gratifying," Sherwood (1924) wrote, "often they are read in the children's happy faces." And delight was written in the essays from the children based on the lesson. One teacher wrote of the impact the trip had on her students:

> Children of little experience in life and meager opportunity for general information speak with ease and familiarity of animals, birds, people and customs.

> You can scarcely realize to what extent you are broadening their horizon (Sherwood, 1924, p. 272).

The Museum provided a service of instruction and guidance in the halls. If a school booked a trip a few days in advance, they would have the benefit of an instructor to teach their class in the hall. These instructors were also present in the halls during opening hours to interpret exhibits to schoolchildren and visitors.

Recognizing the value of the Museum's service to schools, in 1909, the City's Board of Estimate and Apportionment designated funds, which provided for the construction of the School Service Building. This structure would provide the facilities for organizing the slide, collection and film distribution services as well as providing a space for classroom work and other intramural activities. This building, according to Osborne, would provide the means to accomplish what he describes as the chief public mission of the Museum, "to bring the wonders and beauties and truths of Nature from every land and every sea, to exert their broadening and uplifting influence." (Osborne, 1923, p.3)

Original Observation is a Force in Creative Education

Henry Fairfield Osborne

Henry Fairfield Osborne was appointed as President of the American Museum of Natural History in 1908. An eloquent and prolific writer, his theory of "creative education" facilitated lasting changes in the presentation of Museum exhibits that in turn influenced the Museum education pedagogy.

At a first glance of Osborne's creative education theory, one could easily think that Dewey influenced him. His theory situates the learner in an active role in her

education and the teacher as the one who provides the experience for the learners to explore and discover her interests:

> *The factors of education* (emphasis his) are the processes of storage of these forces by cooperation of teacher and student, the former with his constantly diminishing, and the latter with his constantly increasing. (Osborne, 1927, p. 311)

Osborne based his assessment of his students on "inherent interest of the subject" believing that "once captivated by the subject, a student needs to be held back rather than pushed forward!" (Osborne, 1927, p. 309). During his years as a professor of comparative anatomy at Princeton University he stated that he had practiced creative methods before he thought it into theory. He taught experientially and used objects in the classroom to demonstrate concepts—he taught the way he best learned. It was through his reflection on his own learning and teaching that he realized that the basis of education was built on seven principles which are essential to the "creative and productive mind," truth, beauty, learning, observation, reason, expression, and production. "The principle of seven cardinal elements of education is my own," he stated, "it is the product of fifty years of experiment and observation as a teacher, not by reading what other people have written about education." (Osborne, 1927, p. 311)

Osborne saw the Museum as a great silent teacher, "…every specimen, every exhibition, every well-arranged hall speaks for itself" (Osborne, 1927b, p. 240). During his tenure, he placed an emphasis on exhibit design and hired artists and sculptors to express the beauty found in nature in the Museum's halls. He described a successful museum teacher as being "one who is able to teach without speaking, as nature teaches, or as art teaches."(Osborne, 1927b, p. 235) Louis Agassiz, a Swiss scientist greatly influenced Osborne in his theory. He often quoted one of Agassiz' favorite mottos:

"Study Nature not Books." Osborne's professor of comparative anatomy, Agassiz believed that his students should make all of their direct observations on a specimen *first* before consulting a teacher or textbook. Osborne transferred this philosophy to the Museum where he paid great attention to the arrangement of the exhibits and the halls, so to inspire people about the way that nature does and to encourage them to study nature further. Osborne saw his exhibit designers as educators, and the exhibits and halls as the strongest part of the visual instruction method of the Museum. He wanted the Museum to be a place to "bring a vision of the world to those who otherwise can never see it" (Osborne, 1927b, p. 244). Osborne made exhibit design and school and public instruction central to the job and functioning of the Museum.

The Museum in Service to the Disadvantaged

Altruistic in tone, the early education programs focused on recreating experiences with nature for those who do not have opportunities to get out and see it for themselves. Photos from this era often depict poor and immigrant students utilizing the Museum's nature study programs. Figure 2.3 shows a group of the underprivileged, "children of little experience and meager opportunity for general information" (Sherwood, 1924)—a group of mostly African American students observing objects of nature. The idea was that these students would be uplifted through having the experience of seeing and touching these natural objects. There was little idea of them interacting and bringing their personal experiences to bear in their interactions—according to educators at the time, these children did not have any valuable personal experiences.

Figure 2.3. Children studying nature in the Museum.

The example of Johnny and "signs of spring" from the previous section clearly presents the devaluation of students' lived experiences in comparison to the view of nature that the Museum had to offer. Johnny's practical knowledge of signs of spring (swinging doors present on the saloons) was subjugated to the daffodils and frogs present in the nature poem. For Johnny's urban life, he did not need to know about nature's signs that spring has arrived for it had no bearing on his day-to-day experience. Knowledge of daffodils would not impact Johnny's survival, although it may give him an alternative (though not necessarily superior) view of what spring means.

Visual instruction and observation were the prevailing themes in the programs outlined in the Museum's early offerings for schools and teachers, however it was assumed that students and teachers would be enlightened and learn just from being able to see the objects. There was no notion of learning with objects as an interaction between the viewer and the objects and less about the social interactions that occur and influence learning in the museum setting. Osborne's philosophy of creative education came close to personalizing the museum experience, however it fell short including the interactive/participatory aspect of learning. It was his assumption that nature would inspire and this inspiration would lead to learning.

Consistency and Change

As a lived space the Museum is simultaneously past and present. When I visited the Museum's library looking for pictures that I might include in this chapter, I came across the photo in figure 2.4 of a colleague who has been a botany lecturer in the education department since 1956. "Wow, look at him, his posture is still the same," another

Figure 2.4. Botany lecturer with a group of teachers in 1956.

colleague noted, referring to his position between the diorama and the teachers, slightly off to the side while pointing and gesturing towards the diorama. She added, "it is the same but the way he talks about the diorama is different." Figure 2. 5 shows our venerated colleague, in his same position with a recent group of teachers. My colleague and I have noticed that over the past 7 years his interactions with the diorama and the participants has changed from mainly lecturing in front the dioramas to asking questions

to draw the participants into carefully observing the diorama and noting their thoughts and insights.

Figure 2.5. The same botany lecturer in front of a group of teachers in 2006.

Osborne's philosophy of creative education stressed original observation. We call it inquiry or investigation, however it is still central to the teaching pedagogy of the Museum. Central to our professional development is observation and recording—methods that scientists use during their work. We teach teachers how to make rich observations and keep a journal or science notebook so that they can pass on the knowledge to their students. Teachers could teach their students how to make their own rich observations as well as share what they learned from doing their observations. Observation and the visual method of instruction are still alive and strong with what we

do at the Museum, from the exhibition staff, to the education staff, we all teach people how to observe first, and then search for facts.

Education in the Museum: The Present Decades

In a 1911 address to and audience of school teachers of New York, Osborne stated, "the future ideal for the Museum is to provide at no cost[2] a little journey on this planet and among the heavens beyond it" (Osborne, 1927, p. 268). Today, the Museum has grown in both in size and scope from its early decades of educational programs for students and teachers. With the openings of new halls, such as the Hall of Biodiversity and the Hall of Planet Earth, the Museum endeavors to put the public in contact with cutting-edge scientific discoveries. While the basic pedagogy of learning with objects remains intact, recent research about learning with objects and in museums has great bearing on how the information in the halls is presented to schools and teachers. It is now understood that it is the *interactions*—that of the object and learner, between learners, and of the learner and the space—that make the learning experience in a museum unique and motivating.

Framing learning from objects within the framework of distributed activity, Rowe (2002) situates objects within the network of human cognitive activity citing that "individuals solving problems or interacting with objects alone retain traces of those social origins [the social distribution of cognitive activity] (p. 21). Learners coming to a museum are bringing hosts of personal experiences that will influence the how and what

[2] Presently New York City public schools get free admission to the Museum, including certain special exhibits. Unfortunately the "no cost" is not extended to families—the present cost (although the fine print at the admission desk says "suggested admission") for visiting the Museum is prohibitive for many families of students who attend the City's public schools. Additionally, the suggested admission does not cover the cost of "a little journey...among the heavens beyond [this planet]; to see the Space Show or other special exhibits, the family would have to pay the cost of admission and the additional cost for the show.

they learn from the objects on display. Using the diorama as an example each viewer may be attracted to a particular part of the diorama—one may focus on the plants because she is a gardener, while another may scrutinize the background scenery because he likes art.

Falk and Dierking (2001) describe the type of learning that occurs in museums and other similar settings as free-choice learning. It has the characteristics of being nonsequential, self-paced and voluntary and accounts for the social nature of learning—the interaction of the individual with his or her sociocultural and physical environments. In their contextual model of learning Falk and Dierking (2002) highlight four realms that interact when one is learning in an informal setting—the physical, social and personal contexts and time across a lifespan. This comprehensive view of learning recognizes the situatedness of learning in a museum; that there are different interrelated events—conversations, interactions, physical space, as well as individual processing—that occurs in the process of learning or meaning-making in a museum.

Lave and Wenger (1996) describe learning as becoming a different person with respect to the possibilities enabled by a [new or expanded] system of relations. One main focus of the present years has been to educate teachers on how to use the resources of the Museum for teaching and learning. This enables the teacher to move from being a passive recipient of the Museum's resources/knowledge to an active participant in the museum education community. It enables a teacher to become familiar with the Museum's schema and resources from participation in the museum's programs thus, feel confident in her ability to use the museum as a resource for her classroom and her own learning. According to Lave and Wenger (1996) "Learning is a process that takes place in a participation framework, not in an individual mind," thus the teacher/learner in the

museum becomes a part of the museum community and part of her identity as a science teacher is based on her participation in this community—the teacher becomes a member in the community of educators who access and effectively appropriate the resources of the cultural institutions. It is this notion of teachers as partners in education (rather than recipients of a service as in the Museum's programs of the founding decades) that have shaped the current relationship of the Museum to schools and teachers.

An Era of Partnerships

Partnerships put the Museum's education goals in a position to be transformed by the schools and classrooms that it aimed to serve. The Museum could no longer be the silent teacher but rather Museum educators would have to extend and transform their practice to suit the needs of the classroom by developing programs that were responsive to standards and assessments. Museum educators would mediate (rather than interpret) the learning that took place with objects and in the halls. Partnerships afforded an exchange of cultural resources between the Museum and schools—the Museum's artifacts, scientific and human resources were exchanged for the school's resources of curricula, learning standards, and extended contact with teachers and students. The present Director of Professional Development notes that partnerships with schools, "give us, as a museum, the opportunity to really understand how a museum can help schools. We deal with the standards and assessments that are guiding schools so we are more connected to what schools need and do. It teaches us how we prepare ourselves to really help schools over the long haul. We are looking for evidence that we can actually do things for schools." In paying attention to the needs of students and teachers in the partnerships, the Museum was afforded the opportunity to transform its teacher education programs.

"Museum as a resource" is a notion or phrase that school-based educators often use when they refer to the use of a museum for schools. As a co-founder of one of the partnership schools noted, "museums are repositories of both the natural world and of the history of humanity are incredible resources" (Musings, 2001). It is a perception held by many school-based educators that the Museum is a resource to be taken advantage of, but in order to effectively use it, special tools and culture is required to access and appropriate it as a resource. It is also believed by Museums that its role is to be of service to schools as a resource and that its value in education was exposure to the collections that it did not have to do anything to mediate between the collections and the schools in order to ensure a salient learning experience. Partnerships changed the structure of both the Museum and the schools in that it enabled classroom teachers' access to the schema and ability to effectively use the resources to suit the needs of their classrooms while realizing that the Museum needed to extend its practice to educating teachers how to teach in the halls if it wanted to extend its reach in its educational relationship to public schools.

The Museum School—The First Partnership

In the 1992/3 Annual Report (1993), the Museum's education department wrote as its goal:

> To have an individual come away from his or her visit to the Museum with a greater comprehension of the complex ecological issues confronting the world as it approaches the 21st century…major objectives that underscore the department's systemic change initiatives are improving teacher education in natural history, thereby facilitating an understanding of scientific endeavor."

Use of the word *understanding* in this statement indicates that the Museum as an institution realizes that it has to do more than just present content. As a facilitator (rather than silent teacher) the Museum has to engage/initiate the learner in the practice of science thus facilitate an understanding of science as a process and not a static entity.

With this stated goal, the Museum began its partnering relationships with public schools. The first initiative was dubbed The Museum School. It was created with the goal to "create a unique inquiry natural history education model for middle school students and their teachers" (Annual Report, 1992/3, p. 63). This initial partnership included 90 6th grade students and 18 teachers from a local middle school (IS 44), the local community school district (CSD #3) and New York City Public Schools. Teachers in this partnership collaborated with Museum educators on creating units that were Museum-based and connected to the learning standards and lesson topics for middle school. Classes in this partnership experienced "weekly museum sessions using constructivist and cooperative learning theories to investigate intricate natural science concepts." (The American Museum of Natural History, 1992/3).

The Museum as a Classroom

The Museum School was a partnership with AMNH and several schools whereas The New York City Museum School (NYCMS) was a partnership with one school and several museums designed to take advantage of the array of museum resources in the city. Established in 1996, the NYCMS started with an Empire State Partnership[3] grant as

[3] ESP is dedicated to identifying, supporting and developing practices in collaboration between cultural organizations and schools.

a part of the New Visions Schools[4] initiative and was designed "to take full advantage of museums, both as classrooms and as models of learning environments with a goal to equip students to be lifelong learners," according to the co-founder of the school. The partnership with AMNH was meant to strengthen the science portion of the program. It was unique at the time in that it was based on a module system that allowed classes to spend an extended period of time in the Museum on a particular topic, affording in-depth study of science. The collaborating museum educator described the mission of NYCMS as "to give the students the opportunity to visit the museum, have an extended period of observation, to synthesize, to question, to research—goal is just to provide an alternative opportunity to learn a curriculum—using the galleries and resources as an extended classroom." The collaborating science teacher adds, "to get all students [the wide range of income and ethnicity] interested in the museums and to get them excited about learning in museums, learning and being there, black kids from the projects etc. to get the whole range excited in learning about the museums and learning in museums."

The middle school modules are 9 week units based on a topic or theme. Students visit AMNH twice a week for 2.5 hours where they do activities both in the hall and in one of the Museum's classrooms. The science teacher and museum educator plan each module and there is an end-project embedded in each unit. The high school grades use the partnership to study science content for their Regent's classes. Their visits to the Museum were not as frequent as the middle school grades. The school educator cites the State assessment as being a problem and conflicting with the pedagogy of the school,

[4] The New Visions schools are small, community-based, theme oriented schools developed with the main goal of improving student achievement. The schools emphasize student-oriented instruction and alternative assessments and are allowed to select faculty whose interests and skills match the mission and purpose of the school.

> "Yes, [State tests are a problem], [unfortunately] I teach to the test. I am morally and philosophically against tests (said with emphasis)…[due to the partnership] not enough time is devoted to skills building [for success on the State exams]. Ten periods in the Museum [a week], those are time away from skill building, they have not even four periods of math a week and expected to take the same test that others spend more time."

Therefore, although the school emphasizes alternative assessment, due the macrostructure [DOE policy] that the school is beholden to, there must be accountability to the mandated standardized tests. This creates a contradiction in the school (and teachers) of wanting to emphasize extended observations and science inquiry in tune with the culture of science in the Museum while having to dedicate time to classroom-based test taking skills practice for success on the standardized tests.

Cultural Enactment in the Museum and in the Classroom

The culture associated with practices in a field can be enacted in other fields, partnerships between the Museum and the school afforded the exchange of schema and practices. Collaboration between the Museum and the school is key to the success of the partnership, which enables the exchange of culture as museum and classroom educators have to become efficient agents in both fields. As the collaborating museum educator mentioned:

> [In the traditional high school] I found teaching to be a solitary experience, you close the door, do my thing in the classroom, and with the exception of the occasional observation I would not have any real feedback. At NYCMS and here [AMNH], I have had the opportunity to do collaborative teaching over an extended period of time. The single most important thing is the ability to collaborate, not only to plan with but also to be in the room with another teacher and be able to reflect with another teacher who has been in the classroom with me. It is shaped by AMNH now, I can collaborate with my partner teacher, but I find it easy to seek out opinions from others in the museum who are not working with me. The opportunity for me to collaborate has increased here [at AMNH].

As museum educators and school educators work in different fields, the exchange of capital and schema occurs and thus transforms the respective fields. The museum educator in the partnership noted, "Anytime you are in a collaborative experience you will pick up ideas, everything is collaborative and has played a big role in my pedagogy. Seems like a very important piece, played a significant role in my growth as a teacher."

In the 2001 interview, the co-founder of the school mentioned collaboration as central to the school's mission. "Teachers and museum educators work together and share their expertise." This collaboration between teachers serves as a model for students as they collaborate with their peers on projects. It is interesting that it also reflects the working practice of scientists in the Museum, as collaboration is an essential element in what they do. In a recent meeting between scientists and educators to discuss the work of a scientist and implications for revising a science investigation process for students, the scientists highly recommended that students work in groups because this is what they do.

A New Field of Museum-based Resources for Schools: Urban Advantage

In a recent partnership, the Museum and six of the City's science-rich cultural institutions have partnered to make the resources of these institutions accessible to teachers, students and their families. A primary goal of Urban Advantage was to have students use the institutions to complete their Exit Projects—long-term science investigations required for successful completion of middle school. Although each of the partnering institutions has its own history of service to and collaboration with schools, the new field created by Urban Advantage afforded system-wide impact of availing the resources of the science-rich institutions to the schools.

The Urban Advantage partnership began during a time when the structure of the New York City Department of Education was transforming to meet the federal No Child Left Behind mandates. Literacy and math became the central focus of instruction, relegating science to a secondary position of teaching and learning priorities. Ironically, the central administration of the Department formed a science department, dedicated to science teaching and learning and hired a director of science for the first time in its history.

As the new department of science and its new director were struggling to reprioritize the teaching and learning of science in the city, the UA partners had to plan the structure and content of the program without strong input from the DOE science staff. Previous work with middle schools and teachers, as well as printed material on the eighth-grade Exit Project and the content of the eighth-grade standardized test guided the planning of the professional development sessions. Pedagogy was based on the notion of accessing and appropriating the scientific work that took place in the institutions and transforming it into authentic science investigations students could model.

The Museum has had previous experience with school partnerships, in those cases, there was an ongoing co-planning and collaboration of the museum educators with the classroom teachers. There was also an extended period of contact between the museum educator and the classroom students as well as the amount of time that the students could spend learning in the Museum. In the case of Urban Advantage, although the teachers participated in extended professional development (50 hours), due to the number of schools and scope of the project, the same degree of co-planning and collaboration could not occur. Additionally, the middle schools were enacting a culture of

standardized assessment that contradicted the inquiry-based model that was central to Urban Advantage.

It was with this initiative that the Museum and the cultural partners realized that in was important to be aware of classroom implementation of museum-based initiatives if there was to be a sustainable practice of integrating use of the cultural institutions with the ongoing practice of classroom teaching. Early on, when teachers discussed difficulties that they were having with integrating field trips and museum-based resources with doing science investigations and Exit Projects in the classroom, the cultural partners recognized our lack of capital (and lack of knowledge of the classroom field) and how what teachers were learning in the Museum would play out in the classroom.

A New Field within a Field for Science Education

One of the issues that arose from the first year was the need to revise the student Exit Project tasks and procedures to better reflect the actual practice of scientists. This issue came about as a result of direct contact between practicing scientists, museum educators and school educators that was a part of the structure of the field. A temporary field was created where scientists were brought together to look at student work and determine where it resembled the work that they do as practicing scientists and where it did not. In this new field, the culture of practicing scientists intersected with the macrostructure of the Department of Education as the structure of the Exit Project implementation was transformed to accommodate their input in student directed investigations—thus expanding the collective agency of the science department of the Department of Education to include the practice of authentic science.

A Transforming Structure

As the coordinating institution, the AMNH education department was in a position to again have its structure transformed. This is the first time that AMNH and the other partner institutions had to coordinate their efforts and resources and plan with a common goal in mind. It was also the first time that the assessment needs of the schools were central to the design of the museum-based program. AMNH was forced to define its mission and delineate the role of the DOE vis-à-vis the role of the informal institutions. For example, while the cultural institutions were focused on the issue of Exit Project implementation and how our respective plants could support this initiative, it was up to the DOE to see that the implementation became policy—that teachers actually followed through with the realization of the projects. We were in a position to influence pedagogy and policy, however we were not able to ensure that the policy was executed.

Full Circle

It seems as if the Museum has come full circle in its offering to schools all within the scope of its mission of encouraging and promoting the study of natural science. While the early Museum's program served individual schools and teachers with its menu of lectures, and collections-on-loan, it did not become involved in whole school efforts until the 1990s. In doing so, the Museum has had the opportunity to participate in multiple fields—that of the school and that of other cultural institutions thus expanding and changing the Museum's *service* to schools. For me it is interesting to note that in early literature from the Museum the Museum's relationship with schools was always described as a "service." This implies that it is a one-way provision of resources that only benefits the school and that the Museum receives little to no benefit from the exchange.

This possibly transfers to the previously mentioned notion of the museum-as-a-resource rhetoric that is often used by educators and the Museum in reference to its relationship with schools. From doing this research and reflecting on my own experience as an educator on both sides—formerly the school and presently the Museum, I have come to realize that historically and presently, the Museum had as much to gain from its relationship to schools that the schools had to gain from the Museum.

Through the decades, the relationship between the Museum and schools has fostered a sharing of cultures between the two fields. People—agents in each of the fields have to participate in the activities of the other and resources—e.g., objects and curriculum have diffused across the porous boundaries. This has enabled educators, museum educators and in many cases museum scientists to effectively participate in both the Museum and the school field. From its early relationships with schools to recent partnerships, the Museum has been transformed. Through intimate knowledge of the needs of the school, partnerships have enabled the Museum to become more an effective resource for the teaching and learning of science in the city. The partnerships have created a new understanding of what urban science learning is—effectively using the resources of the city (schools and cultural institutions) to facilitate and improve students' access to real science experiences.

Bringing it Back to Culture

I designed and facilitated a workshop session for teachers entitled "How can we use cultural artifacts to teach and learn science?" First, by defining science as any systematic attempt to produce knowledge about natural world (Kincheloe, 1999), I explained that based on this definition, *any* system of gathering knowledge is considered science,

including indigenous systems. I then presented the ideology of modern, Western-based science, including the Cartesian dualism of separating the knower from the known (Kincheloe, 2002) and setting up a norm or universality—"positivism presupposes that reality is singular and objective" (Reagan, 2005, p.17). When we enter the halls and look at the cultural artifacts, we ask ourselves "what science knowledge went into the creation of this artifact?" Through our encounters with the artifacts and discussions we realize that indigenous people had to know and understand a great deal about the natural world in order to create the artifacts that they did. People of East Africa had to know about animal behavior to create appropriate hunting and fishing tools. Indonesian people had to know what we call chemistry in order to use plants to create dyes for fabrics and body paints. Pacific Islanders had to know physics to develop sails and navigation tools and material science to morph the coconut into its many forms and uses. This indigenous knowledge, as Kincheloe and Semali (1999) explain is "the dynamic way in which the residents of an area have come to understand themselves in relationship to their natural environment and how they organize folk knowledge of flora and fauna, cultural beliefs, and history to enhance their lives." (p. 3). I discuss how this knowledge has been subjugated and is an issue of power,

> The power struggle involves who is allowed to proclaim truth and to establish the procedures by which truth is to be established; it also involves who holds the power to determine what knowledge is of most worth and should be included in academic curricula. In this context the notions of indigenous knowledge as "subjugated knowledge" emerges to describe its marginalized relationship to Western epistemological and curricular power (Kincheloe & Semali, 1999, p. 31).

I end the workshop with a discussion about how to use this knowledge with students. Teachers who participate in this workshop often find seeing the science in the

cultural artifacts liberating in that it provides an interesting way of integrating cultural studies with science. It begins to open up the possibility of dialogue about what is science and who decides what gets to count as legitimate knowledge. It also allows teachers and students to examine their own indigenous practices and beliefs and compare it to the science that is taught in school. However this is an enrichment workshop, one that is neither central to teaching and learning in the Museum nor a part of the classroom science curriculum.

During the past 20 years, museums have been taking into account new scholarship in order to interpret cultures from more egalitarian and more authentic perspectives (Levin, 2002). Museums have moved away from the ideological science as the only way of interpreting objects. In a recent exhibit of Haitian Voudou, the Haitian community played a central role alongside the Museum's anthropologists in curating the exhibit—deciding how the objects would be displayed and described. However this has not been the case with science. My workshop is not considered a part of the legitimate discourse of science as practiced in the Museum, as it is not in coherence with the dominant paradigm of science—the paradigm of a universal objective truth. Science in the Museum maintains its ideological stance and authoritative position. Vackimes (2003) maintains that is time for anthropologists to study science museums as sites for the creation of ideology. Perhaps this would expose the notion that there is not a single objective truth, on the other hand since anthropology is a science (unless it is a critical study) this examination would just be the reproduction of an ideology.

The notion of a single objective truth also contradicts with the pedagogy of original observation. Observation and inquiry is a highly personalized experience as each person observing the same object or phenomena may note something different. This is contrary to the idea that there is one objective way of seeing reality—if this were the case, everyone observing the same object would note the same things, regardless of the individual's prior knowledge, personal experiences, and immediate encounter with the object. I believe that if the Museum were to truly become a democratic institution, then it must allow for multiple viewpoints not only in cultural studies, but in its scientific endeavors as well. I am not suggesting that there be an abrupt paradigm shift in the way that science is practiced. I am suggesting that the practice of science in the Museum be recognized for what it is—an ideology. Recognizing the ideology opens up the discussion to the existence of alternative viewpoints and alternative ways of interpreting scientific data. This would make the Museum and its practice of science more egalitarian and consistent with the open-ended and personalized pedagogy of original observation as proposed by the early educators and the meaning making as is practiced by current museum educators.

Chapter 3

Urban Advantage Lead Teachers: Defining A Community Of Practice

We realize that all teachers cannot all be specialists, that we must make many of our special collections more readily understood by you, if you in turn are to bring your pupils here and explain objects and principles to them. We want the teachers to feel that the museum is part of their educational plant; we want their cooperation, their suggestions, and their frequent presence (Osborne, 1927, pp. 271-2).

Museums as Resources for Science Teaching and Learning

I met Violet and her classes in the Hall of Planet Earth on her field trip to the Museum. She brought three of her classes at once—about 80 students—because her administration would only allow her to take two field trips for the year. Each of her students had a brightly colored folder that contained activities for them to complete while at the Museum. Her focus was Earth Science and her goal of the trip was to have students generate research questions for their Exit Projects. She divided her classes into three groups and rotated them between three of the Earth Science oriented halls. She asked me if I could tag along with the math teacher's group in case the students would have any questions that she could not answer. Before I left Violet with my group, she gathered her students in a central space in the hall to let them know what was expected of them.

"You are to visit the halls and complete the activities for each hall. You are working in your groups so you could work together and share your observations. We went over the activities in the class, so if you have any questions you could ask me, or Ms. Adams. " As the students gathered in their working groups within their classes, I took the opportunity to shuffle through the folder so that I would know what the students were expected to do. There were three stapled documents, each labeled with the hall, contained a variety of closed and open-ended questions and plenty of room for jotting

observations. I recognized some of the questions, as they were the same questions that were given to teachers during the Urban Advantage workshops.

During the educator's workshop that Violet helped to facilitate, teachers were divided into three groups and rotated between the Earth Science halls. We (the museum educators) wanted to give them an overview of the resources and the middle school science content that was available in each hall. We framed this portion of the workshop as a field trip and used the questions to model the kinds of activities that could be done with students in the halls. Now Violet was using these questions to guide her students' explorations.

Violet re/produced her learning experience with her students. During the Urban Advantage workshop, she had access to the resources—museum educators, objects and knowledge—of the Museum. As she was enacting a culture of using objects in the Museum to meet learning goals, she was expanding her agency in knowledge and use of the Museum's resources. With her students, she became a resource that enabled them to access and appropriate the Museum's resources for their learning. In doing so, she temporarily changed the structure of the Museum to become a part of her "educational plant."

Violet learned how to use the Museum's resources in the Urban Advantage initiative. This initiative—a partnership between seven science-rich institutions—museums, zoos, and botanical gardens—and the New York City Department of Education was designed to formally link New York City's diverse science-rich cultural institutions with the public middle schools. As a graduation requirement in the 8th grade, students are required to complete an independent science investigation, called the Exit

Project. The Exit Projects are long-term science investigations required for successful completion of middle school. Through providing professional development for teachers, science resources, and access to the cultural institutions for schools and families, the initiative aimed to extend the science resources to the classroom, with the goals of students and teachers using the resources of the institutions to do the Exit Projects and creating a sustainable practice integrating use of the institutions in their teaching practice.

In the early 20th century, Osborne (1927) urged teachers to make the museum "part of their educational plant." More than three-quarters of a decade later, Urban Advantage aimed to continue the practice of extending the resources of the museums to the teachers and schools of New York City. In Urban Advantage, teachers had the opportunity to learn inquiry and object-based pedagogy in the museum. They learned how to use the resources of the museum to teach science and facilitate science investigations with their students. As a goal of Urban Advantage was, within the public schools to build a sustainable practice of using the City's science-rich museums as science teaching and learning resources, I use the following questions to frame this chapter:

1) In what ways did the Urban Advantage Lead Teachers develop a "mediating field' between the cultural institutions and the classroom?
2) In what ways did participating in the Lead Teacher group re/produce identities as peer leaders?
3) How did teachers use their agency from participation in the Lead Teacher group to transform the structure of science teaching and learning in their schools and in Urban Advantage?

Learning to Teach in a Museum is a Culturally Adaptive Practice

Hybridization and Creolization

Kahn (1995) describes museums as heterotopias, "combinations of different places as though they were one.' (p. 324). The culture of a museum is structured around these heterotopias; it is structured around finding the relationships between objects that may or may not be contextualized as they are as in their natural existence. For example, one display that is based on systematics—the science of describing and classifying living things based on genetic and morphological evidence, shows the evolutionary relationships of living things, it is called the Tree of Life. On this tree, model and preserved representations starting with prokaryotes at the base, are arranged to show how they are related to one another and to all life on Earth. However these organisms do not *live* in these relationships, and although they may be right next to each other on the Tree of Life, they may never actually physically interact in their lifeworlds. Heterotopias also exist in zoos and botanical gardens, for example, where different animal and plant life from different parts of the world, but perhaps from the same ecological zone may be displayed alongside each other.

Objects in museums are displayed in such ways to represent certain scientific concepts—in the case of the zoo or garden it may be animal and plant adaptations. To effectively use these spaces as science teaching and learning resources, it is important to learn the concepts/thinking behind the creation of these heterotopias in order not to misrepresent the objects they contain. For example, the Tree of Life could be understood as one representation of life on Earth, while recognizing that there are many other valid ways of representing life on Earth, and even different ways of interpreting the Tree of

Life. Within science there is ongoing debate about the evolutionary relationships of organisms to one another. The structure in the hall may be permanent and static, but the actual Tree is fluid and changes with new information.

In describing culture as a semiotic system and corresponding practices (Sewell, 1999), teachers learning to teach in a museum have to learn how to access these heterotopias, and appropriate them to meet their science teaching and learning goals. In order to use the exhibits effectively, they have to learn about the systems and practices that were used to create the halls, and they have to learn how best to use the objects—the pedagogy around using museum objects to teach and learn science. In essence, they are learning two cultures at once—the culture of science as practiced in a museum and the culture of using museum exhibits and resources to teach science. In addition, they have to learn how to adapt these practices to their culture, which is the practice of science teaching and learning in the classroom. Roth (in press) describes this moving between cultures as a process of hybridization and creolization, where people, in this case teachers learning to teach in a museum, create diasporic identities (p. not known) as a result of learning culture in a new field, taking ownership of that culture and adding it to their toolkit of science teaching practices.

As teachers enact a culture around interacting with objects their agency lies in the meaning that they are able to make as a process of these interactions and how they could use these interactions to teach science. Paris and Mercer (2002) refer to this as a transactional model of interaction with objects, which is defined as, "an object-based epistemology that transcends the actual object by virtue of the…social experiences engendered by the object." (p. 402). As identity arises from transaction, participants in a

museum field search for “features of their personal lives, both actual and imagined selves, during their explorations of objects and museums” (Paris & Mercer, 2002, p. 402). Science teachers in a museum look for objects that are familiar—that they recognize as related to some science content or topic that the would like to teach.

I remember as a science teacher visiting the museum on the weekends to look for objects and displays that I could use to teach my students about classification. I found the objects that I wanted to use, but as my knowledge of how to use these objects to meet my teaching goals was limited, I felt that the museum trip ended up being more of a fun day out of school rather than a fun day of learning about classification. I knew very little of the culture of science teaching and learning in a museum. I would have benefited from learning more about the objects in the museum as well as learning how to use them to teach. So, I believe that as teachers learn more about the objects in a museum through professional education and personal research, and they learn how to use the objects to teach, they learn how to enact museum teaching culture and their agency expands within the museum context as they are able to use more objects to reach their science teaching and learning goals. In doing so, teachers also enable these objects to become resources for their students to learn science.

Science teachers and their classes create a diaspora of classroom teaching and learning into the museum. When teachers teach in a museum, they do not leave their classroom teaching cultures behind, but rather enact a hybridized culture of science classroom teaching and museum teaching, that is they bring elements of their classroom teaching—curriculum goals and classroom management—into the museum where the use different resources and schema to meet their goals.

Tobin (personal communication, April 20, 2005) describes identity as fluid and continuously and simultaneously produced and reproduced as a byproduct of activity. Through this action, teachers often change their identity. Gee described this process occurring "when any human being acts and interacts in a given context, others recognize that person as acting and interacting as a certain 'kind of person' or even as several different 'kinds' at once. He continued, "the kind of person" one is recognized as 'being,' at a given time and place, can change from moment to moment in the interaction, can change from context to context, and, of course, can be ambiguous or unstable." (p. 99). Using objects in a museum to teach science becomes a part of teacher's activity of science teaching and learning and a part of his or her identity as a science teacher.

Cultural Fields

In Urban Advantage, teachers had the opportunity to learn in new fields thus affording access new resources and schema. The Urban Advantage can be described as a temporal cultural field structured around the eighth grade Exit Project and resources of the cultural institutions—hereafter referred to as museums. As this initiative took place across and within a variety of settings—in the classroom, in the different cultural institutions, and within different temporal spaces (like workshops, field trips, and meetings), each of these fields (within the larger field of Urban Advantage) was dynamic and fluid with a central goal being the enactment of inquiry-based science teaching and learning. Generally, fields are defined as spaces where culture is produced and enacted (Roth, 2005) and using this construct enables me to analyze how the culture of inquiry-based teaching and learning gets enacted across and within different the different settings that comprise the Urban Advantage initiative.

The Museum as a Cultural Field

A field is structured around specific schema and resources that people access and appropriate in order to meet goals. These structures are both visible—like the objects in a museum—and invisible—the schema and ideology that create the museum space. These structures and people in a field interact to create a lived space, which is what Kahn (2003) describes as a thirdspace, "a dialectical interaction of conceived and perceived space." (p. 308)—the conception of science as presented by the museum and various perceptions of science that people bring into the museum all of which are culturally bound. In this museum thirdspace history, ideology, and pedagogy all converge to create the invisible structure and shape and enable the scientific activity—teaching, learning, and research—that occurs within the museum.

Objects as Representations of Science

It is the mission of science-rich museums to communicate the work of scientists to the public through the use of objects and visual displays. On a recent PBS special, *Great Museums* the narrator cited, "people tend to trust museums more than textbooks…objects are irrefutable evidence." This is because of the perception of objects in a museum imbued with symbolic capital because of their place in a museum and because of what they represent to people who interact with them. To a scientist an object could represent objective scientific facts or proof of scientific phenomena. To a teacher, although the facts may be present (in the accompanying text) the same object could represent an object of inquiry subject to interpretation. To a student coming into the museum, objects are polysemic—they are based on the knowledge and schema that students carry with them and their meaning-making as they interact with the object draws from this knowledge

base. For example, a meteorite could be a giant rock to a student whose contact with such specimen are boulders that they climb on in Central Park, however with a teacher as a mediator, the student can begin to see this "giant rock" as an object that has provided information about the composition of our solar system. The giant rock is still schematically a giant rock, but now this schema has been hybridized to include the scientific knowledge that make *that* rock an object of science. In order to begin to get students to see such objects as objects of science, it is important to familiarize their teachers with the science objects in the museum and model how they could build on their students' prior knowledge and experience in their explorations of objects.

One of the activities that I model with teachers is "what do you wonder?" I prompt teachers to look at an object (in the halls or in a museum classroom) and write down questions that they have about the object. In this activity, teachers' lived experiences—immediate interactions with the objects become sites of inquiry as they ask questions about the object. In this activity, objects are approached scientifically through making observations and asking questions as a way of understanding the natural world. In this context, observations and questions lead to research—the search for scientific facts about the object. It is through this process that teachers have opportunities to become more attuned to scientific ways of knowing about an object. In this activity, objects become sites of the hybridization of classroom and museum science as they play both roles—representations of scientific facts and sites of interpretations—at once. Teachers using objects in a museum to enact inquiry-based teaching change the structure of the museum to reflect this hybridization of science teaching and learning. Teachers learn the objective facts, but also learn how to use the objects to elicit ideas.

Haspgood and Palinscar (2002) describe inquiry-based interactions with objects as an "investigatory stance,"

> Integral to investigation is the role of questions guiding the encounter with a phenomenon text or object. These questions are typically pursued through close and systematic observations, often in the form of collecting data, which are in turn linked with assertions and claims (p. 172).

Teachers learning to teach in a museum are taught how to make these interactions with objects relevant to meeting their content and curricular goals. In doing so, a teacher learns how to appropriate the museum's resources to enact an object/inquiry-based pedagogy. When teachers have access to various fields, they also have access to more resources and opportunities to learn different cultures (Kress, 2006). The knowledge of objects—what they represent—and the ability to teach with objects reproduces the structure of the museum as a site of science education and research. Using objects to enact inquiry-based science becomes patterned actions of science teaching and learning in the classroom thus becoming a resource for all participants in museum teaching and learning. The knowledge of using objects to teach can also be transformative in the classroom—the teacher embodies the diasporic identity she gained in the museum and returns to the classroom where she re/creates the structure in the classroom to enact a similar object/inquiry-based pedagogy. Creating new structures in a field is agentic and potentially will change the identities of teachers and students, as the re/produced structure allows a teacher to re/produce an inquiry-based teacher identity in the museum and in the classroom.

Central |Peripheral Participation in the Museum

Counter to the notion of legitimate peripheral participation (Lave & Wenger, 1991) that proposes that people join communities at the periphery and move to the center as they become more competent in the practices of a particular community, In the museum, scientists, teachers and their students are at the margin/center of the practice of science in the museum, however each community has different goals. The scientists produce the content that is displayed, teachers appropriate the content to teach, students learn the content, and (it is our hope) become the scientists that produce the content. Roth (in press) cites, "the peripheral nature of participation lies in the fact that it always takes place at the center; all participation *simultaneously* is marginal and central." (p. not known). Without the collective participation of the teachers, students, museum educators, and scientists (and other museum staff) the museum, as we know it, would not exist. The mission of the museum, "of encouraging and developing the study of natural science; of advancing the general knowledge of kindred subjects, and to that end of furnishing popular instruction" (American Museum of Natural History, 1930), would remain unfulfilled.

It is central that defines what is peripheral, and those defining characteristics are fluid—they change as the knowledge and skill base of the community evolves. However, the agents in a community, regardless of their level of knowledge and skills in relation to the goals of the community, all participate at the center. This becomes a peripheral |central or margin |center dialectic as Roth (in press) calls it, where participants are simultaneously marginal and central participants.

School Science Contrasting to Museum Science

The resource-rich museum environment is in contrast to many urban classrooms where science materials are often outdated or non-existent. In some of the schools that I have visited during my teaching career and as a manager in this program, I was often confronted with labs that resemble abandoned factories—a sorry testament to a space that was once bustling with activity but has long since been neglected. Science became the forgotten subject in the forgotten schools. In these schools, teachers are often forced to utilize—to the best of their ability—these outdated resources. This is especially problematic for new teachers, as they may not have the on-the-ground pedagogical base from which to draw in order to plan and implement student-centered, hands-on lessons with the resources at hand. As the textbook seems to have the most physical longevity, teachers end up using these to plan and implement their lessons and these lessons become chalk and talk, as there are few objects available to facilitate hands-on inquiry. The lack of resources and support for science teaching and learning sets up structures that minimize the importance of science, especially in the recent climate that emphasizes math and literacy; therefore, quality science does not get taught.

Science teachers and their students of science are a part of the City's community of science teaching, learning and practice. However, there is often a disconnect between the science that is practiced by scientists and the science methodology that is taught in schools. Lemke (1992) suggests that what students encounter in conventional school science courses are a proxy for science:

> They encounter simulacra of the subjects and objects of science: science teachers in the place of working scientists and technologists, textbook discourse in place of

> the spoken and written language of working science, "school science" topics and information in place of those which might actually occur in any actual context of use or practice of science, school laboratory and demonstration equipment in place of the actual technologies in use everywhere else in our society. They encounter simulations of science as a process of activity: school laboratory exercises in place of professional investigative practices; efforts to solve problems that have no real contexts, no real parameters, no realistic complications; study of examples and are idealized, oversimplified and decontextualized.

In other words, schools, especially those lacking in adequate science, resources are engaged in a ghettoized science—a science that is out-of-context and distant from the social practice of science. The science Exit Projects (long-term science projects required for 8th grade graduation) were designed so that students would have the opportunity to engage in long-term science investigations that model science as a social practice.

New Resources Require Enactment Structures

While learning in a new field is the opportunity for agency expansion, it can also be a source of cultural conflict as one has to be able adapt the learned culture to new or preexisting contexts. In Urban Advantage, middle school teachers—many from the "abandoned factory" middle schools or newer smaller schools that did not invest money in science resources—are afforded access to resources both inside and outside of the classroom. While the teachers expressed excitement and enthusiasm in having this new access, many were faced with the challenge of actually utilizing the resources, as there were many challenges to implementation. It is like the abandoned factories were starting

to come to life, but tools that the participants did not have were needed to work the new machinery.

During the first year of Urban Advantage, many of the first year teachers struggled with issues ranging from the logistics of planning fieldtrips to the process of integrating the investigation-based pedagogy into their classroom practice. It was a struggle of conflicting fields in many instances—the classroom teachers did not have the capital (symbolic resources) necessary for successful integration of resources. In addition, a number of teachers were not familiar with project-based assessment or hands-on inquiry-based learning.

The Issue of Transference

Teachers needed enactment structures in order to put into practice their professional learning with their students. Urban Advantage started with the notion that the museums would teach teachers content and how to utilize the museum resources, while the Department of Education would provide training and support for the Exit Project implementation—the classroom and curricular aspects of the program. In response to their role, the Department hired teacher facilitators—teachers who were experts at facilitating Exit Projects with students—to participate in the professional development as consultants to the partner institutions and mentors for the teachers. Although they were able to assist teachers in the classroom implementation of the Exit Projects, they were not familiar with the culture of the cultural institutions, and were not able to offer teachers the help they needed in accessing the resources of the institutions to do the Exit Projects with their students. One teacher noted, “He knew his stuff about Exit Projects, but every time I asked him if my kids could do this question or that, he would say no, no, no. They

wanted to design an exhibit and he said no. We talked about exhibit design in the workshop so I allowed my students to do that project anyway." Other teachers told similar stories.

I believe that although these facilitators were experienced and effective classroom teachers, because neither did they participate in the professional development sessions with the teachers nor did they have an active practice of using the cultural institutions to teach and learn science, they were not able to bridge the cultural gap between the museum and the classroom; they were not able to make the resource accessible to the Urban Advantage teachers. The facilitators did not have knowledge of the museum's resources therefore were not able to assist Urban Advantage teachers in appropriating/transferring what they were learning into their classroom practice.

Although Urban Advantage teachers were expanding their agency as science teachers by learning in the new fields, teachers faced challenges to the enactment of culture they were learning in the classroom. For example, while field trips activities were modeled during workshops, some teachers were challenged to design their own trips that were both relevant to implementing the Exit Projects and meeting their curricular goals. Teachers did not know how to develop and implement activities that students could do in the museums that were goal-oriented. I had the opportunity to observe an Urban Advantage teacher with his class, and the students were aimlessly looking at the displays without specific tasks to complete. I suggested to the teacher (and the students) that they observe the objects and displays and come up with questions—"what do you what to know?" This helped to focus the students for a moment, but I wondered if he was able to continue the task in the classroom with turning the questions into investigations.

Although we modeled generating questions from observing objects and displays during the workshops, this interaction with the teacher made me realize that not every teacher was able to make the transference to their students in a place that is away from the museum or even when they bring their students to the museum.

The Urban Advantage teachers needed examples and activities that they could immediately implement with their students. They also needed peer support for the long-term planning and enactment of using museums to complete the Exit Projects and realize science teaching and learning. Effective teacher facilitators would have to be familiar with the resources of the museum and the pedagogy of using museums to teach science. There was a need of an intermediary field to bridge the cultural gap between the museum and the classroom. This sentiment resounded during an end-of-year focus group session: "What we need are institution teacher liaisons...[to say] here is what we really need as teachers…content is good, but applicability is paramount—the institution has to be presented as more than or beyond a resource" (Mike V., focus group discussion, June 6, 2005).

The Urban Advantage Lead Teachers: The Cultural Mediators

To bridge the cultural gap between the resources of museums and the needs of the classroom, a group of Urban Advantage Teachers self-selected to become peer support for new teachers in the initiative; they became the Urban Advantage Lead Teachers. These sixteen teachers participated in the first year of the initiative as learners. While they had varying levels of experience with using out-of-classroom resources for science teaching and learning, they were all new to using the museum for the Exit Project with their students.

Initiating a Leadership Identity

Urban Advantage first-year teachers, including the Lead Teachers faced both challenges and successes with making effective use of the resources to do the Exit Projects with their students. Pamela mentioned as her reason for wanting to become a Lead Teacher, "I fully understand that many science teachers would love the opportunity to have other teachers…someone to help guide them. I know I would have wanted that when I was new. The students shouldn't suffer because of our lack of knowledge."

Pamela is in her early 30s and has been a science teacher in New York City for 7 years. During her first year in Urban Advantage, she not only had to negotiate being able to integrate new resources into her practice, she also had to deal with implementing independent science investigations while having to cover her science curriculum. She had to become familiar with the museum's structure and learn how to enact teaching using the objects and exhibits and extend that object/inquiry-based pedagogy into the classroom. After going through the first year, Pamela knew first-hand of the challenges that a classroom teacher would face in being successful with the initiative—including time management, managing student activities during field trips, and negotiating standardized tests. As a Lead Teacher, she would have the opportunity to share her learning experience with other teachers and help them to learn and enact the inquiry-based culture with their students.

In stating her desire to "help guide" other teachers, Pamela has presented herself as a teacher who is familiar with the museum-based pedagogy; familiar with the structure of Urban Advantage and would be able to share her practice with others. Similarly Violet,

another Lead Teacher stated, "I decided to become a lead teacher to encourage other teachers to use the resources [of the institutions] to guide them through the stumbling blocks I encountered and to help them understand how best to use "out-of-classroom" scenarios." She also used the word "guide" in her discussion. Roth (in press) mentions, "we always are *in relation to others,* who constitute the context and *condition* that co-define us, (p. 5). Pamela and Violet both recognized the condition, the need for enactment structures for new Urban Advantage teachers. Both teachers desired to be a part of that enactment structure—to share what they have learned during their first year in Urban Advantage in a peer leadership capacity. They both developed a sense of agency in negotiating the structure of the new pedagogy and resources during the first year. They implemented the field trips and had a number of successful student Exit Projects that demonstrated science inquiry and use of the cultural institutions. Pamela and Violet felt that they were in a position to help others, perhaps believing that their experience could "jump start' other teachers' experience—that they would not have to, in essence, start from a place of total unfamiliarity.

During the second year the Lead Teachers were still learners in the museum field, however they moved to a higher level of competence of appropriating the museums' resources for teaching as apprentices to the museum educators and scientists. (In the central |peripheral dialectic, the museum educators and scientists also became apprentices to the teachers as they learned how to adapt their activities and content to match the reality of the classroom.) As a fledgling community of practice they began to learn how to support other teachers in the learning and cultural enactment process. In essence, they created a field that was in between the cultural institutions and the classroom. According

to Tobin (2005), "agency requires access to the resources of a field and the cultural capital needed to appropriate them; individuals use resources to meet their goals, and in so doing, change the schema and practices which become part of the structure of the field and resources for the production and reproduction of culture" (p. 50). If the practices of the Lead Teachers become a part of the structure of the museum field and the school/classroom field, they can become resources for the agency of all Urban Advantage participants—the work of the Lead Teachers would have the potential of having system-wide impact on science teaching and learning.

Forming the Lead Teacher group: I, as an Educator in Several Fields

At the first Lead Teacher meeting in August 2005, we (the facilitators) placed flipchart paper around the room with questions that we wanted the Lead Teachers to answer—we felt that this would help us to get to know each other and become aware of the collective ideas in the room. One of the charts was headlined, "What do you see as your role as Lead Teacher during the upcoming year?" This chart became key in articulating the Lead Teacher roles and was turned into a document called a "memoranda of agreement."

As a manager in the Urban Advantage initiative, it was my role to facilitate the Lead Teacher group. I planned and facilitated the monthly Lead Teacher meetings and was also the initial contact between them and their assigned cultural partners. In the monthly meetings, it was my goal to give them a forum to network—to share and discuss their experiences in working with the institutions and in their classrooms, openly struggle with issues around Exit Project implementation, and offer each other suggestions and advice. It was my mindset (having adopted a culture of building community from my previous work in experiential learning with Outward Bound) to create a community

among the Lead Teacher group by affording a culture of idea sharing and peer feedback. Although I was in a position of leadership within the group, I tried to sit back and allow discussions to unfold without my input until I felt that they needed a "voice" or opinion from the cultural institutions or if there were policy or political issues behind decisions that were relevant to the issue at stake.

I was able to participate in the group as the participants evolved from individual teachers to a leadership cohort. They were aware that I was doing my dissertation but a potential conflict of interest never came up as an issue. When I asked for permission to videotape, the participants were amenable as long as they were assured that I would not share the videotape or personal information beyond the group, as written in the informed consent that they signed. I participated in group discussions sometimes as the voice of the cultural institutions, other times as the voice of Urban Advantage management and other times as the voice of a previous classroom teacher. Although I taught high school, I felt that some of the issues that they struggled with were experiences that I shared as a teacher—such as having their own classroom (one that is not shared with other teachers) to display their resources without worry of them getting vandalized or not cared for,

Identity, Agency and the Activities of the Lead Teachers

Lead Teachers created a hybridized field that was between the museum and their classrooms. Their field was structured around their group interactions and discussions about enacting object/inquiry-based pedagogy and doing Exit Projects with their students. They also discussed their participation and interactions in their role of working with partner institutions in the planning and implementation of the workshops for new Urban Advantage teachers.

Urban Advantage Lead Teachers Marginal|Central to the Museums

As the liaisons between the classroom and institution fields, a part of the Lead Teachers' group identity became defined by their marginal|central participation vis-à-vis the museum educators. Wenger (1998) described the marginal participation as a *peripherality*, "some degree of non-participation is necessary to enable a kind of participation that is less than full. Here, it is the participation aspect that dominates and defines the non-participation as an enabling factor of participation." *(p. 165)*. In viewing this as dialectic, both the museum educators and the teachers are both full participants in the field, but there is a certain degree of non-participation with respect to each other. The following example illustrates this notion:

Vignette—Jake's partner institution had what he described as "pre-programmed professional development"—it was fun and interesting, but the activities were not relevant to the Exit Projects. Jake expected the professional development to be tailored to the needs of the Urban Advantage teachers; the activities offered should have been directly related to implementing the Exit Projects, but they were not. He struggled with trying to set up planning time with the educator from his partner institution; he felt that this educator was evasive and not willing to include others in the planning process. "I tried to call, email and meet with them but could not get through, I think she [instructor] is on vacation or something." I attempted to act as a go between—emailing the museum instructor and trying to set up planning time, but my efforts also went ignored. He was visibly upset when he discussed his futile efforts to make himself available to the museum educator for planning.

Jake's agency was truncated as he attempted to fully participate in the professional development planning. He had a lot of ideas about changing some of the activities to match what teachers needed to know and do for the Exit Projects. Having participated in last year's professional development, he believed that he had valid feedback and he was excited about the possibility of affecting change for this year's teachers. He felt that his position as a Lead Teacher would afford him a certain degree of input in the planning of the professional development.

Defining Roles

Jake's interactions with the museum educator seemed to keep him at the margins of participation in the museum field. I was not present for any of the interactions between the museum educator and Jake, so I could only base my interpretations on what I learned from Jake and my interactions with the museum educator on several occasions. Although she never made any direct reference to specific events in her conversations with me about her interactions with Jake, she often described him as a "character." This led me to believe that while she was resisting his Lead Teacher role, he might have been assertive in offering his suggestions to change the professional development based in such a way that he felt would fulfill what teachers need to know to do the Exit Projects. Jake admits that he is "undiplomatic" in stating his opinions and was very critical about the museum's professional development agenda. From my point of view, the museum educator was resisting his role of assuming a leadership identity in *her* professional development. I believed that she was being consistent with the notion (that was established among the museum partners) that the role of the Lead Teachers was to support her in meeting her

goals of presenting her curriculum to the Urban Advantage teachers. Jake saw his role as having active input in planning and facilitating the professional development.

Partnerships between individuals from various working cultures are particularly fragile. Ideally as the facilitator of the Lead Teachers group and their relationship with the museum educators, I wanted to play a more active role in opening the lines of communication between Jake and the museum educator. This would have given me the whole story and not just Jake's account and my interpretations. However this open communication depends upon a variety of factors including willingness of members to participate, overcoming scheduling issues, and structuring so that issues are dealt with proactively. Jake, the museum educator and I could have benefited from using cogenerative dialogues. This would have given us a structure to discuss what was going on and collectively design and agree upon actions to come to a resolution (Roth & Tobin, 2004). Due to schedule conflicts, we were not able to meet as a team. By the time I got to talk to the museum educator about this incident—I asked an undirected question of "how are things working out with the Lead Teachers?" The museum educator replied that everything was working well which led me to believe that the issue between she and Jake was resolved.

Roth (in press) describes how in certain events, people sometimes participate in peripheral ways relative to the central activity. In this case, the planning of the professional development, Jake and the museum educator were participating peripherally with respect to one another. It was important to Jake that he was able to enact his identity as a Lead Teacher, and I believed that it was important for the museum educator to maintain her control over the agenda that got enacted in her space. However peripheral

they were to one another, they were central to this event as it unfolded. This event became a role-defining event in the Lead Teachers' community of practice, as I will later describe.

Contrasting to Jake's experience, Mike mentioned that he was able to make significant contributions to the planning and implementation of the Urban Advantage sessions. Mike cited that his institution was "easy to work with and receptive to my suggestions in planning the [professional development] for teachers." Mike was able to enact his classroom teaching culture by aligning the museum's resources and professional development activities to what Urban Advantage teachers needed to know to implement the Exit Projects. His participation too could be interpreted in terms of marginal|central. Distance and traveling times kept him at the margins, but he was central in his contribution to the professional development sessions by providing the classroom enactment knowledge that the museum educators did not have. They used email and free time during the professional developments for planning, as the weekend was the only time that Mike was able to get to the institution. His practical applications to the classroom were valued and a necessary contribution to the enactment structures that the Lead Teachers were re/producing. The museum educators who worked with Mike described how helpful Mike was to them in reviewing their professional development activities and offering suggestions for better alignment with the middle school curriculum and Exit Project requirements.

Boundaries and Identity

The experiences of the Lead Teachers vis-à-vis the cultural institutions demonstrated the notion of boundaries in communities of practice. The Lead Teachers were a part of a

diaspora that brought them across the borders—with their identities and practices—of their classrooms to the museums. Along with diasporas, comes the processes of negotiation and transculturation (Hall, 2001) that occurs when different cultures come into contact and roles and identities are transformed and redefined. In the case of Urban Advantage and the Lead Teachers, the shared practice that was integral to the implementation of the initiative created boundaries (Wenger, 2000). Science object/inquiry-based education was shared practice between the cultural institution and the Lead Teachers. Jake became an example of a boundary crosser as he attempted to enact his role in shared planning of the professional development sessions with the cultural institutions. In being an "expert" in the classroom field and knowing what was needed to be successful in the implementation of teacher education in the classroom, he wanted to move to the center of the planning of the professional development sessions. However, in being at the boundary of the cultural institution and not having access to the resources—in this case the instructor/facilitator—he had to find other ways to enact his expertise in the cultural institution field. "A boundary interaction is usually an experience of being exposed to foreign competence," or foreign schema and practices (Wenger, 2000, p. 233. This foreign competence could be also seen as "differential participation along a gradient from central to peripheral" (Roth, in press, p. not known) where sometimes people engage in peripheral roles, however this does not preclude them from participating at the center. This peripheral|central participation was characteristic of the relationship between the Lead Teachers and the cultural institution. As dialectics can be source of tensions, this created a challenge for the Lead Teachers in figuring out how

they would enact their role to support teachers during professional development within the cultural institution.

Jake's experience became a shared experience in the group as it enabled discussion amongst the Lead Teachers about how each of them was working with their cultural partners and allowed the group to process successes and challenges in a context of role definition. These stories and shared repertoires became important in shaping the identity of the group and the individual Lead Teachers—these shared experiences defined their identities in relation to others both inside and outside of the Lead Teacher group. According to Roth (in press) it is the others who create the context and conditions that co-define us (p. not known). This notion of boundary interactions also demonstrates the dynamic nature of identity—how it changes as people act in different structures. The Lead Teachers' identities worked the central|peripheral dialectic as they moved closer to defining their roles vis-à-vis the museums and creating hybridized practices.

As a group, the Lead Teachers imagined themselves as being the a bridge between the schools and the cultural institutions, as Wenger (1998) describes, "[boundary] trajectories find their value in spanning boundaries and linking communities of practice." (p. 154). The boundary trajectories that Wenger (1998) can also be attributed to the hybridized identities that boundary crossers adopt. The Lead Teachers felt that their hybridized identities and practices—being fluent in multiple fields such as the museum, the classroom and the Lead Teacher community—enabled them to provide enactment structures in the form of support and examples that other teachers could access was key to their practice as Urban Advantage Lead Teachers.

Enacting a Leadership Identity within the Schools

Vignette—The room had not been touched for 30 years, then during one summer it was transformed. Pamela and her colleague Andrea negotiated with the principal to have this room for a science resource room. They also wanted a space where science teachers could plan and prepare their lessons and science clubs could meet after school. This was the old science prep room so it seemed appropriate that it should become the "new" science resource room. "We cleaned out the whole room and got rid of a lot of old chemicals and stuff." I pictured how the room might have looked before—grey, dust encrusted with old beaker and flasks filled with crystallized chemicals. I also thought about poor Pamela and Andrea having to contend with the noxious chemicals during the oppressive summer heat, but being familiar with the system I knew that if they wanted it done and had to wait for the red tape to be cut it would not have gotten done and the room would have remained useless for another 30 years. "We had them paint the room and the kids made signs." Even though it was after dark when I saw the room, it was bright yellow with a few potted plants, which gave the impression of high noon sun. The counters were clean and the covered microscopes were lined up in neat rows towards the window end. There were cheery signs ornately handwritten by middle school students that labeled the cabinets along with photographs of the students who frequented the room.

Appropriating a Space for Science

I asked Pamela what gave them the impetus to clean up this room. She responded as I expected, "Well, I thought if we were going to be Lead Teachers that we should have a space for the science resources." I asked this question because I wanted to confirm my belief that it was her participation in Urban Advantage that gave her the motivation to

reestablish this room as a science resource room. I thought that in her role as a Lead Teacher, she would want to create within her school a model science program with related resources. Her school had a mock courtroom for humanities, so why should it not have a space dedicated to science. Pamela was able to use her expanded agency in her role as a Lead Teacher to transform the structure of her schools' science program. She acquired the room and involved other staff and students in transforming the room; thus affording a sense of collective ownership of the room as a resource for science education. Science teachers in her school now had a space to meet, plan and discuss science and students with an interest in science had a space in the school to develop their culture of science.

Pamela's school was the first school that the Lead Teachers visited as a group. Since one of the roles of the Lead Teachers was to create model classrooms it was a decision of the group to have the meetings at a different Lead Teacher's school each month to see how the others set up the Urban Advantage resources in their rooms. Intervisitations enabled the beginnings of identity construction around classroom display, as I describe in Chapter 4. Display became central to the pedagogy of the Lead Teacher group as it began to identify as a group around the issue of the demonstration classroom.

Contradictions to Pamela's Leadership Role

As a science leader in her school, Pamela managed to accomplish getting a science resource room, creating her own science inquiry classroom, and support the science and teaching-learning efforts of the other science teachers in her school. Pamela also managed to do this in the wake of changing administration—an event that often causes

established initiatives in the school to go unnoticed and unsupported. Pamela had to be this support for science while the school was going through this change.

At first, Pamela's principal did not seem to be involved with science education or Urban Advantage. On several occasions, Pamela mentioned to me that her principal was not interested in Urban Advantage; therefore at times she had to assume the role of an ad hoc science administrator—an anchoring force for the Urban Advantage teachers and other science teachers in her school. For example, Pamela showed up instead of her principal for the first Urban Advantage administrator's event. In addition, it was Pamela who submitted the names of the Urban Advantage teachers for the second year and it was through her that I communicated information—such as professional development dates—to the teachers in her school. "I wanted to make sure that my school stayed involved," Pamela, said when she discussed her reasons for "taking over" in response to her disinterested principal.

Later in the year however, Pamela reported that the principal began to resist her efforts by leveraging her authority over her. As a new administrator, the principal could have felt threatened by Pamela's role as a peer leader in the school. The principal mentioned to a program evaluator that she "felt out of the loop" in regard to Urban Advantage; she started to demand that notices about Urban Advantage be sent directly to her instead of via Pamela. From what Pamela relayed to me, she made every effort to keep the principal in the loop, (by following up with program-wide emails sent to all Urban Advantage administrators) but when there was minimal response, Pamela used her agency within the school and within the initiative (as a Lead Teacher) to enact her agenda of her school's continued participation in Urban Advantage. As Pamela's principal made

more demands to know about Pamela's every move within Urban Advantage, Pamela was not able to freely enact her efforts to establish her inquiry classroom and rally teachers in support of science education, thus agency was reduced in the school. This stands in contradiction to the goal of the Lead Teachers to build science capacity within the schools.

Pamela asked me to reach out to her principal about her school's continued participation in Urban Advantage and the issue of Pamela's classroom becoming a demonstration classroom (as described in chapter 4). She viewed her principal as being hierarchical, "she will only speak to other principals and administrators," Pamela mentioned. I emailed her principal twice, but got no response and as it was approaching the end of the school year when Pamela made this request, I was unable to further pursue this matter. Additionally, as I had no power with in the structure of the Department of Education, I would not have been able to influence any decisions that the principal could make about Pamela's role in her school. I would have only brought to the table the symbolic capital of being an administrator from the museum. The influence that I would have had on Pamela's principal would have depended on the value that she ascribed to my symbolic capital.

Agency, Identity, and Ownership

Vignette—The Lead Teachers were gathered around a table working on modifying the Exit Project assessment rubric. As they were discussing the rubric and suggesting modifications, Mike was making changes on the master document that was only visible to him on his computer screen. In noticing the darkened LCD screen on the wall behind him, Mike wondered aloud if he could project his computer on that screen so that

everyone could look at the document while he made changes. I offered to help, but admitted that I had no idea how to operate the screen (although the screen was in "my" space—one of the Museum's classrooms. Mike nosed around while the others offered suggestions like, "try that button," or "use that cord" and collectively figured out how to turn on the screen. Although this was a small task, with smiles, claps, and corresponding cheers the teachers expressed a collective feeling of accomplishment and positive emotional energy once the document was projected on the screen—it was a mini celebration. The document became the mutual focus of the group and energy was directed towards the task of revising the document to reflect the teachers' practices of doing science investigations with their students.

Re/vision and Re/envisioning

This vignette occurred during one of the first rubric meetings and for me was telling in how the Lead Teachers evolved to form a community of practice around inquiry/object-based science education. Wenger (1998) posits engagement, imagination and alignment as modes of belonging to a community of practice. The re/vision of the assessment rubric was one of the means that aided in defining the Lead Teacher's practice. I use re/vision here because the Lead Teachers created a diasporized artifact that redefined the process of science inquiry to include the hybridization of school science and out-of-classroom resources and, as I describe below, required imagination of a reality beyond their teaching experience.

According to Wenger (1998), "mutual engagement merely creates a shared reality in which to act and construct an identity" (p. 177). In the vignette, it was important to Mike that all of the teachers involved were able to see and participate in creating the

master document. When the idea of using the screen was presented, all of the participants in the room became engaged in the process of figuring out how to appropriate the screen. Although all Lead Teachers were involved to some degree in creating the rubric, the screen enabled mutual focus on the task; this document became a community created artifact. Wenger (1998) also adds that imagination is another means of creating a shared reality. In the creation of the artifact, the Lead Teachers had envisioned what the document would look like and more importantly, how students, other teachers in Urban Advantage, and teachers beyond the initiative would use it. They had to "transcend space and time" of their practice to create a new image of the assessment rubric in a context of what they learned from the museums about the process of science inquiry. They also had to consider that this document would be adopted as the official rubric for the City, therefore they had to take into consideration those teachers who would use the document that might not have the access to the cultural institutions and resources that they had in Urban Advantage. In other words, they had to align their practices with the larger community of NYC middle school science teachers. They had to extend their imagination beyond their shared reality. As a diasporic artifact, this document reified the connection between the Lead Teachers, the cultural institutions and scientific practice and it also allowed them to define their practice as a group of inquiry-based pedagogues.

Contradictions to the Community of Practice

"How come my name is not listed first?" Jake questioned as he scanned the list of names credited for the rubric revision. The names of the Lead Teachers and administrators who contributed to the rubric revision were listed in alphabetical order. Jake thought his name should have been the first because it was his rubric that provided the template. Although

he said it with a laugh—meant it to be a joke, I knew that he thought that his name should have been given more prominence since the rubric was modeled after the peer-assessment rubric that he developed for his students.

There was a group of about five Lead Teachers that consistently worked on the rubric, although all Lead Teachers contributed something, ranging from examples of rubrics that they have developed and used to active participation in some of the rubric revision meetings. In the final document, all were given equal credit, no matter how small or large their contribution.

The Lead Teachers worked as a cohesive community of practice on revising the rubric. The rubric became their shared reality of teaching inquiry based science as it documented delineated and defined what they thought was a good science investigation. It also codified how they thought science investigations should be assessed. However the revelation of the individual names on the final document broke the sense of community. They were no longer the Urban Advantage Lead Teachers, but individuals seeking credit for work negotiating their identities around their value to the revision process. It became an issue of individual vs. collective ownership of work, although it was the individual|collective that produced the work. Ironically, this was the same discussion that came up about students working in groups in the revision process—the question of how do you account for individual work? This is proof of contradiction to the community of practice and it became a source of contention whenever the issue arose. As a facilitator, I could not think of a way to resolve it. I just hoped that the Lead Teachers, especially Jake would have eventually moved beyond it. I later found out that one of the Lead Teachers decided not to return because she felt that there was a small group of Lead Teachers

doing work for the whole group. I used this experience to think about the second year of the Lead Teacher community. During the initial meetings, I aim to facilitate a process where the group collectively decides what is equal and sufficient participation in the Lead Teacher group. In a way, this would model how they could facilitate the notion of individual|collective responsibility of students working in groups on their Exit Projects.

The Discrepancy of "Street Talk"

The executive office at the Department of Education was peripheral relative to the overall practice of Urban Advantage. They were responsible for allowing the initiative to occur, however they were not a part of the actual inquiry-based science that was learned and implemented by the teachers. Their role did not become central until there was an official document that had to receive their stamp of approval. In the case of Urban Advantage, it was the assessment rubric that was to be adapted and used citywide by all 8th grade teachers, whether or not they were Urban Advantage participants.

The Lead Teachers designed the rubric to be student friendly—it contained language middle school students would understand; they tried to avoid what they referred to as "teacher talk." Once the rubric was completed (and labeled as the final document), the Lead Teachers were relieved to have it in place in time for when most teachers were implementing the Exit Projects. The rubric was sent to the executive office for final approval. As it was a seamless document of science assessment and included the work of a group of exemplary teachers and a person from Department of Education (although not with the power of the executive office), there was no foreseeable problem with the document. However, the document was rejected. The policy makers did not approve of the phrase "street talk;" apparently viewing it as racist.

The Lead Teachers discussed the absurdity of this notion, citing that they were the ones in the classroom and *knew* what the students would find offensive or not. (Teachers in the classroom often become hybridized with the students' culture, especially in use of language. For example, the word "dis" most likely worked its way from urban classrooms into mainstream American lexicon via teachers who learned this word from their students and shared it with their peers). The executive office decided that the word "slang" would be more appropriate. With resistance from the Lead Teachers, the document was changed to include the word "slang." There was disagreement between the policy implementers and the Lead Teacher group over the phrase "street talk." Perhaps there was a genuine concern or misunderstanding about the perception of the phrase "street talk." Perhaps the executive office was concerned over the possibility of lawsuits and negative media attention if the public perceived the phrase as racist. However, I was not able to identify a specific motive because there were no discussions between the Lead Teachers and the executive office about this contradiction.

The assessment rubric became a boundary object, reluctantly coordinating the perspectives of the Department of Education with the Urban Advantage initiative Lead Teachers. As a diasporic artifact and boundary object, it was exposed to the foreign competence of the Department of Education central office where it also became an object of power negotiation. This object created the need for an assertion of power rather than an issue of who was best to decide what language was more appropriate for middle school students. In this incident, the knowledge of the Lead Teachers, whose practical knowledge was valued and codified in the initial document, became subjugated in the final document because of the term "street talk."

Roth (2005) discusses the "organizational effect" of boundary objects. In the case of the rubric, the Department of Education central office did not feel that it had control over the rubric, because it did not originate with them. As the rubric was also an assessment policy document, the Department used the issue of "street talk" to reinstate its power over the teachers. This was an isolated incident that involved the Lead Teachers and the Department, however within the context of Urban Advantage, there have been other incidents where boundary objects created similar conflicts and contradictions, including the case with Jake and the museum educator as previously described.

Learning and Re/producing

Whereas the individual Lead Teachers had varying experiences in their schools and in the museums, what I aimed to provide was a snapshot of how the activities of the Lead Teachers were integral in shaping their identities as object/inquiry-based teachers and peer leaders in utilizing the museums to teach and learn science.

Learning in the museum expanded the science teaching and learning resources that science teachers had access to. Learning in the museum expanded the science teaching and learning resources that science teachers had access to, however in order to effectively enact science teaching and learning in the museum and integrate those practices in the classroom, enactment structures were needed. This required the creolization and hybridization of classroom teaching with museum-based resources. The Lead Teachers formed a hybridized community of practice that was between the museum and the classroom. Because of the collective knowledge that they generated in the group, they were able to make transformative changes in science teaching and learning in their

classrooms and schools. The Lead Teachers became resources for other Urban Advantage teachers by sharing their knowledge and practices.

The experience of interacting with objects and learning how to teach inquiry-based science using objects enabled the reproduction of an inquiry-based culture of science teaching and learning within Urban Advantage which became evident in the Lead Teacher group, as they created diasporic artifacts—such as the assessment rubric—that codified the inquiry-based learning that they learned in the museums.

The Lead Teachers developed a community of practice around creating a structure that allowed both themselves and other teachers to enact object/inquiry-based science in the museum and the classroom. Participation in the Lead Teacher group enabled them to continue to expand their agency by learning in the museum field and sharing/building their classroom practice (in the Lead Teacher field) of using the resources provided to them in Urban Advantage. As they were learning and participating, they were continuously re/producing their identity around being object/inquiry oriented teachers and becoming peer leaders in support of other teachers being able to enact the inquiry-based pedagogy and Exit Project implementation.

By creating the assessment artifact and co-facilitating teacher education sessions, the Lead Teachers developed a "mediating field" between the cultural institutions and the classroom. The presence of the Lead Teacher in the cultural institutions was a resource for other Urban Advantage teachers as they were able to provide examples and activities of how what they were learning could transfer to the classroom. As an individual|collective, the Lead Teachers built a group identity as peer leaders and inquiry-based teachers. This enabled them as individuals to transform the science

teaching and learning structure of their schools through the re/creation of spaces and availability of resources for other teachers in their schools to enact inquiry-based teaching and using the museums as resources for teaching.

Chapter 4

Re/Creating A Field For Inquiry Based Science In The Classroom: Resources Create Structures & Intervisitations Reveal Identities

The Urban Advantage initiative is a partnership of seven science-rich cultural institutions with the goal of teaching teachers how to use cultural institutions to do inquiry-based investigations with their students. Realizing that access to the institutions alone could not facilitate quality investigations, Urban Advantage provided schools with tools and resources to extend the investigations into the classroom. Each of the participating cultural institutions selected resources that could support the content of their professional development. For example, the Botanical Gardens chose a Growlab ™ so that classrooms could do controlled experiments with plants. The American Museum of Natural History selected rock samples, which would facilitate the teaching of the rock cycle and characteristics of rocks in support of Earth science related projects. As science is a resource intensive subject, the resources could help schools to build their science teaching collection and help teachers create a space where science inquiry is continuous. However, it is not simply a matter of providing resources, but also affording teachers the opportunity to gain knowledge of using the resources to support science inquiry.

One of the roles of the Urban Advantage Lead Teachers was to use the Urban Advantage resources to set up classrooms that demonstrated an ongoing practice of inquiry-based pedagogy, referred to as demonstration classrooms. The Lead Teachers decided to have their monthly meetings at their schools in order to visit each other's classroom to see how they set up and used the resources. This also enabled me to see the different classrooms and experience the interactions of the Lead Teachers with each other within each other's created spaces. In this chapter I examine the following questions:

1) What did the science learning spaces created by Lead Teachers reveal?
2) In what ways did museum-based practices and resources affect the Lead Teachers' identities as science teachers?
3) How did visiting each other's learning spaces shape science teaching identity?

Display as a Pedagogy/Display as Inquiry

Lemke (2001) describes meaning making as a material process, transactive between persons and things. In the museum, object observation is transactive and one of the central skills of doing a science investigation. Each Urban Advantage teacher (and student) was given a special science notebook to record observations and to jot down notes and data. As a learning activity in the museum, teachers were prompted to look at objects and displays and write their observations and impressions in their notebook. They were then encouraged to take these observations and turn them into inquiry questions, i.e. "what do I want to know," that could lead to a science investigation. This placed the dialogue between teachers and objects as central to the learning or meaning-making experience in a museum.

Developing Museum Literacy

Museum literacy is defined as the ability to read objects (Bain & Ellenbogen, 2002) and reading or interpretation of the object is influenced by the prior knowledge and experiences that the viewer brings to the encounter with the object (Rowe 2002). Hooper-Greenhill (2002) describes the interaction between the object and the viewer as having two sides: "the interpretive framework brought to bear by the individual [as an active agent], which is both personal and social, and the physical character of the artifact" (p. 112). She goes on to say that meaning-making is a dialogue between the viewer and

object (p. 117). van Kraayenoord and Paris (2002) note, "it is important to consider objects as both something to connect to prior experience as well as something that will be[come] past experience for future interactions" (p. 226-7). Much of the literature on learning in museums is based on constructivist theory, where the viewer is involved in actively constructing their own meanings based on his/her interaction with the object, the museum text, and prior experiences.

Objects displayed in a museum demonstrate a strong "curatorial presence in the form of contextualizing display settings" (Bain & Ellenbogen, 2002, p. 155) In other words, whether it's a taxidermy of an organism in a natural scene or grouped according to its evolutionary relationships, or a cross section of a rock showing a fault in a section about Earth processes, the objects are displayed in a context that represents the work of scientists and curators of science in a museum.

The schema and resources of a museum are structured around the display of objects. Display is a form of visual culture that asks questions about "the social practices of looking and seeing, which are related to the processes of learning and knowing" (Hooper-Greenhill, 2002, p. 14). In a museum, teaching and learning happens in the interactions between people and the objects on display. Teachers learning to teach in a museum are learning museum literacy—they are expanding their agency as educators to include the use of objects and display (as found in the museum and re/produced in the classroom) to meet curricular and content goals. This could be both a source of power and identity for teachers since it affords them access to different ways of knowing and enacting science teaching and learning.

Extending Museum Literacy to the Classroom

Knowing how to use objects to extend the practice of science inquiry into the classroom can be empowering for the teacher because it allows the teacher to build a discourse of science around looking, observing, and generating hypotheses, in a similar way to a practicing scientist. In addition, as the teacher has choice in what she chooses to display, the identity of the teacher (as a science teacher) also becomes integrated into the hybridized teaching and learning lived space. The objects become symbolic capital to the teacher and the classroom becomes a space of object/inquiry-based science, reflecting science that is practiced in the cultural institutions. (Here, I use object/inquiry-based science to describe a practice of using science objects to motivate scientific inquiry.) In this respect, the museum and the object/inquiry-based classroom demonstrates a visual discourse of science and enables us to examine the relationships between looking, knowledge and power (Hooper-Greenhill, 2002, p.15) in relation to science teaching and learning. It also enables us to question the issue of power and agency within the museum field and how knowledge and appropriation of the visual discourse to the science classroom begins to initiate students into the practice of science through processes of hybridization—creating practices and creolization—forming identities (Roth, in press).

The hybridized science classroom becomes a third space (Kahn, 2003)—a lived space where the visual culture of the museum and the classroom culture interact to create a new cultural form (Roth, in press). In this third space a teacher has the potential to enact an empowering culture of science teaching and learning, where they—the teacher and students—could take advantage of the free-choice (Falk, 2001) learning that characterizes learning with objects in a museum, while learning science content as required by the

curriculum and standardized tests. The hybridized cultural form of museum science and classroom science privileges looking as a way of coming to know in addition to reading and writing as the primary means of exchanging information and building meaning.

Objects as Representations

Objects in a museum are representations of science concepts and phenomena. Callanan, Jipson, and Soennichsen (2002) cite, "a representational object is an object in its own right, but it is also intended to be used as a symbol for some other entity" (pp. 261-262). Objects are imbued with meaning that people assign to them and these meanings are socially and culturally bounded—even in the case of science and its self-proclaimed objectivity. According to Lemke (2001), "in the sociocultural view, what matters to learning and doing science are primarily the socially learned cultural traditions of what kinds of discourses and representations are useful, and how to use them" (p. 298). In the same way, learning to do science in a museum entails learning about objects as representations of scientific fact and theories and learning the process behind the inscriptions of particular objects as objects of science.

Science objects ascribed as such have the ability to reify the abstract. For example, one of my favorite displays in the Rose Center's Hall of the Universe is a case with various small living and non-living objects (a seashell, piece of iron, and a beetle's carapace among other things—see figure 4.1) with the following statement, "We Are Stardust. Every atom of oxygen in our lungs, of carbon in our muscles, of calcium in our bones, of iron in our blood—was created inside a star before Earth was born." These small objects seem random but within the context of a museum display they become

objects of science imbued with the symbolic capital of being science objects in a

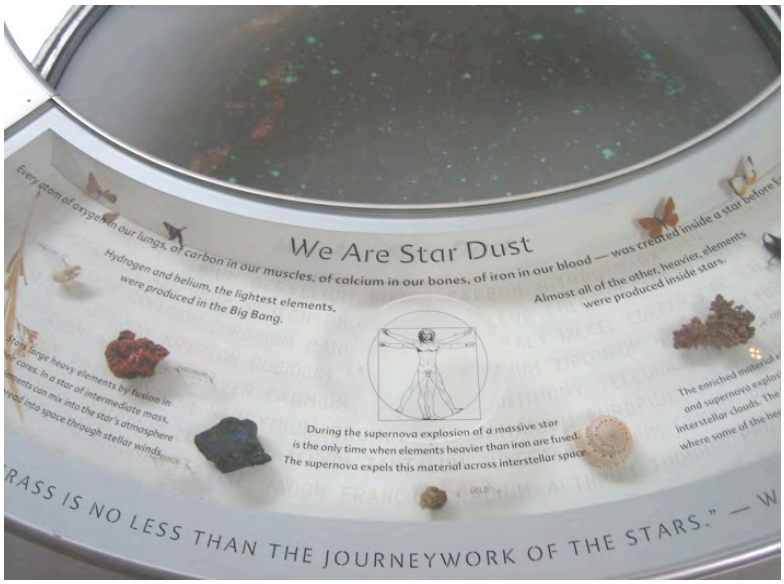

Figure 4.1. "We are Stardust" display in the Rose Center for Earth and Space.

museum. In this particular display, these particular objects become representations of the concept that all things on Earth are connected to the cosmos. They offer tangible evidence of the abstract idea of the origins of planet Earth. Through seeing the object and reading the accompanying text, a teacher or a student could visualize their connections to things on Earth and beyond. With science resources, teachers are able to re/produce a visual culture in their classroom, where looking and knowing are part of the social practice of learning in the classroom.

Objects and Identity

The Urban Advantage Lead Teachers used objects—both their personal objects and objects received or purchased for science—to re/create science displays in their classrooms. Hooper-Greenhill (2002) theorizes that collections of objects may be used to

construct identities; she cites collecting as being one form of the production of the self. In a context of the Lead Teachers, I interpret this to mean that possession and display of science objects are re/productions of being a certain kind of teacher. I believe that the objects create a structure that allows a teacher to enact object/inquiry-based teaching thus reproducing and transforming an identity as an object/inquiry-based teacher. In addition, the objects that teachers select to display are uniquely tied to their multiple identities, both in and out of the classroom.

Hooper-Greenhill (2002) mentions, "within societies that are increasingly diverse in ethnicity, cultural traditions and historical experience, people within differentiated social and cultural communities respond to museums and their collection according to their own perspectives." (p. 7). In museums, objects assume hybridized meanings as they take on meanings inscribed upon them by people who view them. When teachers bring objects into the classroom to teach science, the objects become diasporic artifacts as they represent the teacher's interpretation and understanding of science and science teaching. Teachers' science teaching identities are re/created in their interactions between their objects, their students, and their classrooms and it is interwoven with their identities—their ethnicity, cultural traditions and historical experiences, and their identities relative to the diverse students they teach.

Re/creating a Field for Inquiry-Based Science

Urban Advantage teachers were given resources to extend to the classroom the inquiry-based pedagogy that is central to Urban Advantage. Along with the re/vision of an Exit Project assessment rubric, the object-based demonstration classrooms became one of the shared repertoires of the group. During the initial Lead Teacher meeting in August 2005,

beginning with the question "if you entered a classroom where there was active science inquiry, what would you expect to see?" Lead Teachers brainstormed and developed a description of what an inquiry-based classroom would resemble. Central to the theme of the discussion was the display of science objects and resources that the students could observe and manipulate. It was also crucial to the teachers to have student projects displayed so students could see examples of science projects. This process enabled them to reify the inquiry-based classroom as they visualized/imagined and discussed their notions of inquiry-based classrooms and visited a hands-on classroom in the museum that contained objects and displays that teachers could reproduce in their classroom. In this classroom, they saw various observation stations, including preserved butterflies and mineral samples, microscopes set up for viewing the fine details of objects and terrariums with living objects. Display is a major form of pedagogy in the museum (Hooper-Greenhill, 2002), and it seems that this pedagogy became central to the classrooms of the Urban Advantage Lead Teachers.

Cabinets of Curiosities and Teachers' Identities

The precursors to modern museums, cabinets of curiosities or *wunderkammer* were displays of personal collections of natural history objects and artifacts. In Figure 4.2, you can see the assortment of animal and vegetable matter interspersed with artifacts, such as a cameo and globe. As the name suggests, (curiosity or wonder in the German name, *wunderkammer*) these cabinets attempted to produce an overall picture of the world (Müsch, Rust, & Willmann, 2001) and were meant to attract the viewer and spark interest in the collected objects.

Figure 4.2. Historical cabinet of curiosity
Reprinted from Earmarks in Early Modern Culture (2006).

During visits to the Lead Teachers' classrooms, I noticed that several of them created similar cabinets filled with objects from their personal collections and with resources received from Urban Advantage. Jake's classroom had several wooden cabinets with glass doors. The one shown here (Figure 4.3) displays human skull casts that he purchased with Urban Advantage money, along with other bones, stones, balls and plastic figurines. A cabinet adjacent to this one had a collection of Happy Meal ™ toys and Superman ™ figures. Jake admits that he likes to have a lot of stuff around, because it "makes it interesting to the students." He encourages them to ask questions about his collections and views this as a way to foster inquiry and gives them a small window into who he really is. When we visited Jake's room, immediately we were struck with wonder and were running around trying to see everything that was in the classroom. A former zoo volunteer, Jake had an assortment of animals—rabbits, gerbils, parakeets, and fish—each carefully labeled with the name of the animal and special instructions about handling animals. The Lead Teachers commented that his classroom resembled a museum or small

zoo. He refers to his animal collection as "*his* private zoo." "I wish that I had a teacher like you in Junior High," one teacher remarked. According to Lave (1996), "[teachers] are probably recognized as 'great' when they are intensely involved in communities of practice in which their identities are changing with respect to (other) learners through their interdependent activities" (p. 158). In the Lead Teacher community, objects and displays in the classroom were markers of integrating and using resources in science practice. When we visited other teachers' rooms, they were quick to point out that their displays were not as elaborate or "good" as Jake's. Although they did not aspire to create a classroom as sophisticated as Jake's, the Lead Teachers aimed to create a classroom where objects were displayed and accessible to students as they were in Jake's space. Jake's colleague imbued positive emotional energy on the objects and displays in Jake's classroom and recognized him as 'great' because of his science collection.

Figure 4.3. Jake's cabinet of science objects

This colleague imbued symbolic capital on the objects and extrapolated that feeling to Jake's teaching pedagogy—in this example, a teacher is as great as his classroom.

Ironically, in my own Junior High experience, one teacher had a room that was similar to Jake's and called the "Animal Lab." Students had to apply and were chosen to eat lunch in the room once a week for the opportunity to learn about and interact with the animals. I could not wait until the 7th grade when I would've had a chance to be officially in this teacher's class.

Visiting Jake's classroom, led me to dub him "Accoutrements Man" because of the amount and variety of objects that he had displayed in the classroom. To me, his collection of objects represented a convergence of his multiple identities—his multiple memberships in different communities of practice—in his classroom. There were twirling rainbow wind catchers hanging from the fluorescent lights and in between the science objects were colorful toys and other seemingly random objects—random to me but carefully chosen by Jake to represent who he is as a science teacher and an individual. As a magician he travels to the Midwest for his work during his vacation and has brought back pieces of his sojourns to the classroom, like a giant cattle skull that he hung from a snake cage. The skull could be used to demonstrate science concepts like anatomy and/or adaptations, but it can also be a window into a story about Jake and answer questions such as—How did he come to possess this skull? Thus the classroom becomes a physical representation of Jake's identities. Many of the objects in Jake's classroom were simultaneously teaching tools and stories about Jake's identity. I address aspects of Jake's identity changes below.

Jake's classroom is representative of his identity as reconciliation of various forms of membership. As a participant in school science, Jake's classroom demonstrated his *diasporic identity* (Roth, in press) where he has acknowledged his familiar cultural forms—an eclectic, Caucasian-American male, former zoo volunteer, and traveling magician—through his classroom display. I know of him as a science teacher and through discussions I became familiar with his identity as a magician and his affinity for the southwest and I am sure that he has other identities with which I am not familiar, all that created the Jake-self. I was able to see elements of his Jake-self hybridized with what he learned and received from his participation in Urban Advantage.

Figure 4.4. The scientific inquiry zone.

The cabinet in Pamela's class is explicitly labeled "Scientific Inquiry Zone" (Figure 4.4). The resources on the top shelf were received from one of the zoos. Similar objects were used in an observation activity where teachers were prompted to observe, generate questions, and try to identify the objects in the jars (which included a snake shed, a moth's cocoon, and other animal related objects). The rest of the collection included carefully chosen random objects, books from various disciplines and amusingly, a lunch bag with pictures of the solar system received during one of the Museum workshops. I was surprised to see the bag there—that it has made it to the category of her "stuff." This bag became a teaching resource worthy of a prominent space in Pamela's display case. In reference to her classroom Pamela said, "I have a lot of resources (Growlab ™, rocks, minerals, fossils, etc.) … I would love some more open display cases because I ran out of room for all my stuff. I would like the kids to be able to look [at] and touch the resources." On a separate occasion Pamela mentioned, "I would like to have lots of stuff for the kids to touch. I want them to touch everything. I will put signs around that say, 'please touch but don't break.'" Pamela often used the word "stuff" to describe her collection of teaching objects. Pamela has built a science teaching identity around her stuff and the display of her objects in the classroom.

In accordance with the agency|structure dialectic, the structures that the teachers created allowed them to act and re/produce their identities as object/inquiry-based teachers. Jake used his knowledge of animal keeping and magic to create resources that his students could use to learn science. In a similar vein, Pamela's love of "stuff" translated into a classroom full of resources that allow her students to re/produce a culture of inquiry. The objects that the teachers displayed in the classroom became resources for

the teachers to reach their goals of enacting inquiry-based science teaching and learning. The above two examples demonstrate teachers enacting a culture of display and inquiry-based teaching and learning into the classroom.

It is fitting that inquiry-based pedagogy would encourage the creation of classroom cabinets of curiosity that are hybrids of the culture of museum display and classroom hands-on learning. As Pamela mentioned above, these cabinets encourage students to look, touch and ask questions and enable the mindset of doing science investigations. In such classrooms, the resources are more than just learning tools, they become physical representations of who they are as individuals. According to Müsch, Rust, & Willmann (2001) the "collections [in the cabinets of curiosities] raised the social prestige of the owners" (p. 13); they were tools of empirical research of the natural world as they contained collections objects and artifacts from around the globe. With the Lead Teachers, their collections and classroom display became symbolic capital of having a demonstration classroom, in essence raising their social prestige within the group. While the object-based classrooms had common elements, like the cabinets of objects, they also demonstrated their identities as object/inquiry-based teachers with memberships beyond their participation in the Lead Teacher group.

Living Objects for Observations and Long-term Inquiry

All Urban Advantage schools received from the botanical gardens a Growlab ™ to facilitate botanical inquiry in the classroom. In each of the Lead Teacher's classrooms that I visited, the Growlab ™ was set up with plants that were student projects and/or a variety of decorative plants received during workshops. As living and changing objects, the plants afforded long-term observations of changing phenomena and perhaps fostered

patience in scientific observation.

Figure 4.5. Growlab ™ with common food plants.

In Figure 4.5, the four plants in corsage boxes in the top row were received during a Lead Teacher session at the botanical garden. The one on the far left is a ginger plant (*Zingiber officinale*) and right next to it is an *eddo* plant (*Colocasia esculenta—a* tuber eaten as a starch in the Caribbean) they were used to demonstrate how some common foods from the market—cheap and widely available resources—could be used to grow plants in the classroom. The desert terrarium at the bottom of the lab reflects the different botanical environments that are displayed in the garden—the teacher re/created a piece of the botanical garden in her classroom. Like a conservatory in the botanical garden, the Growlabs ™ recreate an optimal growing environment in the classroom, so teachers could display a variety of plants as living objects. Students were able to observe and note

different types of plants and how they are adapted to grow in different environments or media.

In the following photo (Figure 4.6), the Growlab ™ displays students' plant experiments. The botanical gardens focused on designing and completing controlled experiments with plants as a primary Exit Project task. The Growlab ™ in the classroom enabled the reproduction of the garden's greenhouse where teachers and their students observed ongoing plant experiments. The plants in the Growlab ™ were even labeled in a similar way that plants were labeled in the garden's greenhouse with the names of the plant (common and/or scientific) and date planted thus re/producing certain aspects of the practice of botany in the classroom. The Growlabs ™ enabled the transfer of the culture of science inquiry as done with living objects in the garden into the classroom.

Figure 4.6. Growlab ™ with controlled experiments.

Legitimate Peripheral|Central Participation

Roth (in press) describes the most salient aspect of Lave and Wenger's (1991) legitimate peripheral participation as "that of differential participation along a gradient from central to peripheral" (p. 9). Lave and Wenger (1991) posit that learners start on the periphery of a community of practice and move to towards the center as they become increasingly competent in the practices of that community. This seems to imply that learners are not at the center of the activity that takes place in a community of practice. In addition, it implies that the center is a pinnacle of competence. In contrast, I view the center as being fluid and expansive with the center shifting and changing as the knowledge base and practice of the community changes. As the community creates and assimilates new resources and new cultures, the competence of the community changes. Furthermore, often the learners—as new participants bringing new cultures and schema—bring new resources to a community of practice. In addition, as it is the center that defines what is peripheral, as the center shifts, so with the periphery, one does not change or even exist without the other. This creates a center|peripheral dialectic with all activity happening at the center (Roth, in press).

Teachers learning to teach in a museum are at the center of the science activity that takes place in the museum. They are peripheral to the practice of the museum educators and the scientists, but as learners they are central to the goal of the museum of educating the public in science. The scientists and museum educators' practices also change as they become more familiar with what teachers need in order to effectively use the museum's resources to meet their classroom teaching and learning goals. As the Lead Teachers participated in the activity of doing science in a museum, they become more

knowledgeable in using the museum's resources to meet their curriculum goals and this contributed to their identities as science teachers, as demonstrated in their classrooms.

In bringing back the resources (knowledge and science objects and resources) to the classroom, certain aspects of the museum culture were reproduced as the center|peripheral dialectic extended to include the classroom. The teacher and her students became center|peripheral participants in inquiry-based science, with elements of the museum re/produced in the classroom. In this instance, the practice of learning science with objects in a museum was extended to include the classroom as the teacher enacted the culture of science inquiry with her students. Many of the students' final projects contained elements of this extension by actually continuing the work that their teachers started at the museum. . For example a group of Pamela's students completed a project entitled "How Safe is the Bronx Water Supply." The students extended the water testing that Pamela did in the botanical garden to the drinking water in their homes and school. Jake's students did multimedia projects on exhibit design and animal behavior, which reflected his work with the zoo. One of Violet's student-group experimented with hydroponics. A long-term investigation that went deeper into the investigation that Violet began during her session in the garden.

Creating Hybrid Identities that Include the Culture of Museum Education

Visiting the Lead Teachers' science spaces revealed to me so much of who they were as individuals who teach science, as individuals with many interests and prior experiences and as individuals who were undergoing a process of creolization of their science teaching identities. They experienced and learned different ways of knowing that sharpened the visual, aesthetic, and material understanding of the natural world in the

museums and they used their expanded agency to transform their science teaching spaces. They came to identify as teachers who use out-of-classroom resources and objects within the classroom to teach science. The Lead Teachers used the new tools and objects, such as microscopes, globes, and videos and new pedagogies around teaching with objects to create spaces that were hybrids of school and museum science, and these resources became a part of who they are and revelations of their individual interests and passions about science that they shared with their students and in many cases their schools.

As a small group, the Lead Teachers gave me a window into the possibilities of what could actually be happening in many other Urban Advantage classrooms and schools throughout the City with access to the objects, the resources, the professional education sessions at the various institutions. The inter-visitation—where I was a participant, facilitator, and researcher—revealed the creolization process that had been taking place and at the same time it touched me in ways I would continue to understand as I examined or followed specific resources and how they were used and made real by the individual interests and science teaching identity of each teacher. The inter-visitations, I came to learn also had a powerful effect when I moved my lens from the Lead Teacher group to my case study Violet as described in Chapter 5. The power of the resources in the hands of those who need them, are taught how to use them and make them a part of the structure of their science teaching make for empowering and transformative changes in practice and identity.

The Object/Inquiry-Based Classroom and Being a Kind of Teacher

In an earlier Lead Teacher meeting where we were discussing the issues and challenges of setting up demonstration classrooms, Elena mentioned that she did not realize that her

classroom was a demonstration classroom until district leaders visited her class. "The room was a mess, stuff was everywhere…they [the students] were busy working on their projects." The other Lead Teachers commented that her classroom *is* a demonstration classroom because the students were actively engaged in doing science. The room was not neat, but it was a lived-in room. Elena sat back and seemed contented that she had a demonstration classroom. Although at this point, the Lead Teachers had not visited Elena's classroom as a group, however due to their shared visits and descriptions, they were able to imagine Elena's classroom as a demonstration classroom as their community defined it—students using the science resources and objects to do their science investigations. According to Wenger (1998), "the work of imagination defines a trajectory that connects what we are doing to an extended identity, seeing ourselves in new ways," (Wenger, 1998, p. 185). The Lead Teachers' interactions and development of a repertoire enabled them to re/create their identities as inquiry-based teachers and having object-inquiry based classrooms. The discussion that ensued around Elena's classroom allowed the teachers to compare their classrooms with Elena's description of her classroom activity—as participants in a object/inquiry-based community of practice their identities were dependent on how they were viewed in the group as being a kind of teacher. Elena felt validated when her peers determined that she had an inquiry-based classroom and thus, in the Lead Teacher group was able to re-envision herself as a teacher with a demonstration inquiry-based classroom. Identity depends on others who participate in activity. Identity is created and recreated in interactions between people.

The intervisitations created a shared reality (Wenger,1998, p. 177) that became certain markers of the community—like the cabinets of curiosity and display of living

objects—their classroom spaces were representational artifacts of the Urban Advantage object/inquiry-based science classroom (Wenger, 1998, p. 185). I enjoyed visiting the Lead Teacher's classrooms and seeing how the display of resources and evidence of ongoing science inquiry were apparent, however, what they displayed and how they were displayed reflected individual teachers' identities and multimembership in other communities of practice. The Lead Teacher classrooms reflected the culture of inquiry and observation that they learned in the cultural institutions and the identity that they created for the Lead Teacher community.

High Stakes Assessment and the Practice of Inquiry

The newly designed "science spaces" are powerful. At the same time, their use seemed to always be affected by the larger reality of the standardized curriculum and corresponding high stakes assessments. Falk and Dierking (1992) characterize the type of learning that occurs in museums as free-choice, which they define as a self-paced learning environment that allows the learner to pursue his/her own interests and inquiries. The Lead Teachers set up classrooms to foster this type of learning; they set up objects and displays to motivate students to ask questions and pursue their own interests in science. Although the Lead Teachers desired that their students became self-motivated learners, they also had to realize the constraints of time and standardized test curricula in the implementation of inquiry-based practices in the classroom.

Although Jake had a variety of objects and references around his classroom representing the various disciplines of science, "I only allow my students to do animal behavior studies," Jake mentioned when he discussed the topics that his students selected for their projects. He wanted them to focus on animal studies because that is what he

knew best. He said, "I told my students that if they wanted to do something else, they were on their own…animal studies is what I know the most about." Jake talked about his time management and since the Exit Projects are only worth 20 percent of the students' grade, he dedicates 20 percent of class time to working on the projects. That works out to one 45-minute period a week. The rest of his class time is dedicated to structured lessons—more chalk and talk than reflective of the ongoing inquiry that seemed evident in his classroom display.

Jake, like the other Lead Teachers had a curriculum to cover and the 8th grade science test to implement in May. The curriculum was a review of all of the science content covered in middle school, so it left little time available for students to pursue their own interests in science. This year, Violet said that she "made the mistake" of allowing her students to choose any topic for the Exit Project. "This made it really hard for me to help them all in finding information for their projects, while trying to cover the curriculum" Violet commented. "Next year I will narrow it down to one or two topics." Thus, even in the inquiry-based classrooms, the looming standardized assessments made it difficult for the consistent enactment of inquiry-based teaching and learning.

The inquiry-based science learning happened during the after school hours and only included self-selected students. The time and curriculum constraints did not afford the ongoing practice of inquiry in the classroom. It was during the after school session that students were able to work on their projects and the teachers were able to fully enact inquiry-based science. Both Jake and Pamela discussed their after school sessions; while students worked on their projects, they were also able to "play" with the other objects in the classroom as they explored different science topics. Both Pamela and Jake talked

about their after school clubs and the number of students that "hung out" in their rooms. It would be a good question for further research to see if the after school students contributed in any way to the learning that happened in science during school-hours. This contradiction moved inquiry-based science to the margins of the classroom and the fact/recall-based science that is tested to the center of the classroom—central|peripheral dialectic did not seem to exist—both practices were not equally central to the school-hours classroom. There was limited time for inquiry to be the central activity; the remaining time was spent on reviewing science content for students to succeed on the standardized test.

Wondering about Unused Resources

Urban Advantage provided teachers with resources to extend object-based science inquiry into the classroom. While many of the resources were used, some remained unused and in some cases, remained in their original shipping boxes. This presented a contradiction to the goal of using the resources to create object/inquiry-based classrooms.

There were many reasons given for the unused resources. The Lead Teachers cited that some of the resources did not arrive on time, for example rock samples arrived after they covered the rock cycle in class, therefore they would be used the next year. Others cited not knowing how to use specific resources. For example, some of the Lead Teachers did not set up the Growlabs™ until after they attended a special session at the botanical garden where they were given plants to start their collections. Some of the physical science resources remained unused because the teachers were never exposed to them during and workshop, and did not have time to tinker with the resources to determine how to use them. In one classroom that I visited, such resources were

prominently displayed on the counter, but still in their plastic shrink-wrap—not forgotten, but unused. The teacher clearly stated that she did not learn how to use them.

In order for teachers to use resources, they have to learn how to use them and have a purpose for using them to meet curricular goals. They have to see them modeled so that they could have ideas about how they could use them with students. The teachers who had practice with using the resources during the workshops were more likely to use the resources in the classroom. The reality of the classroom is that if a teacher were not taught how to use novel resources, they would not get used. Simply put, teachers had to know what they were doing if they were to use materials to support their science program. Without the requisite stocks of knowledge teachers have truncated agency to address the goal of supporting their students' learning.

In order to be able to use resources to meet teaching and learning goals in the classroom, the resources would have to become a part of the activity structure of the classroom that is, the teacher would have to have agency in using the resources. Teachers gained the material resources from participating in Urban Advantage, however needed the cultural capital to be able to use the material resources to meet science teaching and learning goals in the classroom.

Identity in Practice

Hooper-Greenhill (2002) eloquently wrote, "objects embody feelings about ourselves and about each other. They are used to construct meaningful environments" (p. 110). For me this quote sums up the spirit of the science teaching and learning spaces that the Lead Teachers have created. According to Wenger (1998), "engagement in practice gives us certain experiences of participation, and what our communities pay attention to reifies us

as participants" (p. 150). The Lead Teacher community as an individual|collective negotiated its identity around the creation of object/inquiry-based classrooms. They defined and created structures that enabled the enactment of inquiry-based teaching and learning. The demonstration classrooms developed to show aspects of the museum field being reproduced in the classroom with the corresponding culture of inquiry and observation thus creating a hybridized space of museum and classroom science teaching and learning culture. The display and use of the resources in the science classroom were cultural and symbolic capital for the teacher—cultural in her knowledge of the pedagogy of display and being able to effectively apply this pedagogy to setting up an inquiry based classroom and symbolic in the association of lots of resources (or "stuff" as Pamela referred to it), with good science teaching and learning.

It is interesting to note that while the culture of display was not explicitly taught in the museum workshops that the Lead Teachers used their expanded agency—through being immersed in the culture of display and learning how to apply that culture to science teaching and learning—to attempt to reproduce this in their classrooms. It could be that the practice of using objects and resources in the institution and the access that teachers had to classroom resources in Urban Advantage afforded their interest and ability to move their classrooms towards a pedagogy of display. In the Lead Teacher community, the object-based classroom inscribed upon them an identity of being a kind of teacher—an object oriented inquiry-based middle school science teacher who accesses, appropriates and takes ownership of a variety of resources to make science teaching and learning interesting for themselves and for their students.

The classrooms displayed the diapsoric identities that the Lead Teachers developed from learning and adapting the museum culture to their classroom, while including aspects that were tied to their identities outside of the classroom. These diasporic identities and subsequent hybridized classrooms also enabled students' developmental culture as middle schools students—their sense of curiosity—to become resources for their learning of and participation in science.

Writing this chapter led me to ask what is the difference between classroom decoration and classroom display? As I observed the Lead Teachers' classrooms and compared them to my memory of other science classrooms, I believe that decoration is about creating an attractive and stimulating environment. However, display in a science classroom is about systematically creating structures for students to observe, ask questions and collect scientific data; carefully planned, deliberate display could foster inquiry and the investigative stance with objects (Hapsgood & Palinscar, 2004). It is about creating a structure that affords the enactment of ongoing inquiry enabling students to learn science content and foster a sense of inquiry as a lifelong learning practice.

The Science Classrooms as my Mirror

Within each of the Lead Teacher's spaces I began to see elements of my own diasporic identity, that includes but is not limited to a Caribbean-American former classroom teacher, a teacher educator in a museum, scholar, and collector of stones and shells from around the world being reflected back to me. These classrooms afforded me a certain degree of reflexivity on how I came to be who I am as a research practitioner and my own beliefs about science teaching and learning. In the next chapter, I move the lens I used in the inter-visitations to focus only on Violet, one of the Lead Teachers. As I saw her in her

created space with her resources, her colleagues, and as I watched her vision of having a space dedicated to science come to fruition, I began to see myself. I found myself as a person of Caribbean descent in her school and in her/my community, and I relived aspects of my classroom teacher identity in my transactions with her and her students in her classroom. At the same time, I also saw myself as from the museum with my own passions about teaching and learning outside of schools and as a person who spent most of my lived experience of learning and teaching in New York City, and affording other teachers access to the City's science rich cultural institutions as an Urban Advantage educator.

Chapter 5
Creating A Structure For Science Teaching And Learning In A High Needs Middle School

Artifacts of Object/Inquiry-Based Practice

One of the goals of Urban Advantage was within New Your City middle schools to expand to establish a sustainable practice of teachers and students using the cultural institutions to teach and learn science. The development of demonstration sites that show the integration of museum-based teaching practices in the classroom context would provide an infrastructure where others can see and learn object/inquiry-based practice in the classroom, and discuss the policies that encourage the enactment of learning outside the classroom.

As described in Chapter 4, the development of these classrooms demonstrated a process of creolization, where the Lead Teachers took ownership of the culture that they learned in the museum and created learning spaces that showed this hybridization of cultures—the cultures of the classroom, the museum, and their personal interests and lived experiences. The museum based pedagogy added to their cultural toolkits—their different ways of learning and knowing about the natural world. The Lead Teachers developed a practice and science teaching identity around the notion of object/inquiry-based pedagogy and accessing out-of-classroom resources of science teaching and learning. The spaces that they created—the Urban Advantage demonstration classrooms—were the artifacts that represented their hybridized identities of science teaching and learning.

In order to understand the process of cultural transformation that enabled the creation of the object/inquiry-based demonstration classrooms, I began with two of the

same questions I brought to the Lead Teachers group in Chapter 4 and focused sharply on one teacher, Violet. My research questions were:

1) What did Violet's created learning space reveal about her and her school?

2) In what ways did Violet use the Museum's practices and resources to transform her school?

This allowed me to deeply examine the transformative process in a school and classroom that begins with a teacher who values using science resources and who identifies with using museum-based resources to teach. She was also a central member of the Lead Teachers' community of practice and therefore has engaged in collegial learning within the Lead Teacher group.

The Bathroom Pass

While Violet was presenting a PowerPoint lesson demonstrating how to organize what they had learned from their research, a student raised his hand and asked for a bathroom pass. "Write one out and I will sign it," Violet responded without missing a beat in her lesson. He asked a colleague for a piece of paper and she ripped one from her Urban Advantage journal. When he presented Violet with the pass, she abruptly stopped her lesson. "That is disrespectful! Urban Advantage gave us these resources and with Ms. Adams standing here you are going to use that paper for a bathroom pass?" Embarrassed the student tried to explain that another student gave it to him (in true middle school fashion that student was giggling because he got in trouble). "You will apologize to Ms. Adams right now!" The student apologized and sulked to his seat and Violet resumed her lesson. To Violet, these resources, especially the journals were sacred objects (Collins, 2004); they were imbued with the practices—observation, journaling and keeping a

science notebook—which were central to science inquiry in the cultural institutions, and sacred to the Urban Advantage community. To the student it was just a notebook to be used to meet immediate needs, in this case for access to the bathroom, however to Violet the journal was a valuable science resource. The journals became central resources in Violet's class and to me, their use was symbolic of the creolization of Violet's science teaching practice that happened over the year. Keeping science journals or notebooks were one of the practices of scientists that were emphasized in Urban Advantage professional development. To document their insights and research process scientists use similar notebooks. Teachers saw examples of scientists' journals and were encouraged to keep their own journals during the professional development as they learned science content and did their own Exit Projects. The journals and the resources were pieces of the Museum and pieces of Urban Advantage that became a part of the structure of here science teaching enactment.

From the beginning of my interactions with Violet, she always focused on the "wonderful resources," that Urban Advantage provided to her classroom, including the vouchers that allowed her and her students free access to the cultural institutions. She mentioned to me that her school had been involved in several initiatives since she had been there (only three years); "They charge a lot of money, come in a couple of times for professional development but you never see them again. Urban Advantage gives the professional development *and* the resources." As indicated by Wenger (1998), "a learning community needs resources to create a rhythm of engagement, imagination and alignment" (p. 250). Having access to and knowledge of using a body of resources is an affordance for a group to become a community and align itself with certain goals and

practices around using those resources. In the case of Urban Advantage, science resources—teacher education, access to the cultural institutions and equipment—were central to the initiative, and the Urban Advantage learning community developed practices around integrating the resources—including symbolic resources such as science content knowledge and the pedagogy of using objects to teach—into their teaching practice. This was especially evident in the Lead Teacher group where Violet was a member. To Violet, the Urban Advantage resources demonstrated a true commitment to the school; in turn she was committed to use the resources to enact in her classroom the inquiry-based pedagogy that she learned in Urban Advantage, which shaped her identity as an inquiry-based science teacher.

An Unstable Structure: The Discourse of a "Bad School"

"Get your son out of that school! Only animals go there!" My mother recalled a guidance counselor's exclamation when she told her that my brother attended the school. In the early 80s Central Brooklyn Middle School had the reputation of being a "bad school." Situated in the heart of a predominantly Afro-Caribbean community, it was the zoned school, and parents who were aware of the reputation resisted enrolling their kids there. However, due to the difficulty of enrolling in schools outside of the neighborhood, my brother ended up attending for one year—which was about all he could handle. My brother told stories of students constantly disrupting the class and cussing at the teachers; this indicated that there was very little learning happening at Central Brooklyn Middle School. I visited the school once with my parents during parent-teachers conference night and while I don't remember much, I remember the halls and classrooms being drab and

dirty in contrast to the clean, bright halls of the gifted and talented junior high that I was bussed to. That was the Central Brooklyn Middle School with which I was familiar.

I visited during the fall of 2005 in an effort to support Violet in recruiting more teachers for Urban Advantage. Since the school is in the community where I was raised and still live, I had a personal interest in supporting this school in Urban Advantage. I was excited that Violet, as a teacher from this school, chose to be a Lead Teacher for Urban Advantage and I was also curious to see if the school had changed. Although at the time I was not yet considering visiting the school as a part of my case study, I felt that Violet's participation in the Lead Teacher group would be a source of additional resources to the school.

When I first entered the school, I noted a different building. I saw acrylic self-portraits of students displayed in the foyer. The fact that they had not been written on or torn to me was a good sign that perhaps the tone of the school had changed. The 1st floor halls were clean and quiet with displays of student work and art on the walls. Also displayed prominently was the English Language Arts (ELA) assessment rubrics and related student work. I looked for evidence of science on these bulletin boards but saw none.

The Existing Structure for Science

Central Brooklyn Middle School is designated as a "high needs" school. In "high needs" New York City schools students tend to be of a lower socioeconomic bracket, black and Latino, with many not reaching mandated levels in math and reading. According to Violet and other teachers that I met from the school, much of the instructional focus was on the literacy and math assessments, leaving science as a low priority in the school. The

minimally used lab with broken chairs, excessively scratched tables, and busted archaic random equipment were a testament to the neglect of science. The lab had the appearance of an old abandoned factory in an economically failed mill town. Presently, this is the only usable lab in the school. “There are two other labs, but I have never seen them and they are not used,” Violet pointed out.

“Most of the time this lab is empty.” Violet commented, as we looked at the small whiteboard in the front of the room with a schedule grid that included the names of teachers and the periods that they were scheduled to use the lab. The lab had eight blacktopped lab tables and each table could accommodate 4-6 students comfortably. It is a good set-up for group work, so Violet used the lab for lab activities and for her students to do group work on their Exit Projects.

Besides Violet’s class, I only saw the lab was actively in use once. This was during the 8th grade science practical exams. The lab was set up in stations weeks before so that the students could practice the assessment skills and sit for the exam. This was in early March, and during subsequent visits up until late May, the practical exam was still in place, although the implementation of the exam was complete.

In contrast to the lab, by May Violet’s science classroom had evolved into the place that she dreamed of with working stations, displays, and student Exit Projects placed around the perimeter of the room. A door separated Violet’s science room from the lab and that very door also separated two contrasting views of science in the school. On Violet’s side of the door science is a practice, a skill or way of thinking that could be used in life. “I want the students to see science as everyday life. They could use scientific thinking to solve everyday problems,” Violet said when talking about her view of

teaching science. The resources are always present reflecting Violet's view of the ever presence of science. The contrasting view in the lab is a hidden or forgotten science only to be revived when it is a priority. In this view it is not a central practice of living or thinking, but a subject that is only as important as the mandated assessments make it. The lab only became an active lab in response to an exam.

A Nomadic Structure

In an effort to reduce behavioral problems that occur in the halls when students change classrooms, in Central Brooklyn Middle School, the teachers travel to the students rather than the other way around as in many middle schools—the students spend most of their day in their homeroom classroom. As Violet explained, "normally the students have science in their classrooms. Carts are provided for teachers to take any materials that would enhance the lesson." This is in contrast to the other Lead Teachers with science classrooms where science objects are always on display and accessible to both the students and the teacher. Violet mentioned on several occasions how it was challenging to travel with resources and teach science in a room that was not set up for science teaching and learning.

In Central Brooklyn Middle School science was nomadic, not having a permanent space of its own, neither in the physical realm nor in the realm of the mandated subjects. In order to get science in the classroom, Violet had to both literally and figuratively cross boundaries that were created by the literacy and math mandates. With her science cart she entered the students' homerooms, which were also the literacy and math classrooms as indicated but the overwhelming array of literacy and math related objects in the room. Even the students' desks had neon-colored essay writing rubrics taped in the upper left-

hand corners. She had to bring science into less-than-welcome spaces and like a leave-no-trace hiker, once she left the classroom so did traces of science.

Settling the Nomad: Re/Creating a Structure for Science Teaching and Learning

Envisioning a Space for Science

Violet had a vision of science becoming central to the practice of education at Central Brooklyn Middle School, "my dream would be to see every student at Central Brooklyn Middle School as a scientist." For her students and for the school, Violet wanted her homeroom to be space that would be safe for students to learn and engage with the science resources and a place where the resources would not get vandalized.

"This is where I would like to put the resources." Violet opened some empty overhead cabinets above the counter with plastic baskets of books, videos and other science curricular materials. It was Violet's desire to create "a place where students could come and do projects," and to display them once they are done. Violet's classroom, which was also a sixth grade homeroom, had evidence of her efforts to bring inquiry-based science to the school. Amidst the literacy posters and rubrics, Urban Advantage science resources were waiting for their chance to be prominently displayed, waiting to be moved to a central space in the instructional schema of the classroom. The Growlab ™ was in the back of the room set up with plants that Violet received from the botanical garden during a recent Lead Teacher meeting. On the right side of the room, there was a little station set up with two Petri dishes—one containing a dead beetle and the other a dried maggot. She had the students use the dissecting microscope to observe these specimen and draw them in their notebooks. On the same table, there were two jars—one with a brownish fluid and the other with water plants (also from the botanical garden)—

set up to be an observation station. It appeared that the Urban Advantage resources were the only science resources in the room. Violet was proud of her classroom and the resources that she had displayed. She also knew that she wanted this room to be *the* science room.

The display and use of resources began to change the physical structure of her classroom to reflect one where inquiry-based science happens. "I wanted the students to have something to observe and write in their notebooks." Violet wanted to start the term with the habits of observing and recording so she used the dissecting microscopes that she received during the summer Lead Teacher workshops to set up mini observation stations in her classroom. Violet wanted to start the year off with implementing key practices of scientific inquiry in her classroom. These resources—the microscope and the journals—and Violet's knowledge of using these resources began to change the structure of her science teaching to include active inquiry-based participation thus reflecting the hybridization of the practice of science in the Museum with her classroom science practice.

Claiming the Space

"We will have science in this school." (Violet, personal communication, 1-4-06)

"My interpretation was to use this classroom to teach students. Teachers could take their kids there for special lessons. It was my suggestion. We did not have a room especially for science, I suggested to the Principal to use it as a model classroom." When I brought my students there for a lesson, [my Principal asked] 'Why are you bringing students here? It is supposed to be a model classroom for Professional Development [for

the teachers].' I told him if it will be a resource room [for teachers], then we will need another room to be a demo room [for students]."

Violet wanted to have a space for students to practice science, this seemed to conflict with her Principal's idea of having a resource room for teachers. Violet wanted the room available so that other teachers could come and use it *with their students* when it was available. In keeping with her vision of having all students at Central Brooklyn Middle School being scientists, she wanted her room to become the place where students and their teachers could come and *be* scientists.

Violet's classroom was occupied by a literacy homeroom. This was evidenced by the array of literacy rubrics and slogans that decorated the room. There was little room for science. After the literacy teacher was promoted and her classes dissolved, Violet was given the room. Like a realtor pointing out the potential of an old building, she pointed out all of the different stations that she would set up—one for Earth science, another for Life science and one for Physical science. In a corner near the windows, there was a dusty bookshelf that would be cleaned and used for reference books and videos. With her teacher's choice money she hoped to purchase a TV and VCR for the room.

Violet's participation in the Lead Teacher group afforded her access to resources that gave her the impetus to transform science education in her school. With Urban Advantage, Violet had access to resources both physical in the form of science equipment and human—my relatively frequent presence in the school affording her a resource and a connection with the museum. She often introduced me to her colleagues and students as the one who brought Urban Advantage to the school. In addition, as a Lead Teacher, she became a member of a community of teachers whose focus was to build science

education capacity in their schools. Violet agreed that visiting the other teachers' classrooms during Lead Teacher meetings "gave her ideas and encouragement to work on the demo classroom." Her finished classroom was the physical representation of her participation in the Lead Teacher community of practice as it contained certain aspects of the intervisitations and her work with the museum. Through her association with me and the Lead Teacher group and knowledge of setting up a science classroom, Violet was empowered to advocate for her classroom to become the room dedicated to science in her school.

Setting up the Resources

Figure 5.1. Solar System and Earth science displays on the walls.

"There was some more discussion about the demo classroom. It was agreed that depending on how it was set up some students would be allowed to use this class [room] for particular lessons. The Principal was also trying to obtain some computers for the

room. “It is left up to me now to have the room ready for use. I have used up two Saturdays to start fixing it. Seems as though I would have to do this for a few more weeks because it is difficult to work on it during the regular school week, however it has already shown signs of development,” Violet reported to me in an email. When I visited the school shortly after this email, I saw the signs of development. Posters depicting the Solar System and a chart listing the steps of the scientific method replaced the literacy posters (see figure 5.1). Student literacy essays were replaced by chart paper listing students’ questions gathered from a recent museum trip. Many of the resources were moved out of the closet and on to the counters around the room.

For example, using milk crates, she set up a mini cabinet of curiosity (Figure 5.2). Included in this “cabinet” are both objects that she collected and some she received from one of the zoos. These cabinets were one of the diasporic artifacts created by the Lead Teachers and markers of their community, as it seemed to identify them as being object/inquiry-based teachers. The cabinets were hybrids of museum display and classroom resources. A member of this community, Violet recreated a similar cabinet in her classroom.

Figure 5.2. Objects for observing

For Violet, the science equipment not only represented resources, but symbolic capital in that it associated her with Urban Advantage and the museum. She greatly valued the resources and valued a place to put them. She also valued being associated with having and using the resources in her classroom as it demonstrated that she was an inquiry-based teacher. Violet was able to re/produce a structure for inquiry-based science in her school. She was also able to advocate for students' use of the classroom. This activity re/produced her identity of being a "kind of teacher" (Gee, 2001) that wants her students to be active participants in science learning—an inquiry-based teacher.

Extending the Science Resources to the School

"There is a need for science teachers to get together and make science work for the school." (Violet, personal communication, 10/17/2006)

As the afternoon sun casts the steel grate shadows on the floor, Central Brooklyn Middle School science teachers gathered in Violet's homeroom for after school professional development and to share the grapes, cookies and beverages that she provided. Once teachers had their cocktail plates filled, Violet began the meeting by describing Urban Advantage as, "a great opportunity and I think we need to take full advantage of it." She

gave each teacher a carefully prepared folder with informational documents about Urban Advantage and two inquiry-based worksheets, one of which she received during an Urban Advantage workshop. While she went through these documents, the teachers were quietly following along referring to the same documents in their folders.

Violet invited me to this meeting in support of her recruiting more teachers in her school for Urban Advantage. She introduced me as "the one who brought Urban Advantage to the school," and she mentioned to me on several occasions that it was an honor to have me in the school. To her, I was a resource—one that brings cultural capital in the form of knowledge of and access to the museum and Urban Advantage to Central Brooklyn Middle School middle school.

"Now I must show you some the things that we have from Urban Advantage and they are not for Violet Williams, they are for the school; these are here for your use." Violet moved to the part of the meeting where she introduced the teachers to the Urban Advantage resources. It was clear that while she had the resources, she wanted the other teachers to make use of the resources. This goes back to her personal mission of bringing science back to the school. Violet's possession of the resources and her capital in being able to use them put her in the position of changing the structure of science education in her school. As Violet continues to take out the resources, the buzz around the room increases:

Female teacher:	"Where did you get all of this stuff?"
Violet:	"That's how good Urban Advantage is"
Male teacher:	"You 'ear the word advantage…"

Violet: "…yes its taking advantage of the science institutions…

Male teacher: "..exactly…"

When I reviewed the video of this event, Violet showing the resources was clearly the highlight of the meeting. The conversation and noise level increased and there was positive energy generated around the idea of having access to the assortment of science resources presented. Laughter and joking increased and as the above exchange demonstrates, joking around the word "advantage" in Urban Advantage created a moment of solidarity amongst the science teachers—indicated by group laughter that collectively increased and subsided—at Central Brooklyn Middle School. On an unconscious level, Petal was beginning her goal of bringing teachers together to make science work for the school. The teachers were excited about having access to resources and four of them signed up to be part of Urban Advantage.

To use museum descriptors, Violet was the curator of the science resources in the school. This put her in a position of power, something that I did not feel she was comfortable with at times. For example, when an issue arose with the participation of the sixth grade teachers participating in Urban Advantage, Violet was more than happy to have me explain to one of the teachers why they were not able to receive the full resources, "I do not want them to think that I am keeping anything from them," Violet mentioned. She was happy to have the resources for the school, however she seemed conflicted about having the power that came with having the resources[5]. Perhaps also

[5] This same issue came up with other Lead Teachers—not wanting to be seen as "keeping the resources for themselves" or "the one who gets everything." While this issue did not become central to my research, it made me think of the notion of the possession of resources and the perception of power that it held for other teachers in the school. The Lead Teachers who

adding to Violet's discomfort was that since she was relatively new to the school she probably wondered what other teachers would think about her getting all of the "stuff,"—if there would be feelings of resentment or jealousy. This would contradict her goal of building solidarity amongst the science teachers for science at Central Brooklyn Middle School.

Hybridizing the Literacy Space

In early March, Brenda and Linda—two educators from one of the gardens—and I visited Violet's school in support of Exit Project implementation. Brenda and Linda were interested because of the number of Urban Advantage teachers that Violet managed to recruit from the school. Additionally, several of the teachers participated in workshops at the Garden as it is quite close to the school. When we entered Violet's classroom, which was now the science resource room, we were pleasantly greeted by the smell of Chinese take-away and an array of goodies that Violet had prepared for us, her guests. Alongside the prominently placed science resources, student projects were also displayed around the room to show the work that students have done with the Urban Advantage resources. While we waited for the meeting to begin, one of the 6th grade teachers approached us, "Ms. Violet said that you would like to see our classrooms."

We followed her downstairs to her room. When Brenda, Linda and I entered the classroom, as I expected the space was dominated with literacy and math posters and student work. She led us straight to a small rack of test tubes propped on a windowsill; each filled with a clear liquid that looked like water from across the room. Proudly she pointed out to us that these were the DNA extractions of various plants that she did with

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mentioned this conflict wanted as many resources that they could get for their own classroom; their own students, but were careful to get enough to share with others for what seems to be fear of isolating themselves from the others because of their possessions.

her students. Posted near the widow was a small poster of a plant cell. Amidst the literacy in this teacher's classroom, science has found a space. As DNA is the structure within the plant cells where the scientific process of creating hybrids takes place, the display of the DNA extractions in this teacher's classroom were evidence of the beginning of the hybridization of the literacy space to include science.

With Violet's involvement in Urban Advantage the school had started to develop a culture of science. Her enthusiasm around the resources and efforts to create a science resource room for the school seemed to create a catalytic energy in the school, even among teachers who were not science teachers. Although the Urban Advantage was earmarked for 8th and 7th grade students, the 6th grade teachers became interested because of the resources that the initiative brought to their school. The 6th grade teachers even brought their students to the end-of-year Science Expo so they could see what would be required of them in the later grades.

The Established Room

"The science classroom will be extended to all science teachers and science students. It is expected that we will all benefit from it," Violet proclaimed in one of her emails to me. The classroom finally established its place as central to science teaching and learning at Central Brooklyn Middle School. During one of my last visits to the school this year, I got to see the completed classroom. Since it was late in the term and some of the resources had been packed away, I did not get to see the room as fully set up, but there was evidence that it was an inquiry-based science classroom.

Student projects decorated the perimeter of the room and there were several student artifacts—two terrariums demonstrating global warming, beakers filled with crystals from a crystal growth experiment and ginger plants placed around the room alongside their corresponding projects. These projects contained elements of their apprenticeship in science—learning alongside Violet as she was learning alongside the staff at the museum. One of the projects pictured in figure 5.3 utilized resources that were purchased through Urban Advantage (the fish tanks). The theme of the project, "global warming" was one of the topics covered in the museum. These students became very interested in global warming after learning about the topic from Violet and viewing exhibits addressing global warming in the museum. They created their own demonstration of global warming—their visual display of a science topic.

Figure 5.3. Global warming project

Another project utilized the resources and project idea from the botanical garden (see figure 5.4). The student grew three common plants—an avocado, ginger and tomato—to see how they grew in comparison to one another. In the garden, the professional development included growing plants from foods commonly found in the market. Students using science to learn about their world was Violet's vision of science at

Figure 5.4. Growing plants

Central Brooklyn Middle School and these projects were evidence of Violet's dream coming true.

The remainder of the projects displayed varied in topic from mosquitoes to growing crystals. Violet allowed the students to explore whatever questions they had. It was important to her to foster their curiosity and personal interest, even though she later realized that having such a wide range of topics was difficult for her to manage. However she used all of the resources that she had at her disposal to help her students pursue their interests in science.

As the 8th grade assessment covers a variety of science topics, the displayed student projects demonstrated how learning in a variety of contexts supported Violet's teaching and her students' learning across the science curriculum. In the gardens she learned how to do life science studies with plants and at the American Museum of Natural History she learned how to do field investigations to study the Earth's processes. What Violet learned became a part of her classroom—she created her own diaspora of science by moving in between and learning in different science fields and she brought back her diasporic culture into her classroom where she enacted a creolized form of

science teaching and learning. This creolization of different science content and contexts in Violet's classroom enabled her students to pursue a variety of science interests and questions. In between the student projects, were some more of the Urban Advantage resources that recently came in and were still in boxes on the counter. True to being a hybridized space of science in an assessment driven school, Violet and her colleagues were using the space to grade the recent eighth grade exams.

Conclusions

Violet's expanded agency transformed the structure of science in her school. She was able to use her resources and capital to create an object/inquiry-based science classroom, and she became a science resource for other teachers in her school. Her association in a community of practice—the Lead Teachers—enabled her to identify with a community of educators with similar goals and pedagogies. Participating in this social network afforded her the opportunity to visit the other Lead Teacher schools to see how their classrooms were set up and how they were utilizing the Urban Advantage resources. These inter-visitations contributed to her creolized science teaching identity and hybridized learning space, as she, like the other Lead Teachers took pieces of their visits to each other's classrooms and made it their own in their own classrooms. Participation in this group also enabled her to envision her classroom as an active inquiry-based learning space and use her resources to hybridize a literacy classroom into a space of science inquiry. In doing so, she was able to extend her identity as a scientist, or "a curious person" as she described herself to her students by affording them the space and the resources to explore and actively engage in science.

Violet's transformation of her classroom also afforded school-wide structural changes in science. In Central Brooklyn Middle School, Violet became the enactment structure for the use of science resources to teach science. She had the resources, made them available to other teachers in the school, and shared her knowledge of science and how to use the resources with her colleagues. It was her ultimate goal to create a space where teachers could come and plan their lessons and gather the equipment they would need to demonstrate science concepts. Violet was well on her way to achieving this goal and was looking forward to starting the following school year with a well-equipped demonstration classroom.

My Changing Identity

My identity changed in respect to interacting with Violet and her students. At times I felt like I resumed my "Ms. Adams, science teacher" identity, especially when the students responded to my "teaching voice" and when they referred to me by last name (rather than my first name as is the practice in the museum). However most of the times, I was a resource—I came along with the objects and access afforded to Violet through Urban Advantage. Violet was always sure to point out that I was from the museum and that I was responsible for bringing Urban Advantage to the school. While I was happy that I was able to "help" this school in my community, I felt conflicted in my self-perception as a resource. For me, this is where the issue of race comes in—unfortunately, not many museum educators look like Violet, her students, or me; not many museum educators, or people who come into the school as "resources" are of Africanized decent.

During my teaching tenure, those who came from outside of the school to provide services and resources for the school were always white. The white not-for-profit types—

for many of them I felt as if they approached my predominantly minority school with a missionary fervor; they wanted to save the inner-city souls. They would often use the discourse of "these students" not having access to certain things and experiences. While they were right to an extent—many of my students had never been canoeing or visited a museum, to me they neglected to acknowledge the rich experiences that my students had that they have never experienced, such as picking and eating a mango fresh from a tree or being fluent in more than one language and/or having a culturally rich transnational lifeworld. They did not see value in the capital that the students already had. They approached the student from a deficit perspective—they could offer students the world, but the students had nothing to offer in return.

As a resource, when I am standing in front of a group of teachers and students of color, I wonder about their perception of me. Do they see me as removed from the community because of my association with the Museum—being associated with/employed by an institution that is seen as "white" by many people of color? When I reveal my previous teaching experience and/or my Caribbean ancestry, does it make me accepted as a member of the community? Am I seen as giving back to the community? These questions at times make me feel self conscious when I stand in front of students and especially teachers in Violet's school as I re/negotiate my identities as a teacher, museum educator, and member of the community.

Coda

When I began the research, I painted a picture of Central Brooklyn Middle School as lacking in science resources and using this as an indicator of the ailing structure for science in the school. Violet showed me the threadbare science lab and her science

classroom dominated by literacy and math mandates. In addition I was biased by my prior conceptions of Central Brooklyn Middle School as being a failing school so I went in looking for deficits and found them in Violet's science lab and classroom.

It was when I had the opportunity to discuss Violet's school with her during a summer museum program unrelated to Urban Advantage that I found out that Violet thought that her school was lacking in resources too, "that's because I did not know about the resources. It wasn't until Urban Advantage start[ed] pumping materials into the school and I start[ed] sharing with teachers, then is when they let me know that 'look, this is what we have'." The teachers who were in Central Brooklyn Middle School long before Violet revealed to her the resources that were tucked away in the classrooms and closets. Violet previously thought that the only resources that were available to her were the ones that she received from Urban Advantage:

> Now I am getting excited that I'm getting materials to work with, I don't want my classes alone to use these materials. [I] share[d] it with the other classes so that we could get the science going. Then is when I was told that this school has tons and tons of materials. Take for instance the rock samples that we got from Urban Advantage. I carry the rock samples and I show it to them and I said, "look what we have!" and then the teachers tell me 'we have a whole room full of rock.' When I tell you rock, we had thick rocks about this size (gestured with hands)—5lbs or more.

I asked Violet if the other teachers used the resources, she said that they were not, "in fact science teachers are seen as "teachers who teach on their seat and not on their feet." In other words, in her view, the science teachers were not active teachers; they did not use the resources available to make science come alive to their students. The teachers there before Violet were working within a structure that "played down" science, as Violet described, so the teachers were not encouraged to create interesting lessons and learning experiences for their students. As Violet described:

> There is one teacher there especially who said he was very enthusiastic when he arrived in the school 5 years ago. [He had] tons and tons of ideas, but everything he put forward was put down. It was put down by administration and then by the students.

The administration did not regard science instruction as important and thus contributed to the weak structure of science teaching and learning. This weak structure and negative attitude became a resource for students to reject any creative science teaching that a teacher would attempt to enact. This left effective science education and resources in the closet on the periphery of the schools' activity.

In spite of coming into this weak structure, Violet maintained a positive outlook on science teaching and learning, she mentioned that she has been doing whatever she can to make the lessons exciting, because "if the lessons are exciting, the students will want to learn." She extends her excitement towards getting teachers to use the resources "the materials are there, but somebody needs to get somebody excited. And I have a feeling that might be my job (laughs)." She believes that the science classroom that she has set up will be instrumental in bringing the teachers around,

> I know that these are teachers who can work but the will is not there. That is why I am hoping that this science classroom that I am given permission to set up and operate this school year; that I could fix it in such a way that administration allow teachers to use this room for at least for preparation. And if we have a special lesson, say for instance if we looking at the use of the pulleys, we could set up pulleys in the room and have students come to the room rather than have to dismantle them and take them to the classrooms every time. I am hoping that we could do things like that so that teachers could be encouraged. So, for this new school year I am not given a homeroom. I'm given the responsibility to have that room ready. I think we have made strides in that area.

Violet brought resources to the school and through her participation in the Lead Teacher group; she made these resources available to the entire school community to reach science teaching and learning goals. Violet's resources also enabled the other science

resources in the school literally and figuratively come out of the closet and become a part of the collection of resources and the individual|collective growing school practice of using resources to make science teaching and learning exciting for the science teachers and students at Central Brooklyn Middle School.

Chapter 6

Auto/ethnography and Auto/biography as a Lens to My Diasporic Identity

"Wherever one finds diasporas, one always finds precisely those complicated processes of negotiation and transculturation that characterize Caribbean culture." Stuart Hall (2001)

My Changing Construction of Learning

This chapter will address my diasporic identity and how it shapes my role as a researcher and multifield educator. As I outlined in chapter 1, I aimed for my research to be critical and emergent. While I was researching others, I was also a central subject/participant. Using the constructs of ontological and educative criteria (Guba & Lincoln, 1998) enabled me to look inward and examine my experiences as a researcher and educator. It also helped me to reflect on my process of doing research and how it transformed my construction of self in relation to others.

Learning as a Purely Cognitive Process

Coming from an empirical science background I sought to find/construct scientific theories that would describe how people learn in museums. I thought of learning as a purely cognitive process that happened in the brain in the absence of cultural influences so I wanted to learn how the brain processed the museum experience. I was interested in children's reading and comprehending science text; I hypothesized that developing readers used visualization as a strategy for comprehending text. As I wrote in my research paper:

> Objectives of this study are, first to determine if children show evidence of incorporating background knowledge from a museum visit into the text they are reading and second, to discern if the museum experience (through visual and verbal evidence) help to enhance children's understanding of the text.

I designed a study were I took subjects (my nieces and a friend's daughter) to a specific diorama. I taught them in front of the diorama about the deep ocean ecosystem in the same way that I would have taught a class. Approximately a week later, they read a related text entitled, *Creeps of the Deep* while I used the think-aloud protocol (Kucan & Beck, 1996) to determine whether or not they visualized images from the museum while they were reading the text. I aimed to answer the following questions: 1) do children show evidence of incorporating background knowledge (schema) from a diorama into the text that they are reading? 2) did the imagery from the diorama help enhance children's understanding of the text?

In doing my background research, I found that Sadoski, Paivio and Goetz's (1991) theory of dual coding supported my hypotheses. As I indicated in my paper, Sadoski, et. al. (1991) describe schema or prior knowledge in terms of the verbal representations and the nonverbal or sensory representations that are stored in the brain,

> The theory of dual coding (Sadoski, et. al., 1991) holds that cognition consists of the activity of two separate mental subsystems, one specialized for the representation and processing of information concerning nonverbal objects and events, and the other specialized for dealing with language. They describe verbal mental representations as logogens and nonverbal or sensory representations as imagens. Imagens could represent a natural order (or sound, feeling etc.), a part of that object, or a natural grouping of objects. According to Sadoski and Paivio (2001), during reading, these mental representations are activated by text features.

Based on this theory, because memory is processed and stored in two mental subsystems, people learning in places that allow for multisensory experiences, such as museums, would be better able to process and store information because each working memory system would not be overloaded. Reading and processing this theory, I pictured the brain as a file cabinet with the verbal documents and the nonverbal documents going into

separate drawers. When the information was needed, the separate documents would be retrieved from storage and reconstructed by referential connections (Sadoski et. al., 1991).

There was no mention in this theory about other aspects that influence learning and make memory, namely interactions with people and the integration of the new "imagens" and "logogens" into the existing ones to create new meaning. The dual coding implies that the memory is retrieved in the same condition in which it was stored—separating the knower from the known (Kincheloe, 2001).

When I did the think-aloud with my nieces, there were very few direct references to the museum. From what they reported to me, while they were reading the text many different experiences came to mind, most of it having nothing to do with deep ocean life, but to family memories and interactions around marine life. For example in response to the sentence, "Below the sunlight surface layer, the sea gets dim, dimmer and then dark," my niece responded, "it makes me think that the ocean is getting dark and its like in the deep sea when we went to the dock when we got the fish." Similarly, my colleague's daughter mentioned pirhana-type fish she saw when she visited the zoo with her patents. My subjects learned about fish and ocean life from lived experiences in school, at the museum, at home and through visiting other places and having other experiences. It is difficult to describe their interpretation and understanding of the text as simply a matter of neatly retrieving information, as learning is a function of complicated processes of social interactions and appropriating new schema and practices.

Moving Towards a Sociocultural View of Learning in Museums

As I moved towards a more comprehensive view of learning, I read Lienhardt and Crowley's (1998) work on museum learning as conversation elaboration and wanted to extend that study to learn how a museum educator and a scientists talked about a diorama as they used it as a teaching resource. Leinhardt and Crowley (1998) proposed learning that takes place in museums as a function of conversations between a cohesive conversational group (e.g., family groups, friends, individual with docents, etc.). Leinhardt and Crowely (1998) identified three dimensions—identity, explanatory engagement and learning environment—that simultaneously relate to conversational elaboration. This enabled be to begin to theoretically situate museum learning as a social activity. I also reviewed the edited volume, *Perspectives on Object-Centered Learning in Museums* (Paris, 2002) and began to understand that interpretation of objects in museums is associated with social interactions and the prior knowledge and experiences that the viewer brings to the interaction with the objects. I also accessed expert/novice theories, such as Wineberg (1991) and Rowe (2002) that proposed that experts use multiple cognitive strategies when interpreting objects. Thus, the cognitive activity of a museum educator and a scientist would be evident in their discourse about the same object.

On separate occasions, I prompted the museum educator and the scientist—who are both colleagues of mine—to talk about the mangrove display in the Milstein Hall of Ocean Life, in a similar way they would talk to a group of teachers. I recorded, and transcribed their conversations; and I borrowed from Leinhardt's (2003) descriptions of instructional explanations to code the transcriptions. I also to looked for evidence of the narrative mode in which teachers express their knowledge versus the paradigmatic mode

expressed by scientists and researchers as proposed by Munby, Russell, and Martin (2003).

The museum educator used narrative to allow the viewer to be a part of a story as it unfolded in the diorama. The scientist described the diorama with the objectivity often associated with the practice of science—she emphasizes the need to know the components in order to understand the system. This demonstrated that people's experiences in museums are related to their identities and cultures. Bringing her culture of being a scientist to bear in her interaction with the diorama, the scientist pointed out objects that represented facts and stressed knowing science content. Having a background in systematics, she emphasized learning the groups of the organisms in order to understand the whole ecosystem. The museum educator enacted a culture of storytelling by giving life to the diorama—she used action verbs to give life to the static diorama, prompting a viewer to note things "going on." In using questions or queries as a way of approaching the diorama, both the museum educator and the scientists were enacting a culture of teaching with objects and displays in a museum.

Learning as Cultural Re/production

I started from a purely cognitive framework and evolved towards a full sociocultural way of thinking about teaching and learning. Moving from learning as happening within the individual's brain—in the perceived absence of outside influences to—learning as cultural reproduction has been both a process of letting go and liberating. I had to let go of my preconceptions of learning as purely cognitive—a neat process of storing and retrieving information. It was liberating because it validated experiential learning—learning as active engagement in activity; learning as appropriating new schema and

resources. I believe that out-of-classroom experiences allow for learning opportunities that are unique and powerful and that these experiences are best described through sociocultural lens.

The different sociocultural lens also allowed me to make sense of my own experiences and identities with teaching and learning science. First, it expanded my definition of culture to include more than ethnic identity, customs and traditions. Viewing culture as a system of semiotic meanings and practices allowed me to see culture as being fluid and adaptive and inclusive of the identities that people take on when they learn and practice in different fields. Practicing science is cultural enactment, as is practicing science teaching and learning. The structure that teachers create to support science teaching and learning is a form of cultural re/production.

Secondly, using the sociocultural lenses enabled me to understand my cultural evolutions from being a classroom educator, to an out-of-classroom educator, to an out-of-classroom teacher educator, and finally to a researcher studying teachers learning to use out-of-classroom resources to teach. It allowed me to see myself as learning and incorporating different science teaching schema and practices into my identity as a science educator.

Finally, the sociocultural lens also allowed me to understand my ethnic-self. Being a part of the Caribbean diaspora allowed me to see science teaching and learning as a process of hybridization to produce a creolized culture. It is a process of hybridization—learning and appropriating new schema and resources that shape identity and practice. In the following sections, I describe my journey through science and

education and my personal creolization process and identity transformation as I traveled through different places where I learned and practiced science.

Similar|Difference

Much of the education literature that I have read places the culture of students in violent contrast to the culture of the school and situates the school as a bastion of white, middle class culture. However, this has not been my experience of schooling and of teaching in New York City. In the classrooms that I traveled through during my lifetime, I never felt that it stood in opposition to my home culture, but rather it either embraced or made me more aware of my home culture--which I would describe as a working class Caribbean-American culture as similar|different to those of my classmates. I also found that within the classrooms, there was a re/created culture that was not white middle class, but a hybrid of the embodied cultures that the students and teachers re/produced in the classroom (Roth, in press). From the warmth that I felt from my second-grade teacher with the Afro and bell bottoms, to the painful racism I experienced when I was bussed to an Italian-American school in Bensonhurst, to becoming a teacher in a high school in my community, my lived experience re/created my diasporic experience of learning and of teaching. These different learning spaces, although all located within some sort of school, did not represent one homogenous dominant school culture. The culture re/produced in each classroom was dialectically related to the students and the teacher whose lifeworlds unfolded in each classroom.

I have found that the experience of teaching and learning in New York City is an experience of intracultural and transcultural education. Teaching and learning in New York City is teaching and learning within a diaspora where in any given classroom, one

can find teachers and students of a variety of cultures, many of them first and second generation Americans still very connected to their cultures of origin. As people of similar cultures tend to live in the same neighborhoods, New York City has many culturally re/created communities that become reflected in community schools.

> Waters (2001) describes West Indians as quintessential postmodern peoples,
>
> The influence of the capitalist system, the interpenetration of cultures in the created societies of the Caribbean, and the long-standing role of migration in the everyday lives and life cycles of the region's population all point to the kinds of situational, multilayerd, and socially constructed identities that are said to characterize the post modern world (Waters 2001, p. 203).

In this chapter, I use auto/ethnography and auto/biography to turn the lens on my Self in order examine my socially constructed diasporic identity as a Caribbean-American woman and science educator. I examine the experiences in my personal expansive cycle—forming a new identity based on a preceding one (Engström, 1993) that led me through the classroom, to the classroom and out-of-[the]-classroom as I learned and appropriated new and different cultures—the culture of science teaching and learning that I enacted as I journeyed through my lived experience as a learner and teacher.

Living a Diasporic Life

I was born and raised in a Caribbean diaspora within Brooklyn NY. At first the diaspora was within my home, with my mother being from Jamaican and my father a descendant of a Portuguese-St. Kittian mother and Antiguan father. It was through my grandfather and my mother that I learned my first language of Creole English. My mother endearingly described my speech, which was also her speech, as "talking bad." Talking bad meant that I spoke Patwa (Patois) well.

My first educational diaspora happened when I sent out of my home and community and bussed to school in Bensonhurst, This experience was a painful one as I experience prejudice and racism from both sides—the African American kids on the bus teased me because I had an accent and wore ribbons that my Aunties sent from England. The white, mostly Italian American kids and my Jewish-American second-grade teacher shunned me because I was black. Ironically, my best friend, Lenore was an Irish-American girl living her own diaspora of being the only white family on an African-American block.

Since I was considered a smart student, both teachers and guidance counselors encouraged my parents to have me bussed from my predominantly African-American and Latino school across the borough to a "better" school. I had fond memories of my first school and was above reading and math levels for my grade when I left. Bussing would afford me the opportunity to receive a good education, implying that staying in the neighborhood meant that I would receive a less than adequate education. My parents were never told that I was going to be bussed in an effort to desegregate the white schools—I don't remember any white children desegregating the neighborhood school. Although not stated outright, the discourse of good vs. bad schools became racialized and re/produced however my grades quickly plummeted due to the prejudice and racism that I experienced in the better school.

My family moved to Flatbush when I was 10 years old. This was a neighborhood that was rapidly transforming in to a Caribbean-American community as the phenomena of white-flight sent the remaining white families to the suburbs. My Aunt Nell lived across the street from us, she was one of the first Caribbean people/black people to move

on the block. It was between the triangle of my family's home, my Aunt's home and my community that I began to experience the Caribbean diaspora outside of my home. Instead of having to drive to Moore Street market to buy yams from the Puerto Ricans we could now buy them from the Korean stores within our community. This was also the first time when I felt proud to be Caribbean, as the same African Americans who teased me for my accent now listened to reggae, tried to emulate Jamaican speech and donned the red, gold and green.

My educational diaspora led me to an all-girl Catholic High School, an evangelical college in the Midwest, and eventually back to Brooklyn where I became a high school science teacher. I decided to become a teacher because I had the science credits, the city needed science teachers and I needed a steady job with benefits. My track teammate recently became a teacher and encouraged me to visit the recruitment office at 65 Court Street and do the same. For her, teaching was also a means to a steady job with good benefits, but additionally it was the opportunity to afford to send money back home (Antigua) to support her mother and by land for an eventual return.

65 Court Street

"Hi Fran, I have a beautiful, young African American candidate here…okay…" A recruiter for the Board of Education called my would-be supervisor.

I sat there listening nervously, clutching my "Teach for NY" folder filled with red tape. "What am I doing here?" the butterflies in my stomach led me into deep thought. I reminisced about my high school days; my teachers in particular and how much fun some of my classes were. I thought about Ms. Jamison, my math teacher who helped me to find a date for a cotillion and I smiled when I remembered one of Sister

John Joseph's—my homeroom teacher—favorite lines, "youth is wasted on the young." Somewhere in the limbo of being youthful and young, I was making my first career change from being a physical therapist assistant to being a NYC DHS GS/Bio Teacher. The butterflies multiplied and fluttered wildly.

"…I will send her right over…you have a great day too!" The recruiter hung up the phone, gave me the paperwork and sent me on my way.

Ten o'clock am, the following morning, I entered South Shore H.S. The halls were quiet as the kids were all in classes. I met Ms. Fran Salom, the science assistant principal and the principal, Ms. Stempel. Fran took my letter and looked over my folder. I was waiting for my moment to be enthusiastic and articulate and talk about my only teaching experience, which was a Sunday School teacher during my teen-aged years. Ms. Salom put the folder down and looked over her glasses straight at me. I was about to open my mouth…

"When can you start?" She stared.

A few days later, Ms. Salom handed me a Delaney book and the spiral-bound Regent's Competency Test (RCT) practice book. She also gave me the keys to my classroom and the staff bathroom, and my schedule and then wished me good luck. This was the beginning of my professional educator self, my identity as "Ms. Adams." My father, who was a Metropolitan Transit Authority bus driver, was proud that I had a city job with benefits. My mother, on the other hand was worried because she heard that South Shore was a rough school. I did not know much about the school; I only remember that Mickey, one of the teenagers on my block when I was growing up, wore the schools' purple and gold track uniform.

Bringing my Diasporic Identity into Teaching Science

On my first day of teaching, I wrote "aim" on the board because I remembered that's what my High School teachers wrote. I also had the student fill out Delaney cards because I was told that this would help me to learn the students' names and keep order in the classroom. I prepared lesson plans, but as I really did not know what a lesson plan was. Mine consisted of a bunch of definitions that I copied from the RCT book—it looked more like a vocabulary list. I did not know how to enact elements of classroom teaching culture such as positioning in front of a blackboard so the students could see what you have written, or how to write and talk at the same time, nor did I know how to apply enough pressure on the chalk so that it would be legible to students seated in the first row, "Miss, I can't see what you wrote!" I used fat, yellow sidewalk chalk until I figured that out. My first 2.5 months of teaching was a daily emotional whirlwind that ended with me crying on the sofa each night and wondering how I would make it through the next day. "It will be better once you get your classes at the beginning of the term." one of my veteran colleagues told me. "This way you will establish your class rules from the beginning." By the time I started teaching in November, my classes had gone through a number of substitute teachers, each of them lasting no more than a couple of weeks. Therefore my classes had no established science classroom culture. What made matters worse was the fact that they were 9th graders who had yet to establish a culture of being high school students.

It did not get better until the term ended and I spent the midwinter days grading papers. It was during this time that I was able to have a good look at my colleagues. I was the youngest member of the science department with the next youngest being more than

20 years my senior. At the time, I was also the only person of color in the department. Most of my colleagues were over 40, Jewish and former Brooklyn residents who now lived in the suburbs of Long Island. They were a part of the white flight that left Brooklyn to the Caribbeans; one of my colleagues often told me stories of hanging out at a major cross section in the heart of my community during his youth. In my community one group of historically diasporized people replaced another. In my school, these two diasporized peoples were connected by education, but separated by age and culture. I stood in the middle of these two groups. On one hand, I was a Caribbean-American young person, not much older than those who sat in our classrooms. On the other hand I was also one of their colleagues, who was told that I should look to Long Island for a teaching job for better pay and better students. They treated me as a colleague although they were quick to remind me of the age that separated us. They also (consciously or subconsciously) reminded me that I was also one of the *others*; their comments about the downward spiral of the school and quality of the students—"its just not like it used to be"—stung like a sharp blade of grass as I knew these comments also referred to the blackening and/or the Caribbeanization of the school. There were a few white and Jewish students left. They were protected from the incoming diaspora by being sheltered in "honors" classes.

As a same|other the veteran science teachers took the time to help me learn the tricks of the trade. "Don't smile for the first, at least, three weeks." "Tell them that you have the power of the red pen!" "Have a book for them to sign out the hall pass and only let not more than three students out during one period." These were among the suggestions that the teachers offered to help me get my first full term started in control. I

eagerly wrote down all of their suggestions and created my first lesson plan entitled "class rules and regulations." I read the rules to my first class and got the expected teeth kissing, eyes rolling, and stares with attitude. After all these were *my* people, I knew what to expect. Although my stomach was churning with anxiety, I read my "rules" lesson plan with the same degree of attitude and even stopped once to let them know, "if I get attitude, I can give it right back. It is my attitude towards you that counts as I have the power of the red pen…"

During the first few weeks of my new term, I chalked and talked. I asked questions, and the students looked at their notes and responded. It was about establishing control and order—that was to be my priority as my colleagues told me. I should not bring in the demos until I have established the order. Compared to my first term, my class was orderly. Students came on time, sat in their assigned seats and spoke when spoken to. I was ready to burn peanuts—I was ready to bring resources into the classroom to demonstrate science.

The Demonstration

I was teaching about heat and energy, so Mr. Haas showed me how to burn peanuts to demonstrate calories—the amount of energy it took to raise one milliliter of water 1° Celsius. He set up the demonstration for me and I put it on a metal cart and wheeled it to the classroom.

"What is that Miss?" Upon seeing the contraption on the desk, the students became curious. "You will see in a bit." I responded like a magician with a carefully planned trick. Their assigned homework reading had to do with calories and energy, so I asked questions like "what is a calorie?" and some of them—those who actually did the

homework—answered. I burned the peanut to demonstrate a calorie and all I got was a smoky and smelly mess and the students could not see the temperature rise on the small thermometer in front of the room. I did not have time to recover from the embarrassment of my demo failure before the first class left and the next class entered. I had no choice but to repeat the lesson and the demo. Only this time, I had the students in the front of the room do the demo with my verbal instructions. When the demo students took their place behind my desk, my classroom became a performance space. Comically, the two male students did the demo and wrote the results on the board in a stylized graffiti. I laughed and my students were shocked that I was laughing. I was also surprised that I laughed—my first couple of weeks of no smiling was not yet over and here I was laughing. I worried that I had broken a cardinal rule of teaching and fretted that my class would disintegrate into the chaos that was my first term. Luckily none of that happened. Although by nature I am not a jovial person, my classroom became a place of laughter and students found humor in my non-humor, "Yo, she said that with a straight face, she got jokes!"

The burning peanuts helped me to connect with my students in a way that I could not with the chalk and "rules." As I brought more objects and demos into my classroom, the students became more active participants in the process of learning and creating. I also felt like I became more than just a teacher, perhaps because I was similar in age and culture, I became like an older sibling or young aunt. Because I was a science teacher, I was like the smart relative—so I was expected to be quiet and conservative. In the Caribbean community everyone seems to have those studious relatives that would rather read than play outside or listen to the latest tunes. "I bet you got good grades Miss," my

students openly surmised. I remember the gasps that I heard when I reached over my head accidentally revealing a recently pierced navel.

In addition to teaching science, I participated in other school activities like being a part of the senior advisor team and staying late to practice with the track team. I began to feel like a hybridized student and teacher where sometimes I was participating in my school life as an adult and at other times more like a student. On many occasions, cops outside of the school would accuse me of being truant and within the school new security guards and teachers who did not know me would ask for my hall pass.

Moving my Diaspora Out of the Classroom

With the Outward Bound club, I had my first experience of winter backpacking. Along with 7 students, including one recent immigrant from Jamaica and two teachers, I left the warmth of the 13-passenger van for two nights of sleeping under the stars in Harriman State Park. It was in early march and we were still experiencing the deep cold of the winter months. The air and ground were so frigid that when I peed, the steam from the warmth of my body was immediately replaced with ice crystals. From the top of a mountain I saw the orange glow of the city—for the first time in a long time I wished that the weekend would go by faster to that I could once again be a part of the life underneath those lights. During the days we did orienteering and hiked and during the night made a lean-to and tried to sleep. On Sunday morning, my Jamaican student was yelling, “Miss, I can’t feel mi foot!” woke me up. While he slept, my poor student slid out of the tarp in his sleeping bag, leaving his feet exposed to the cold night air. I thought this was harsh welcome to the unfamiliar climate, however once we started walking his feet were okay. Mine however, were numb for three days.

The Outward Bound club allowed me to access a culture of enjoyment of nature through outdoors sports. Although I always enjoyed nature, my outdoors activities were mostly family outings to the beaches and local state and national parks. My mother, a true country girl always talked about "roaming the bush" and climbing trees for fruit and for hiding when she grew up in Jamaica and always aimed to re/create those experiences whenever my family visited a state park. I would follow her along the trails and my eyes would follow her upward as she disappeared in the leaves of a tree. When I hiked with the Outward Bound club (in warmer weather!) I sometimes felt like I re/created my mother's lived experience in Jamaica. I bought field guides to learn about the different types of flora and the healing properties that they may hold. I bought the appropriate gear to keep my feet steady and my body dry on the trail. I learned many skills—hiking, backpacking, rock climbing and canoeing—through Outward Bound and I welcomed the opportunity to team-teach an environmental science class with an Outward Bound instructor. This allowed a class of about 40 students to have access to what I was experiencing as I lived and learned nature.

With the class, we canoed in Jamaica Bay to learn about the estuary and we climbed the 55-foot Alpine Tower to model surmounting challenges in learning and life. In the classroom, we rearranged the desks to accommodate the map-making, water testing and other group activities that became the structure of the classroom. Through journaling, we created a culture of personal writing, reading and reflecting—unwittingly bringing literacy practices into the study of science. For the final activity of the semester, we took the students out of the classroom into the courtyard at the center of the school. The collected leaves and identified the different weeds and plant found in the courtyard. They

brought their collections back to the classroom where they used my books to look up the plants and determine their medicinal uses. With index cards and contact paper, they recreated botanical specimen cards and created a botanical guide to the courtyard. For me, the courtyard became a metaphor for the notion of out-of-classroom experiences as being central to science teaching and learning.

Becoming a Museum Educator

At the end of my flamenco class, I went to pay my *maestra* and chat with her a bit, at the same time, one of her dancers who was on a hiatus and recently returned to class was chatting with her as well about her current job. I mentioned to La Meira that I was no longer teaching but looking for a steady job (at the time I was doing per diem work for Outward Bound). Chrissy, the dancer asked me what I did, and I told her that I was a science teacher. I asked her where she worked and she said, "I work at the American Museum of Natural History."

"Wow, I love that place, I've always wanted to work there!" I responded.

"Well, we are looking for a science teacher, please send me your resume." She suggested. After several months, I was called in for an interview—it was for a position of coordinating a middle school science program. I got the job and continued my teaching career as a museum educator. For me it was a dream job as it afforded me permanent access to the museum's resources, which was way more that the few hours that my school schedule and distance previously allowed.

The funder of the program I was hired to coordinate wanted it to be a program for whom he referred to as disadvantaged kids. The group of students that started the program was a diverse group excited about science. When the funder saw the group that

consisted of African American, Caribbean American, Puerto Rican, and Asian students, he said that the group did not *look* disadvantaged. I read this to mean that the group did not look black enough. These students were from communities that were rich in culture, but poor in access to science and quality education. Two of the students—a Trinidadian girl and her Caribbeanized Vietnamese best friend, Loretta—came from my community. Loretta has graduated to the high school program, and still visits me at my desk. I related to her in a similar way that I did to my Caribbean students. In what Spears (1999) would describe as directness—speech events deployed in the context of consciously manipulated interpersonal drama (p. 5). She tells me my desk is messy, I tell her to clean it, she calls me evil and I call her annoying. These speech events may seem negative to those outside of Caribbean culture, however members of the Caribbean speech community are able to correctly interpret these events for what they are. Loretta coming from a Caribbean school and community has been hybridized into the culture and language of the community and therefore unconsciously knows how to re/create the drama that the directness intends.

Loretta won an award for an essay that she wrote about finding worms for fishing in a community park. Like me, she is a diasporic child with a hybridized cultural identity that includes science. Her and my experience traveling between cultures makes me think of the spider crabs of the Majidae family that pick up bits and pieces of algae, shells and marine life to decorate/camouflage their shells. Although it remains a spider crab, its identity changes as it visits different places and incorporates pieces of the things that it came across in its travels into its being. Lemke (2001) describes the role of experience of stirring us to a "heightened vitality" (p. 309) and contributing to the development of our

identities. My teaching, learning and lived experiences in various cultural contexts have shaped who I am as an educator and as an individual with eclectic interests.

I coordinated the middle school science program for a spring and summer before moving into professional development. For me, summer was like the boot camp of learning to teaching in a museum. I began learn how to use the objects and dioramas in the halls to do observations and my questions moved from being didactic to open-ended. I learned how to bring student observations back into the classroom space where they recreated models, dioramas and art based on what they experienced in the halls. That summer, we learned about paleontology and anatomy though the observation of dinosaur fossils and models from Mongolia.

When I moved into professional development I used what I learned to teach other teachers how to use the Museum's resources to teach science with their students. As I was teaching, I was also learning. I tagged along during my colleague's workshops and read research about learning in museums. I learned about Falk and Dierking's (2001) notion of free choice learning, which they describe as self-paced and voluntary. While I thought that this applied to the Museum's casual visitors, I wondered how this applied to teachers who come to the Museum with specific teaching and learning goals? As I began to create a structure that allowed other teachers to have access to the Museum's science resources, I began to ask myself questions about the nature of learning in a museum in the context of classroom teaching goals and implications for teaching teachers how to use the museum to enact standards/curriculum-based teaching and learning.

As I read more about museum learning, I had more questions about using the museum's resources to teach and learn science in the era of standardized assessments. In

the advent of NCLB, I guess that museums would have to justify fieldtrips within the context of the mandates if students were to continue coming—I pictured school administrators denying fieldtrips because they were only enrichment activities, not central to the teaching and learning the content required to pass the standardized exams. Museums would probably have to prove them wrong.

With these questions in mind, I entered the doctoral program in Urban Education at the Graduate Center. I initially wanted to pursue a doctoral degree because it was the thing that a smart Caribbean-American daughter should do (especially since I decided to teach instead of going to medical school). After entering the program however, I began to question my smartness and whether or not I was scholar material.

Coming from a quantititative science background, I found the largely qualitative reading and writing challenging. I never thought of myself as a good writer and always struggled with using correct grammar and words. I knew that my struggles were similar to people for who English was a second language. It was not until I took a linguistics course about Creole and Pidgin languages that I realized that English was my second language and that Creole English; my first language was a legitimate language and not just "bad" speaking. For me, this explained my difficulty in pronouncing certain words and finding the "correct" words to describe certain things (for example, I cannot find a better verb than "cotch" to describe placing something temporarily in a spot or holding a door open with something for a moment). As a result of the linguistics course, although I still have insecurities about my speech, I became more aware of my speech patterns and those of people around me.

I was personally and intellectually challenged by the cultural studies that I was reading where everything was genderized, racialized, and problematized. I did not think in those terms, perhaps because I lived my life in genderized, racialized, and problematized contexts, unpacking it would have been a long and painful process. I did not want to be described in those terms and neither did I want to be put in a scholar's box that described me in those terms—a Caribbean-American, urban, woman of color scholar. I just wanted to be a scholar who studied learning in museums and science education.

However after learning/realizing more about how my culture and life experiences influenced who I am—who I have become, no matter how much I wanted to be the faceless scholar, those terms mentioned above are a part of who I am and make up the lens through which I interpret my world. It was through my red, green and gold lens that I asked my research questions and chose how to collect and interpret my data. My lens led me to study a particular group of teachers and choose one of them, in particular, to be my case study.

Re/living my Ms. Adams Identity in my Research

> I feel comfortable in Violet's class. I feel like I am reliving a part of my Ms. Adams identity without the full responsibility [of a classroom]. I don't feel like an outsider even though I am. The kids [who remember my name] call me Ms. Adams and to the others I am "the Urban Advantage lady." However, they see Petal and the science authority. Some of the students she's had since 6th grade. Several times when a student raised their hand and I responded they would remark, "maybe you don't know this but…" because it was a science content question. They knew that their science teacher had the answers (Field Notes January, 12, 2006.)

I often reflect on my years of classroom teaching, especially recently when I spent time in Violet's classroom for my dissertation research. In her classroom, I felt like I was between worlds, similar to how I feel about my Jamaican identity—I am *of* Jamaica, but

not from Jamaica. Jamaica is a part of who I am, but I was not born there. In the case of the classroom—I am from the classroom but not of the classroom. My identity as a science educator stems from my experience as a classroom teacher, but I am not currently of a classroom. During my dissertation research, I felt like the *of* was an apparition—a ghostly reminder of what I once was. I would stand in the classroom and felt the urge to take my place between the students and the chalkboard, like it is a part of my habitus, but I had to stay on the periphery because now I was a resource to the classroom. The experience of doing research in a classroom was an exercise of re/constructing my identity as a museum educator and serving as a resource for a classroom teacher. This happened while Violet was re/constructing her science teaching identity around access to and participation in the education of the museum.

Re/connecting with My Caribbean Roots.

When I went first visited Violet's school to begin my case study, one of the first things that I noticed was the student artwork that decorated the office and the halls. In the office there were popsicle-stick houses painted in the pinks and blues of houses in the Caribbean. Hanging in the halls were 3-D collages painted in the colors of Caribbean flags. As I walked through the halls towards Violet's classroom, I saw some students with the flag bracelets and bandanas and I heard the accents and idioms that were familiar to me. When I visited her Assistant Principal's office, I noticed his Trinidadian flag and a picture of a beach scene facing his desk, perhaps a reminder of a quiet spot "back home."

Like the school where I taught for seven years, Central Brooklyn Middle School was what I would describe as a Caribbean school. Violet, was a Caribbean teacher, so like myself, Violet was a Caribbean teacher of Caribbean students in America. The

primary difference is that unlike Violet, I was not born and raised in the Caribbean, I am what Rogers (2001) describes as an ethnically identified Caribbean—on West Indian American Day (Labor Day to everyone else) I don a Jamaican bandana.

The Disadvantage of Caribbean Schools

The distribution of disadvantage seems to reflect the ethnicity of students in a school. After growing up in New York City and teaching in public schools in New York City my impression is that the most disadvantaged schools are those that have the highest proportion of black students. in comparison schools with high proportions white and Asian students have many more resources to support teaching and learning.

This notion came up when Violet and I visited one of the Lead Teacher's schools. "Wow, now I can see where they put the resources." Violet remarked to me after visiting one of the schools. The middle school, located in a diverse Asian and white section of the city, had a brand new science lab equipped with hood and safety equipment that was donated by a politician. She also saw the teachers' science classrooms that were filled with a large variety and number of science resources. I am sure that Violet reflected on her own school (as I did). The science lab in her school has almost nothing—just a few plastic cylinders and obsolete Macs pushed in a corner. Her science classroom is evolving to incorporate the resources that she has received from Urban Advantage, but they are limited in number. "You see, they do not put the resources here [in her school] as a way to keep the community down. Uneducated children become uneducated adults that never leave the community." Violet commented. Bobb and Clarke (2001) noted, "the children of West Indian immigrants living in an urban area are likely to attend a school with a

predominantly black student body and inadequate funding and resources." (p. 224) To Violet, this was evident when she saw the other school in comparison to hers.

According to Bobb and Clarke (2001), West Indian immigrants and second-generation experience an unequal educational system, and "this inequality affects their belief in the value of an education." (p. 224). West Indian students learn that black schools are less valued than white and therefore if they are educated in black schools, their educations are less valuable than from a white school. Unfortunately, West Indian teachers, such as Violet, also share this notion. When she saw the well-equipped, bright lab, she immediately made the association between the better lab and the race of the community where the school is located. I mentioned this vignette to my dissertation advisor and he asked be if I believed what Violet said; I briefly thought about it and responded with a tentative yes. Intellectually I knew that there are reasons other than race—such as having a strong political base in the community—that lead to such a disparity in schools, However, it seems that I have also internalized the idea that resources have been purposely kept away from predominantly black schools.

"Getting on Bad"

When I visited Violet's class on one occasion, she was working with her students on preparing PowerPoint presentations of their science Exit Projects. Specifically, she was teaching them how to include pictures in their presentations. As she was working with one student's presentation, she asked him for his pictures. "I have it right here Ms. Violet!" the student called out as he presented Violet with a small red object. "Ms. Adams, this student is getting on bad with his flash drive!" Violet said as the plugged the red object into the USB port of her laptop and continued to work.

I smiled when Violet described her student as "getting on bad" in relation to his science project. Although this idiom is commonly used to describe someone having a good time, it is also used to point out that someone has done something successfully, or to refer to bravery or accomplishment in something, In other words, to carry on bad is to do something well. It is a semantic broadening of the word "bad" to mean good, while it still maintains its original meaning. This semantic broadening is characteristic of Creole languages (Holm, 2000), which includes the Creole English that is one of the languages that Violet speaks. Violet used this phrase because she was proud that her student took the initiative to use his flash drive to progress with his science project, she was proud of his adept use of technology and as she mentioned to me, she uses Creole English when she wants to place emphasis; when she wants her students to know that she means what she says.

Caribbean scholar Donald Winford (2002) defines languages as "vehicles of social interaction and badges of social identity" (p. 13). Sharing a common home language with her students, Violet was able to use this language in the classroom to support her students' progress in science. In subsequent classes, other students began to make use of flash drives to work on and save their projects. They too wanted to be acknowledged for getting on bad. Using this familiar language in the classroom identified Violet and her students as Caribbean people and became a vehicle for the re/production of science identities amongst her students. She said that understanding the culture of the students was the main way of "getting through to them," and when I asked her in what ways, "we speak the language," was her response. "English language is the basic, but there's the sort of Creole language, when you use it they know that you understand what

they're saying and they know that you mean what you say," Violet elaborated.

Violet describes her school as a Caribbean school, "If they are not from the Caribbean themselves they're parents are from the Caribbean. It's a school that's more than 90% Caribbean background." Central Brooklyn Middle school is located in a predominantly Caribbean section of Brooklyn. It is the same community where I grew up and currently live and is dominated by Creole English.

I grew up listening to and speaking Creole English with my mother and my paternal grandfather who was from Antigua. When I went to school, I was teased for my accent and "nonstandard" sentence structure, so I quickly and forcefully tried to emulate African American English so that my peers would accept me. While I neither got accepted by my peers (I was *still* a coconut) nor became fluent in African American English, I lost my Caribbean accent and fluency in Creole English. Presently, I speak a few phrases—mostly common idioms, but I never lost my fluency in understanding my language, and my accent resurfaces when I interact with other Caribbean people, including when I interacted with my Caribbean students in the classroom.

Violet uses Creole English in her middle school classroom to maintain a sense of order as she recalls in one incident:

> …and there was one particular girl especially she would want to disrespect people in the class. And when she tried it with me one day, I say, "don't take you eyes past me!" Don't take your eyes past mean that I am coming behind you! She knew that when I said that, she had to stop! So using their language, helps to control behavior in the class and if the behavior is controlled then teaching and learning could take place.

Language is a way of creating social identities and social networks (Winford, 2002), in the classroom language helps to establish a sense of belonging to a community or a way

of bringing the sense of community into the school and classroom. In my classes that were mostly Caribbean, I noticed that my Caribbean accent was stronger and my use of idioms was more frequent. In one particular class, where the students were spread out among the lab tables, when they were not doing lab work, many of them moved to a long desk adjacent to my desk at the front of the room—making the community physically closer. In between discussions of diseases of the circulatory system were stories of grandmothers and their healing teas. A lesson about evolution led to a discussion of ancestors and eventually their ghosts, issues of cultural importance to Caribbean people, as there is a belief in the supernatural. My classroom evolved into a space of collateral learning (Jegede, 1999) where we discussed both Caribbean and mainstream (as found in the curriculum) meanings of science. The classroom became a creolized space of science meaning—the Creolized people creolizing the science teaching and learning space. Since I also had the luxury of not teaching to a standardized test we had time to explore these constructs as they came up in the class whether or not they were a part of the curriculum.

Creolizing Science

Through my lived experiences and my interpretation of Violet, science and science teaching is an important part of who we are. Kozoll and Osborne (2002) cite, "identity becomes inclusive of what a person believes, values and wants to become professionally and personally (p. 181). Violet wishes that science becomes central to each of her student's lives, and my hope is that learning in a museum becomes central to science teaching and learning in New York City's schools. In a reflection about teaching about earthquakes, Violet wrote:

> It is important for middle and high school students to be taught about earthquakes so that there is a well-informed society. Most importantly, students should be

> taught about earthquakes so that some of them can become scientists to continue studies of earthquakes.

For Violet, the science is key to having an educated and knowledgeable society. Tobin (personal communication, 8/28/06) stated, "multifield enactment demands creolized sciences." If we aim to have a scientifically literate society, science has to be taught in a way that people can make it their own and enact it in their lifeworlds. Winford (2002) describes ideologies of language as having the "power not only to shape the way people talk and interact generally, but also to naturalize relations of power and privilege." (p. 8). Caribbean language has been regarded historically as poor English compared to standardized English—or the Queen's English as it is commonly called. The validation of Creole English as a legitimate language has empowered its speakers to use their language on television broadcasts and in printed media—it has moved out of the streets and home to become a validated part of public—that part that is accessible to the world—Caribbean life and this has made Caribbean language and culture accessible to a wider range of people, including scholars wanting to study it. In the same way, the creolization of science as is happening in the classroom has to move out and begin to creolize science as practiced, interpreted and displayed in the labs and institutions so that science becomes more accepting of the notion that there are multiple ways of seeing and interpreting the natural world and goes beyond the idea that the Cartesian-Newtonian ways of seeing and interpreting the world is the only reality worth discussing in academic settings (Kincheloe, 2001 p. 475).

I believe that science has a lot to learn from the very culture that it has (anthropologically) tried to describe and define. Like most culture, the Caribbean cannot be described in homogenous and fixed terms—Caribbean culture is diverse and the

language, music, food, etc. sounds, looks, smells different on every island and in every re/created community in the former colonizing countries. The very nature of the histories and processes that contributed to the formation of Caribbean culture lends itself to movement and fluidity—even in literal terms when describing the ocean that so many had to cross to get to the islands.

Science and scientists could learn that science is not one objective reality, but interpretive depending on which culturally bound human being is doing the research. Scientists also have different goals—one may be studying a forest to save it while the other may be studying it to harvest it—each of these goals will come into play in what each scientist chooses to observe, how she interprets her observations and how she presents her findings.

As science educators, we can acknowledge the creolization of science as it happens in ourselves and in our practice. This would enable us to recognize the creolization process as we teach others to teach and learn science. We could create structures that allow students to access and appropriate scientific knowledge ways that encourage the process of hybridization and enable students to see science as a part of their everyday life experiences. Using beyond-the-classroom resources, such as museums, zoos, and botanical gardens is one way of allowing teachers and students to learn science in different fields. This affords them the experience of producing a new creolized culture of science that is responsive to their identities.

Chapter 7

Conclusions and Implications

Jah come to break downpression, Rule equality
Wipe away transgression, Set the captives free.
-Robert Nesta Marley

The major goals of Urban Advantage teacher education were the development of scientific knowledge and content for teaching middle school science, teach processes and theories of doing and teaching science outside the classroom, and provide important tools and skill sets to build the capacity of highly qualified and high-quality science teachers within New York City's middle schools. Wilson and Berne (1999) cited "professional teaching knowledge might include knowledge of subject matter, of individual students, of cultural differences across groups of students, of learning, and of pedagogy" (p. 177). Professional teaching knowledge can also be described as professional teaching culture as it describes integral aspects of the schema and practices that teachers have to acquire and use to be effective pedagogues.

Teaching in a large, multicultural urban center like New York City, science teachers not only have to know and be able to teach high quality science content but they also have to know their students. They need to know who is in their classrooms and how to provide a structure that affords all students access to high-quality science learning experiences. Violet described it as being a culturally connected teacher:

> Being culturally connected makes the teacher see the student not so much as a student but as a child. And the child sees the teacher not so much as a teacher but as another person who wants better for them. And so it's like one community rather than two communities, it's more like we're doing this together rather than the teacher wants me to do it. And in that way we get things done, a little faster than we would get it done if we look at it as a teacher/student relationship.

Although Violet's response was to a question regarding her being a Caribbean-American teacher of Caribbean-American students, I believe that the cultural connectedness goes beyond having a common ethnic culture. It is being aware of the cultures that are in the classroom—that of the teacher and the students—and how to adapt science teaching and learning to best fit the needs of the classroom culture. Roth (2006) describes the convergence of different cultures (including that of science) in the classroom as a process of hybridization that produces a creolized culture of science teaching and learning. In the Urban Advantage initiative, the classroom culture was further creolized to include using the resources of cultural institutions to teach and learn science. The combination of Urban Advantage and the existing ethnically diverse experience of teaching and learning in New York City produced a multicultural/multifield culture of science teaching and learning.

High-quality professional development provides teachers with opportunities to build on existing culture and acquire new cultural resources. Urban Advantage afforded teachers opportunities to learn and practice science teaching and learning in different fields. Teachers learned to enact standards and assessment-based science teaching and learning in New York City's science-rich museums, zoos, and botanical gardens. Wilson and Berne (1999) describe quality professional development as affording teachers the ability to gain professional knowledge through providing the following: "1) opportunities to talk about and practice subject matter, 2) opportunities to talk about students and learning, and 3) opportunities to talk about teaching" (p. 177). The individual|collective of the Urban Advantage Lead Teachers had opportunities to build professional knowledge by participating in a community of practice where they talked about multifield

science teaching and learning and co-constructed shared meanings about using the new resources to teach and learn science.

Summary of The Study

In the preceding chapters I described my experience with the Urban Advantage Lead Teachers as they formed a community of practice around using the resources of the museum to teach science. I situated their community in between the museum and classroom fields as cultural liaisons and described their primary role as creating enactment structures that enabled other teachers to effectively use the museums to teach science and implement the Exit Projects. I also examined the Lead Teachers vis-à-vis the cultural institutions and explained the central|peripheral dialectic that defined their interactions with the museum educators and the practice of science in the museums. As I moved my lens from the museum to their classrooms, I described how they re/created aspects of the museum display and pedagogy in the classroom in relation to their changing identities around accessing and appropriating the museum's resources for their science teaching and learning. I then provided a close-up of one of the Lead Teachers, Violet, and described how her participation in the Lead Teacher group transformed the science teaching and learning structure of her classroom and school. Turning the lens on Violet enabled me to turn the lens on myself. The experience of being in her classroom compelled me to reflect on my own trajectory of becoming an educator teaching in different fields; my identity of being a Caribbean-American teacher of Caribbean students and cultural others; and my transforming roles as a classroom teacher, to a museum educator, to a resource for schools and teachers to learn and enact inquiry-based science teaching and learning.

Creolization Revelation

The journey through the research and writing process was also a journey through the literature I read and papers that I wrote during my doctoral coursework. In addition to the education literature, I revisited work from a Caribbean ethnology course and readings from my linguistics course that focused on the Creoles and Pidgins of the Caribbean. This led me to wonder where this would fit into my research about teachers learning to use museum-based resources to teach science. It was then that my advisor, Kenneth Tobin introduced me to a chapter that Wolf-Michael Roth wrote about identity in science teaching and learning and related it to the notion of a Diaspora and the processes of creolization and hybridization that occur when diasporic individuals enter and appropriate new cultures while maintaining aspects of their culture of origin.

Applying these ideas of creolization, hybridization and diaspora to science teaching and learning were a revelation to me as it shed new colors of light onto my research. Creole was a term originally used to describe whites born in the colonies. But along with the mixing of the African, European, Asian, and Amerindian peoples and cultures that characterize the history of the Caribbean, the term had evolved to include those of mixed ancestry and later to describe the language, people and culture of the region. A region that, in spite of a history of "downpression," violence, and forced diasporas, has managed to survive, and create "twice diasporized" (Hall 2001, p.28) communities as they emigrate to the former colonial powers, and re/create Caribbean communities where they Caribbeanize and hybridize the local culture. Violet, my case study, which I discuss in Chapters 5, and 6, lives and works in one such community.

As applied to science teaching and learning, the notion of creolization—of teachers and students being able to personalize and take ownership of science -- is powerful in that it is a way of viewing science as a culturally adaptive entity and as the self-proclaimed objective power that it claims to be. It supports the notion that people bring their identities and histories to bear when they are practicing science—whether it is teaching, learning or doing research in a sterile lab or in the forest abroad. It can be summed up in the cliché—wherever you go, there you are.

The creolization revelation enabled me to revisit and reframe the experience of the Lead Teachers in terms of creolization and hybridization—they were taking what they were learning in the museum and making it their own, thus re/producing their science teaching identities to include accessing out-of-classroom resources and creating object/inquiry-based experiences for their students in the classroom. They were also re/producing hybrid identities of classroom teachers and museum educators as they evolved from being workshop participants to workshop facilitators. I also found that my revelation complemented the notion of multifield enactment of science teaching and learning—as multifield enactment of science requires creolized forms of science, it also requires teachers be hybridized into using the resources of multiple fields to meet science teaching and learning goals.

For me, the ultimate creolization revelation was that it describes the issues of science teaching and learning in a large, diverse, urban center such as New York City. It sets up theory that New York City science classrooms could be described as culturally creolized spaces, where students (and teachers) re/produce hybrid identities as a result of a creolization of home cultures with school, science and cultural others (Roth, 2006).

Revisiting the Questions

As outlined in the first chapter, the following overarching questions guided my research:

1. How did the Urban Advantage Lead Teachers create a community of practice around integrating the museum-based resources of into their classroom teaching practice?
2. In what ways did the culture that the Lead Teachers produced in Urban Advantage get re/produced in their classroom?
3. How did Violet (a teacher featured in the Chapter 5 and 6 case study) use her agency from participating in the Urban Advantage Lead Teacher group to transform the science teaching and learning structure in her school?
4. In what ways did participation in Urban Advantage enable the Lead Teachers to re/produce their identities as object/inquiry-based teachers?

I reviewed my data and hovered between theory and interpretation. I learned that my research questions were interrelated and that it would be difficult to address each question uniquely, without being repetitive. I therefore discuss my findings below in terms of certain themes that crossed research questions and boundaries of theory and interpretation.

Summary of Findings

Transforming Structure of the Museums

Some of the central practices of Urban Advantage were historically constituted in the Museum's practice, such as observations, learning with objects, and sending resources from the Museum out to schools (such as the Bickmore slides and teaching collections). However, as opposed to the seemingly didactic nature of the early Museum's programs,

Urban Advantage saw the transformation of the participating teachers' practices as well as the Museum's practice of partnerships with schools. The transformation of teachers' practices I will discuss in the following sections, here I will briefly discuss the transformation of the Museum.

Peripheral Participating Shifts the Center

In Urban Advantage, teachers learned to use the resources of the cultural institutions to enact inquiry-based science teaching and implement Exit Projects with their students. As the teachers learned, they became participants in museum-based education. They learned how scientists in museums practice science; they participated in their own science investigation; and they learned how to use objects and museum-based resources to meet curriculum goals. Teachers became a part of the central|peripheral dialectic of the practice of science and science education in the museum, since as teachers' practices changed, so did practices of museum scientists and educators. As I described in Chapter 3, Jake's interactions with the museum educator helped define his identity as a classroom teacher in relation to the museum. However, in defining and negotiating his role, it also enabled the museum educator to move her agenda closer to the needs of the teachers by offering sessions directly related to Exit Projects, rather than selecting classes from pre-packaged courses for teachers. Jake made the museum educators realize that they had to shift their practice so that the resources met the needs of the classroom—the museum's resources had to match the standards and assessment needs of the classroom.

This created a center that was expansive, as the practice of the center had to achieve the goals of staying true to the mission of the cultural institutions while changing to meet the needs of those who enter the institutions to utilize its resources. This is where

I move away from the practice of describing the relationship of the museum to schools as a service being provided as it implies that the recipient of the service has no input into the type of service offered and received. In viewing the relationship of museums to schools as a true partnership, both institutions are placed at the center of the practice of science education and both transform with respect to each other.

Using New Resources

Learning to teach in a museum is a culturally adaptive process. For a classroom teacher, a museum is a source of new resources and schema and a teacher has to learn the culture of museums—the practice of science and the culture of display and learning with objects—in order to effectively appropriate museum-based resources to meet their classroom science teaching and learning goals. In Urban Advantage, teachers also received resources for the classroom that were new in the sense of being "straight from the factory" and in some cases new to a teacher's sphere of awareness and practice.

As I showed in Chapter 3, teachers with access to new resources need structures to enact their agency in the classroom. The Urban Advantage Lead Teachers in the process of developing their own cultural fluency of teaching in museums became the enactment structures of other teachers in Urban Advantage. They were also learning themselves, thus creating the enactment structures for their own professional growth in being able to use out-of-classroom resources to teach and learn science. In doing so, they formed identities around using out-of-classroom resources to teach science and objects to re/produce out-of-classroom experiences—object/inquiry-based learning—in their classrooms.

As a part of the agency|structure dialectic, the structures that the teachers reproduced allowed them to act and re/produce their identities as object/inquiry-based teachers. As described in chapter 4, in the Lead Teachers' classrooms the resources—objects and knowledge about and of using the objects to teach—became a part of the activity structure of science teaching and learning where teachers enacted a culture around teaching and learning with objects. They integrated museum culture with classroom culture thus creating a hybridized classroom and a creolized practice of science teaching and learning—where they learned and culturally re/produced object/inquiry-based science both in practice and in the physical classroom. In Pamela's classroom we saw her collections of objects and learned of her desire to have more "stuff" for her students to look at, touch, and learn from. In a recent conversation with me, Pamela empathetically noted that she no longer wanted to lecture; she wanted her class to be all hands-on learning with objects. Pamela created a structure in her classroom that re/produced her identity as an object/inquiry-based teacher. As she acquired and learned how to use new resources, the structure of her classroom and her teaching practice changed to privileged observing and touching as ways of learning and knowing. As identity transformation is an ongoing process, she continued to seek opportunities and resources to add to her toolkit as an object/inquiry-based teacher. She showed me the jawbone of a large mammal that she purchased for her classroom and she attended workshops over the summer where she was able to engage in hands-on explorations to learn Earth science content.

This effect was even more pronounced in Violet's classroom (chapter 5) where the existing structure for science was weak and minimally existent. In her classroom, the

new resources transformed her school in ways that enabled literacy teachers and their students to have access to science and allowed existent resources to come into use, thus reintegrating them into the structure of science in the school. Like Pamela, Violet also sought out opportunities that allowed her to add to her toolkit as an object/inquiry-based teacher. She participated in an Earth science summer program at the Museum. In the program she was able to strengthen her Earth science content knowledge and learn more about using the Museum's resources to teach and learn science. As a part of her action plan she discussed how it was important to her that her school had a room dedicated to science. She believed that it was her job to use this room along with the resources to get the teachers excited about science. "If the teachers are excited," she said with a smile, "then the students will want to learn."

Identity, Agency, and Enactment

Participation in the Lead Teacher group allowed for the production and exchange of capital that enabled them to re/produce their identities as science education leaders. By creating a community of practice around using the resources of museums to teach science, the Urban Advantage Lead Teachers re/produced a creolized culture that was a hybrid of classroom science and museum science. Having the symbolic capital—the title of a Lead Teacher—the Lead Teachers enacted leadership roles by being resources for other teachers to adapt the culture of learning in museums to their practice. For example, in Chapter 3 I described the Exit Project assessment rubric as a diasporic artifact that straddled the boundary between practicing science in the classroom and in the museum. This artifact codified a good Exit Project based on what the Lead Teachers learned from the museums and from their own practice of doing science investigations with students.

In Pamela and Violet's cases, as described in Chapters 3 and 5 respectively, they enacted their leadership roles by appropriating a space for science within their school. As science teacher leaders, they believed that they should have a space within the school that was dedicated to science—a place where they could display and use their resources. This, in a sense, was also a way of building social capital within the Lead Teacher group, as it was one of the goals of the community to create demonstration sites for inquiry-based science, as described in chapter 4.

The Diasporas of the Lead Teachers

"Good science programs require access to the world beyond the classroom" (National Research Council, 1996). I interpret this to mean that there has to be a diaspora of science teachers and students out of the classrooms and into different science learning environments. As diasporic agents, the Lead Teachers went to a new field and produced new culture as they learned how to access and appropriate the resources of the new field. Returning to the classroom, they used their newly acquired culture to transform their "home" culture field. Through a process of cultural production, reproduction and transformation, the Lead Teachers transformed their science teaching and learning to include the new resources and knowledge of using the cultural institutions to teach and learn science. Their diasporas also brought them, with their students, back to the museums where they were able to use their creolized culture—the hybridization of museum and classroom science education—to appropriate the resources of the museums to teach and learn science.

The intervisitations also became a part of the diasporas of the Lead Teachers. I was a participant in this diaspora as I traveled with the Lead Teachers to their science

teaching and learning "homes." In the Lead Teachers' spaces we saw how different classrooms were set up; the teachers saw how their peers used the Urban Advantage resources; and they learned what having the resources meant to their colleagues in the Lead Teacher group. Within these spaces I also saw evidence of the museum visual culture re/produced in the classroom, as described in chapter 4. It reminded me of my travels to other places and returning home somewhat transformed—whether I appreciated a new cuisine or hung a new artifact on my wall. The Lead Teachers returned to their own classrooms with ideas that they personalized and re/produced in their classrooms. I noticed that the cabinets of curiosities and the use and display of the Growlabs ™ were such examples, as described in chapter 4. These artifacts were hybridizations of displays in museums, shared visions and ideas that arose from the intervisitations, and the personal interests and idiosyncrasies of the individual Lead Teachers.

Cultural Hybridization and the Demonstration Classroom

The Urban Advantage Lead Teachers used objects and resources to re/create science displays in their classrooms, thus re/producing and transforming a structure for inquiry-based science teaching and learning. In re/creating aspects of the museum in their classrooms, the Lead Teachers created learning spaces that were hybrids of the museum and classroom culture. The demonstration classrooms were representations of the Lead Teachers' identity transformations. The classrooms were evidence of the negotiation, transculturation, and reconciliation that occurs when one learns and re/produces new cultures. Teachers had to negotiate a physical space for science. In Pamela's case (chapter 3) this negotiation presented a conflict between her and her principal, as it was also a negotiation of power over science education in the school. The transculturation

occurred as a function of learning and integrating different cultural practices and the subsequent reconciliation of these practices into an identity around science teaching and learning that included using objects in the museum and in the classroom to teach science. According to Roth (2006) diasporic identities continually reproduce and renew themselves in difference and transformation. The Lead Teachers created diasporic identities that creolized science teaching and learning with the use of new resources to meet formal goals. Many of the Lead Teachers sought new resources beyond Urban Advantage to enrich their teaching and learning experience. During the summer, Pamela spent an Earth Science week in Minnesota and brought back fossils that she found there to add to her classroom collection. Violet participated in a different Earth Science program at the Museum that focused on Earth and Space science research and content. As a part of their diasporic science teaching identities, the Lead Teachers sought experiences—professional learning and/or personal travel and experiences—that gave them access to new resources and added to their hybridized culture of science teaching and learning.

Boundaries and Diasporic Artifacts

As boundary crossers—which happened as a result of the created diasporas—the Lead Teachers linked the culture and communities of the schools and the museums. The Lead Teachers created diasporic artifacts that were evidence of their travels between and across boundaries. These artifacts defined the Lead Teachers as a community of educators that occupied the hybridized space—the new field that was a hybrid of museum and classroom science teaching and learning. The demonstration classroom, as described above was one of the diasporic artifacts. The assessment rubric was the diasporic artifact

that described and defined the hybridized space that the Lead Teachers created and occupied. This artifact which was created to assess student's progress and completion of the Exit Project deconstructed the process of using beyond-the-classroom resources to do science investigations and made the process quantifiable for students' grading purposes. These diasporic artifacts were resources for the Lead Teachers and other teachers to enact using the resources of the museum and the classroom to enact inquiry-based science teaching.

Revisiting Authenticity Criteria

Since this was the first year of the Urban Advantage Lead Teachers it was a major time for role definition and identity formation. It was also a time for me to form my identity as a researcher while I negotiated my role as the group facilitator. I saw these two activities as connected—I expected that what I learned as I researched would enable me to be more effective in performing my role as the facilitator. With this in mind, it was to my benefit to use research methodologies that were naturalistic and emergent. The original questions that I asked and the data sources that I proposed to collect and analyzed changed as the group evolved. For example, the demonstration classrooms ended up taking a more central role in my research than I originally intended. This was because as I visited the different classrooms I saw physical elements of cultural hybridization and structural transformation that were powerful for me as a researcher. To me it demonstrated a certain aspect of the personalization of the museum's resources and science teaching culture and for me it became a good data source to describe the individual|collective identity transformation.

I wanted my research to be critical and emergent so I did not expect it to neatly follow the plan that I outlined when I started. In making my decisions on methodology I opened certain doors and closed others. As the Lead Teacher group evolved and I developed deeper knowledge of them as a community of learners and individual teachers, I wanted my research to evolve to accommodate my new insights. However, I wanted my research to be valid and trustworthy, so I adhered to authenticity criteria (Guba & Lincoln, 1989) geared towards naturalistic inquiry, which I outlined in chapter 1 and revisit below.

Ontological authenticity. When I started the Lead Teacher group, I had preconceived notions of how the teachers would enact their leadership roles in the cultural institutions. I envisioned them easily slipping into co-facilitation scenarios with the cultural partners and acting as peer mentors for teachers new to the initiative. I thought the transfer from being a classroom teacher to being a peer leader would have been a seamless one. However, after the first Lead Teacher meeting, through the evaluator I learned that many of them were still unsure of how to enact their Lead Teacher roles. I also learned that it was an expectation that the monthly meetings would help them to clarify their roles. I learned that a co-generated list of roles (created during the summer training as mentioned in chapter 3) does not lead to enactment. Just as the Urban Advantage teachers needed enactment structures to re/produce inquiry-based learning in the classroom, the Lead Teacher needed enactment structures to enact their leadership roles. This changed the meetings from being further education on using the resources of the cultural institutions to peer sharing sessions about enacting their roles as Lead Teachers. This is also where my research began to change from viewing them as

individual teachers to viewing them as a community of learners building a culture around using the resources of the museums to teach science.

Once I began to view them as a community of learners, I began to access resources that helped me to facilitate a growing community of learners. It also allowed me to look deeper into Lave and Wenger (1991) and Wenger (1998) to see if I saw the theoretical aspect of communities of practice reproduced in the Lead Teacher group. As it was a new group there were no peripheral practitioners, so it was not until I viewed the Lead Teacher community vis-à-vis the cultural institutions that legitimate peripheral participation was problematized. I realized that if I viewed teachers as practicing peripherally to museum scientists and educators, then I was placing teachers in a subjugated position. This is something that I wanted to avoid because of my own experience of feeling subjugated to scientists whereas scientists are never seen as subjugated to science teachers—even in educational settings! In my goal of describing classroom teachers' knowledge as equal to scientific knowledge in their areas of expertise, I began to morph my central vs. peripheral thinking into a central|peripheral dialectic. This enabled me to describe the teachers, scientists, and museum educators as equal participants evolving with respect to one another and not one group (teachers) being transformed as a result of the other group (primarily scientists, secondarily museum educators), leaving the latter unchanged.

Educative authenticity. For the Urban Advantage administrative group, Lead Teachers provided a "laboratory" to learn first-hand about the implementation of the initiative in the classroom. When I met with the partners, I was able to update them about what I was learning in a context of the decision making process in the initiative. For

example, through the Lead Teachers I learned that all of the classroom resources were not being used. The reason they were not used was because there were certain resources that the teachers were not taught how to use—the Capsula ™ was one such resource. The Capsula ™ is used to demonstrate circuits, energy and force—physical science concepts. Only teachers who attended professional development at the New York Hall of Science learned how to use this resource although all teachers in Urban Advantage received them. The Lead Teachers suggested that the Urban Advantage partners have special sessions to demonstrate the use of the classroom resources, which the Lead Teachers would co-facilitate. These sessions have become a part of the menu of professional learning opportunities for the third year of Urban Advantage.

Catalytic authenticity. A primary role of the Lead Teacher group was the make Urban Advantage more effective for teachers and students. Their position of teacher provided the initiative with an indigenous knowledge of classroom-based science teaching and learning. As they worked with the institutions and brought back their experiences to the group, their teaching practice became hybridized and creolized with new resources and knowledge. Having this intimate knowledge of both the classroom and the museum made them integral to reviewing and revising the professional development sessions offered to new Urban Advantage teachers.

I saw it as my role as the group facilitator and critical researcher to ensure that the Lead Teachers were in a position to share their expertise with the institutions. I invited the Lead Teachers to participate in two partner's meeting during the summer. I saw this as an opportunity to bring them as equals to the planning table as the partners reviewed the second year of Urban Advantage and planned the third. With the Lead Teachers'

input the partners were able to make critical decisions about specific resources to order for classrooms and science content to cover in the professional development relevant to the curriculum.

The New York Aquarium came on as a new partner during the third year and they had to quickly get up to speed in order to be ready to begin the professional development sessions in the fall. Elena and Jake met the new partners during one of the summer meetings and spent a Sunday at the Aquarium reviewing their resources and co-planning the professional development sessions to meet the requirements of the Exit Projects. The feedback that I received from both the Lead Teachers and the Aquarium educators about the planning session was positive. It was helpful for the Aquarium, as they did not have to plan their professional development in a vacuum. Jake and Elena were able to suggest specific exhibits and corresponding activities that met the goals of covering life science content and modeling Exit Project investigations that could be implemented at the Aquarium. Jake was very proud of a grid that he developed that could be placed in front of a display case to study animal behavior. The planning session was also symbolic for the Lead Teachers as it validated their position as leaders and confirmed the hybridized culture that they generated in the Lead Teacher community.

Tactical authenticity. From my standpoint, other Urban Advantage teachers were at a disadvantage because they did not have the opportunity to participate in a long-term community of learners, as did the Urban Advantage Lead Teachers. After three years I saw that the only original teachers from the first year who continued to participate were the Urban Advantage Lead Teachers. It was not the scope of my research to determine the reasons that the other teachers did not stay involved, however based on my research I

would attribute the continued participation of the Lead Teachers to the positive emotional energy and solidarity built through participating in the Lead Teachers group.

The Lead Teacher group met frequently (they met monthly as a group and the rubric revision team had additional meetings for which they were not fully compensated) and these meetings provided the opportunity for peer sharing and building positive emotional energy. The intervisitations were more than the opportunity to see other schools and classrooms; based on what I observed, it also had the social function of allowing the Lead Teachers to host one another, solidify social networks, and build solidarity within the group. I was surprised when I went to Pamela's school and was greeted by a spread of gourmet pizza and Italian pastries from the famed Italian-American gastronomies from Arthur Ave. in the Bronx. Similarly, Elena provided pizza for her meeting and Andrea added Puerto Rican-style empanadas (that she made) to the buffet. As the classroom can be a personal space, I saw the intervisitations as welcoming teachers into each other's homes. Hosting the meetings and the act of providing food for the group was a way of generating positive emotional energy and building solidarity.

Having the opportunity to consider the teachers who did not stay involved in Urban Advantage would address key questions about the sustainability of integrating new resources such as, a) did the teachers continue to use the museum and/or other out-of-classroom resources to teach and learn science? b) were there any lasting changes in their teaching practice as a result of learning in museums? c) if the teachers did not continue to use the resources of the museums, what were the barriers that they faced? Perhaps the answer to these questions could begin to address how to make using out-of-classroom resources a sustainable practice. Answers to these questions also have policy

implications, which I address below. Looking at the teachers who did not choose to become Lead Teachers would begin to answer the question about how to make new or novel teaching practices sustainable.

Tactical Authenticity and My Case Study Selection

From my group of Lead Teachers I selected Violet because of the location of her school in my community and my own curiosity about her school due to my experiential knowledge of the history of the school. As a high needs school, the implementation of Urban Advantage and the enactment of Violet's leadership role might have looked very different than it would have in a low needs school with a well-equipped lab and history of academic success. I believed that as a person from the museum, my presence in Violet's school would provide her with resources that would facilitate her getting a science classroom and helping her students to complete their Exit Projects. In addition, I believed that the common Caribbean ethnicity that Violet, most of her students and I shared created a cultural dynamic that might not have existed if I studied a different Lead Teacher in a culturally different classroom. As a researcher, I was interested in observing the cultural dynamic in a Caribbeanized classroom. Moreover, I felt that I would have been more comfortable participating in a classroom that was ethnically similar to the ones that I taught when I was a high school teacher in a similar community.

Opportunities in My Methodology

Associated with my methodology were opportunities to do certain things while not being able to do others. My visits to Violet's class were not consistent due to last minute changes in schedule—usually standardized test practice on her end and meeting changes on mine. While I was able to watch her classroom and teaching practice evolve over the

year, I was not able to observe the day-to-day interactions that would have been useful in creating a complete picture of Violet's changing identity as a science teacher. However this enabled me to realize the constraints that the literacy and math mandates provide to enacting a quality science program that includes beyond-the-classroom excursions and extended inquiry in the classroom.

On several occasions, Violet did not meet her class during the double periods—the time that she used for inquiry with objects and work on the Exit Projects—because the students had to sit for practice literacy or math exams. (To me, they seemed to practice taking exams more than they practiced *doing* math and literacy). Most of the other Lead Teachers confirmed that this was also the case in their schools. The issue of the standardized practice exams conflicting with quality science programs was an issue that I was able to bring up with the City's Director of Science, but as this is an issue that goes beyond the scope of her work (and that science is still not an instructional priority in New York City) it was difficult for her to issue mandates regarding science instructional time not being taken away for the assessments. In spite of this the Director required that principals who wanted their schools to participate in Urban Advantage agree to full implementation of the initiative. This includes allowing for field trips and ample time for teachers and students to complete the Exit Projects.

The multifield/multi-institutional nature of the Urban Advantage required the Lead Teachers (and other teachers) to participate in different fields. Because it was difficult to get a complete picture of the activities of the Lead Teachers in all areas were they learned and enacted culture, I relied on using my own institution as a lens for interpreting their experience in the other museums. I relied on Violet's classroom as a

lens for interpreting what could be happening in other classrooms—taking into account the vast differences that exist in school building culture across the city. Finally, I relied on the Lead Teacher group to provide a window to view the enactment of the Urban Advantage initiative—learning to use museum resources to teach and learn science with the different Urban Advantage teachers.

Implications

Research

Researching teachers learning to use museum to teach is still an area that is ripe for exploration. As mentioned before, my research raised the question of what makes a practice sustainable? In other words if we would like teachers to use museums and other out-of-classroom resources to teach science, what support structures must be in place in order for the practice to become a regular part of science teaching and learning? My research found that one of the support structures is to afford teachers the opportunity to learn to use the resources and grow as a community, because the community provides the peer support structure that enables them to create an identity and develop a practice around using the resources of the museum to teach and learn science. However a community of learners may not always be feasible, so what other configurations of support structures exist or could be created?

My research also brought to light the issue of intercultural and intracultural teaching that characterizes science teaching and learning in New York City. In a culturally diverse city such as New York, multi cultural teaching and learning goes beyond the assumed dichotomy of middle-class white teacher and lower income African American students. There needs to be a research agenda that studies the phenomena of

the culturally creolized classroom—where students and teachers bring diverse home cultures to the classroom and they have to enact science teaching and learning from a culturally bound curriculum. In addition what happens in a classroom where both the teacher and students are from immigrant communities—creating a literal diaspora of science and culture in the classroom?

Teaching Science

A central practice of doing science in Urban Advantage was journaling and keeping a science notebook. In contrast to school science that often separates literacy and math from science, the practice of good science necessitates the full integration of literacy and math—for example reading research, writing observations, and communicating research to others with words, data, and art. The literacy and math mandates are contradictory to the practice of science. Literacy is a part of the practice of becoming a scientist, whether it is a student scientist completing an Exit Project or an adult scientist writing a journal article.

Access to resources out of the classroom provides teachers and students with rich situated science teaching and learning experiences. This enables teachers and students to participate in the multiple places that science is learned, practiced, and produced thus enabling them to view science as an active practice and lived experience rather than as facts reproduced in a textbook. Experiencing science also enables students to see the possibilities of careers in science.

In helping teachers to learn and use new resources, it is important to create opportunities for teachers to build communities of practice where teachers could share and collectively build practices, solidarity, and identities around using new resources.

This is especially important in large urban centers such as New York City were creolized forms of science teaching and learning—forms that allows for and include cultural difference—could afford a greater number of students and teachers access to a quality science education. Being a part of a consistent and cohesive community of learners could provide teachers with the opportunity to share their teaching experiences and collectively learn how to make new science resources accessible to a wide diversity of students.

Museum Education

Museums change as new culture gets enacted; in this case culture that teachers brought to the museum changed the structure of the museum to meet the classroom enactment needs. Although museums tend to lean towards tradition, especially those with many decades of history, it is important that museums are responsive to the culture that teachers bring into the museum, if museums wish to stay active and move to the center of school-based science teaching and learning. Museum should aim to create true partnerships between the scientists in the museum, museum educators and the science educators that come into the museum to use the resources to enact science teaching and learning. In a true partnership, all stakeholders are transformed as a result of learning and practicing together and there is the emergence of a new hybridized culture that includes aspects of all of the stakeholder groups' cultures and meets the needs of the partnership. In addition, it is important that teachers' knowledge does not get subjugated to the scientists' knowledge. It is important that all knowledges are recognized and given equal credence in creating partnerships that connects science in the museum to school science.

Education Policy

This research demonstrated that quality science education requires resources and time. Along with the physical resources, quality science needs a place where the resources are displayed and accessible to science teachers and students. As we saw in Violet's school (chapter 5) once she acquired a space for science—the demonstration classroom—resources in the school that were previously hidden and unused became reintegrated into the science structure of the school alongside the new resources she received from Urban Advantage. In this case, since the resources were not seen, they were not used. In Jake's case, his classroom structure was created around the resources that he displayed. For him these resources were integrated into his day-to-day practice of science teaching, new resources re/produced his science teaching structure.

Resources also include knowledge—knowledge of science content and knowledge of using resources to teach science content. In order for teachers to re/produce a science teaching identity that includes acquiring resources for science teaching, time and funding should be made available. This would encourage and enable teachers to access professional development opportunities and beyond-the-classroom experiences that would add to their cultural toolkit of accessing and appropriating a variety of resources to teach and learn science.

For the success of a quality science program such as Urban Advantage, policy-makers need to allow for out-of-classroom experiences for teachers and students. This includes providing professional learning opportunities for teachers and learning experiences for students. This means allowing time and ease of planning for fieldtrips, including making necessary paperwork more timely and efficient, and budgeting for

substitute teachers to cover classes in the absence of the teacher on the fieldtrip. Optimally, it would be great to create a school-wide climate of using out of classroom resources where teachers could plan and facilitate cross-disciplinary trips. This would reduce the need for substitute coverages.

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