

“Science Ain’t the Enemy” – Exploring the Experiences of Black and Brown Girls in a Hip-Hop  
Based Science Program

Gifty Akua Asantewa Asamani

Submitted in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy  
under the Executive Committee  
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2018

© 2018  
Gifty Akua Asantewa Asamani  
All rights reserved

## ABSTRACT

### “Science Ain't The Enemy” – Exploring The Experiences of Black and Brown Girls in a Hip-Hop Based Science Program

Gifty Akua Asantewa Asamani

This dissertation is a longitudinal critical ethnographic research study that explores the experiences of four Black and Brown high school girls' who participated in a hip-hop based science program (Science Genius program). The study employed three distinct yet aligned theoretical frameworks: - sociocultural theory, Pygmalion effect, and Black feminist theory. Given that an ethnographic study looks at the cultural patterns of a group over a period of time, this investigation spanned 2.5 years and involved explorations of the participants' experiences with science. In addition, there are elements of autoethnography woven throughout the dissertation as my personal experiences as a Black woman in science informs both my research lens and my relationship to the research subjects (Camangian, 2010). By utilizing a qualitative methodological approach, the study gave voice to students who were racially and traditionally marginalized in science education and professions (Ceci & Williams, 2007; Emdin, 2016; Hanson, 2008; Hill, Corbett, & St. Rose, 2010; Mensah, 2012) and provided an opportunity for them to give personal accounts of their experiences in science education. The primary focus of the research involved a critical analysis of the responses of Black and Brown girls to a culturally relevant science curriculum that was based on the foundations of hip-hop pedagogy (Adjapong & Emdin, 2015; Emdin, 2010a, 2010b, 2016; Gay, 2010; Ladson-Billings, 1995). The findings of this study showed how the girls used the hip-hop based science program as a platform to demonstrate girl empowerment against commonplace Black and Brown girl race/gender biases in

science, technology, engineering, and mathematics (STEM) education and how they built up their confidence to exhibit their scientific knowledge while defining their scientific identities.

## TABLE OF CONTENTS

LIST OF FIGURES.....	iii
LIST OF TABLES.....	iv
ACKNOWLEDGEMENTS.....	v
DEDICATION.....	vii
<b>CHAPTER I.....</b>	<b>1</b>
INTRODUCTION.....	1
<i>On Learning Science.</i> .....	2
<i>Why Is Science Important to Learn?</i> .....	2
<i>Is Science Really for All Americans?</i> .....	3
<i>Women of Color in Science</i> .....	6
<b>BACKGROUND.....</b>	<b>11</b>
<i>Culture in Education</i> .....	11
<i>Culturally Relevant Pedagogy</i> .....	13
<i>Culturally Relevant Teaching and Culturally Responsive Teaching</i> .....	15
<i>Criteria for practice – Culturally Relevant or Responsive Teaching</i> .....	16
<i>Black Feminism</i> .....	18
<i>Historical Dynamics of Hip-Hop</i> .....	20
<i>Urban</i> .....	21
<i>My Complex Hip-Hop Identity</i> .....	22
<i>The Global Reach of Hip-Hop Music and Culture</i> .....	27
<i>Hip-hop Pedagogy and the Science Genius Program</i> .....	28
PURPOSE AND RESEARCH QUESTIONS.....	32
<b>CHAPTER II.....</b>	<b>34</b>
REVIEW OF THE LITERATURE.....	34
<i>Black and Brown Girl Identity in Science</i> .....	39
<i>Drawing a Parallel Between Women in Science and Women in Hip-Hop</i> .....	41
THEORETICAL FRAMEWORK.....	46
<i>Sociocultural Framework</i> .....	47
<i>Pygmalion Effect</i> .....	47
<i>Black Feminist Thought</i> .....	48
<i>Black and Brown Girls’ Resistance and Resilience</i> .....	49

<b>CHAPTER III .....</b>	<b>51</b>
METHODS .....	51
<i>Settings</i> .....	54
<i>Participants</i> .....	55
<i>Data Collection Methods</i> .....	61
<i>Questionnaire</i> .....	66
<i>Videotape vignettes/videotape recordings</i> .....	67
<i>Interviews</i> .....	67
<i>Focus Groups</i> .....	69
<i>Research Questions</i> .....	69
<i>Consent and Ethical Considerations</i> .....	70
<i>Reliability and Validity</i> .....	71
<i>Procedure/Process</i> .....	71
<i>The Analysis Process</i> .....	73
<b>CHAPTER IV.....</b>	<b>74</b>
FINDINGS.....	74
<i>Evaluation of Three Themes</i> .....	83
<i>Impact of Hip-hop on Scientific Content Knowledge in the Face of Adversity</i> .....	84
<i>I'm Not a Host</i> .....	92
<i>Reframing of Scientific Identity Through Hip-hop Pedagogy: A Culturally Relevant Space</i> .....	94
<i>Science Identity Transformation: Individual Testimonies</i> .....	98
<i>Exhibiting Strength: Resisting Negative Black and Brown Female Stereotypes in STEM &amp; Hip-hop</i> .....	102
<i>Coming of Age</i> .....	100
<i>Next Steps–Postsecondary School</i> .....	106
<i>Using Science and Hip-hop to Push Back Against Sexual Assault: A Sociopolitical Stance</i> .....	116
<b>CHAPTER V .....</b>	<b>126</b>
DISCUSSION/IMPLICATIONS.....	126
CONCLUSION.....	130
LIMITATIONS.....	132
REFERENCES.....	133
APPENDIX A .....	149
APPENDIX B.....	150

## LIST OF FIGURES

Figure 2.1: Model of science identity .....	39
---	----

## LIST OF TABLES

Table 3.1. Summary of Data Collection Activities.....	62
Table 3.2. Student Activities While Enrolled In Living Environment Science Course: Spring Semester 2015.....	63
Table 3.3. Student Activities While Enrolled In Chemistry Course with another teacher: Fall 2015/Spring 2016.....	64
Table 3.4. Participants' Science Activities – They were not enrolled in any academic science course: Fall 2016/Spring 2017.....	65
Table 3.5. Research Questions and the Data Collection Procedures Used to Answer Them.....	68
Table 4.1. Students' Responses to Likert-Scale Questionnaire.....	76
Table 4.2. Participants' Science Grade Point Average Over 2 Years.....	81
Table 4.3. Non-Participants' (other girls) Mean Science Grade Point Average For Living Environment.....	83



## **ACKNOWLEDEMENTS**

I take this opportunity to thank my parents: Mrs. Alice Adjoa Darkwa Akuffo Asamani and Mr. Emmanuel Victor Kwame Asamani for their hard work and relentless support for my siblings and me in all our endeavors. Their steadfast dedication and love have propelled us to great heights. Over 40 years ago (mid 1970s) they moved from Ghana to make New York City their new home. They worked tirelessly to educate us and to provide a better way of life for us. For that, we are eternally grateful.

I would like to thank my sons: Kwasi Addo Koranteng and George Nana Kwabena Preston for adding another dimension of love and meaning to my life's journey. I love you both very much.

To my siblings: Kwame Akoto, Ernestina Akua Adisi (RIP), Josephine Abena Asiedua Asamani Addi, Evelyn Afua Ofosua Asamani, and Ritchy Kwadjo Yirenky Asamani thank you for being an element of support throughout my life and not allowing me to get away with anything. I thank you. To my cousins, nieces and nephews, I thank you for adding more value to my life. A special thank you to my late uncle, Mr. Samuel Kwabena Saforo (RIP) for his eternal support and encouragement.

To my mentors, Dr. Christopher Emdin, Dr. Felicia Moore Mensah, Dr. Roger Anderson, and Dr. Yolanda Sealey-Ruiz I thank you for your time, guidance, emotional and academic support throughout my time at Teachers College. To Dr. Rivet, thank you for helping me cement my research interest about women in science. I hope that we continue to collaborate together in the future. I would like to say a special thank you to Dr. James Russo for his continued

dedication, guidance and support throughout my academic and professional life since receiving my undergraduate degree.

I also want to thank my community of friends at Teachers College and beyond who have helped me by offering their friendship and encouragement to persevere. Lastly, I would like to thank all my students, past and present who have been a source of inspiration for me to continue to learn and improve my practice.

## **DEDICATION**

To my sons, who strive everyday to be at their best; to all Black and Brown students, especially the young girls, who are resilient, and continue to persevere against all odds, I dedicate my dissertation.

## **Chapter I**

### **INTRODUCTION**

There are several research reports that document the shortages and struggles of women in science education and science careers (Ceci & Williams, 2007; Hill et al., 2010; Pollack, 2013; Rosa & Mensah, 2016; Rosenbloom, Ash, Dupont, & Coder, 2008; Rossi, 1965). This has led to increasing numbers of researchers who have turned their attention to investigating the shortage of Black and Brown women in science, their limited representation in science education (and academia), and the plight of Black and Brown girls in science education (Hanson, 2008; Hanson & Johnson, 2000; Harding, 1986; Jordan, 2006; Malcolm, 1989; Turner, 2002). This dissertation extends this work further by considering the experiences of a particular demographic within the literature. It is a longitudinal critical ethnographic study that highlights new dimensions of the work such as the cultural patterns of Black and Brown girls in science education.

By employing a qualitative explorative approach, the study gave voices to Black and Brown girls who remain a subgroup who are racially and traditionally marginalized in science education or STEM in general. The study gave voice to the personal experiences in/with science education of Black and Brown girls and sought to highlight under-focused dimensions of their lives. With the understanding that current science curricula are not culturally inclusive (Adjapong & Emdin, 2015; Atwater, 1996; Brotman & Moore, 2008; Emdin, 2016; Ladson-Billings, 1995; Mensah, 2012; see also Lee, 1997; Takaki, 2012), the study explored the girls' responses to a science program that focused on addressing some of the existing cultural divides between urban youth of color and their counterparts, namely the Science Genius program.

One of the chief goals of the study was to find out if the confidence and the engagement level of Black and Brown girls changed, and to what extent negative societal stereotypes about Black and Brown girls in science could be addressed if science were culturally relevant to their daily lives. My goal is that the results of the study will provide insight into how to draw more racially and traditionally marginalized students of color, especially girls, into science education, thereby increasing the diversity pool of participants in the STEM career fields.

### **On Learning Science**

Science is a content area that requires students to not only read about or listen to (e.g., via a lecture) the subject but also to essentially experience the subject through hands-on activities and learning. Hence, cognitive stimulation is important in science, but it must be accompanied by experiential learning for students to be fully engaged in the discipline (DeBoer, 1991; Dewey, 2013). I argue that science learning for girls of color must consider these dimensions in order for them to be fully connected to the discipline.

### **Why Is Science Important to Learn?**

Science learning enables students to become critical thinkers who understand worldly phenomena (DeBoer, 1991; Gelder, 2005; Lawson, 1995). Studies have also shown that children who increasingly engage in experiential science activities, regardless of whether those activities involve project-based learning, cultural interpretations of scientific phenomena, or specimen dissections, become progressively better each time at understanding the nature of science (NOS) and developing a scientific epistemology (e.g., Blumenfeld, Marx, Patrick, Krajcik, & Soloway, 1997; Duncan & Rivet, 2013; Eisenhart, Finkel, & Marion, 1996; Krajcik & Blumenfeld, 2006; Lederman, 1999). Epistemology is how one knows what one knows (Kirschner, 1992; Sandoval, 2005). I argue that learning science in a way that develops critical thinkers who can connect

content to multiple contexts requires that youth are aware of the epistemological underpinnings of their own learning and the nature of the discipline.

Researchers have revealed that children who develop a good sense of the NOS and scientific epistemology are able to engage in scientific discourses either as master participants or legitimate peripheral participants (DeBoer, 1991; Lave & Wenger, 1991; Lee, 1997) who move over time to centrality. These individuals are those who develop a good grasp of scientific literacy. As such, they either become part of the scientific community of practice (COP) or are able to apply their understandings of scientific knowledge to develop new technologies, solve problems, and make *everyday* life decisions in relation to nutrition, healthcare, or environmental issues (DeBoer, 1991; Eisenhart et al., 1996; Lee, 1997).

### **Is Science *Really* for *All* Americans?**

In 1989 there was a call by the American Association for the Advancement of Science (AAAS) that advanced the notion of, “science for all Americans.” In accordance with this call, the National Research Council (NRC) generated the *National Science Education Standards* in 1996. The theme for the newly developed standards was the notion that “science is for all students” (Lee, 1997, p. 219). The goal behind these “battle cries” was to make science accessible to all Americans so that everyone would become scientifically literate (DeBoer, 1991; Lave & Wenger, 1991). However, that hasn’t been the case.

According to recent statistics by the Pew Research Center, science, technology, engineering, and mathematics (STEM) jobs have significantly grown from 9.7 million in 1990 to 17.3 million in 2016, outperforming the overall US job growth. However, African Americans and Hispanics are underrepresented in the STEM workforce. African Americans occupy less than 3% of the total science and engineering jobs in the US, while Hispanics take up only 4%

(Graff, Fry, & Funk, 2018). Given these trends, it is apparent that significant shifts in teaching and learning must occur. Furthermore, the statistics related to science outcomes for youth of color makes it apparent that the goal of the scientific literacy crusade for all Americans has yet to be realized. Not *all* Americans have been afforded the opportunities to learn and excel in the STEM fields. Too many have been culturally disengaged because of their gender, race, language, socioeconomic status, ineffective or inexperienced teachers, and other sociopolitical reasons that are often far too prevalent in African American and Latina/o schools and communities (Harding, 1986; Ladson-Billings, 1995, 2006; Lee, 1997).

In her 2006 American Educational Research Association (AERA) presidential address, Gloria Ladson-Billings spoke about the magnitude of the educational debt that is plaguing Native American, African American, and Latina/o communities. Ladson-Billings (2006) made the argument that the educational debt, which is a combination of the “historical, economic, sociopolitical, and moral decisions and policies that characterize our society” (p. 3), has fueled the achievement gap and if left unaddressed, the gap will only continue to grow bigger.

In the book, *Reproduction in Education, Society and Culture*, the authors Bourdieu and Passeron (1990) highlight the social injustices that persist in society that are powered by educational institutions. The authors pointed out that in many ways, schools function to perpetuate the same pattern of inequities present in the society writ large. For instance, they argue that children of wealthy parents have access to better schools and acquire the skills necessary for high-level salary jobs that in turn enable them to maintain their aristocratic statuses in society. Regrettably, the opposite is true for children of poor parents. In the United States, Whites (particularly those who are socioeconomically advantaged) are the dominant or aristocrats (in relation to Bourdieu and Passeron’s depictions) in society, and Blacks and

Latinos/as are the minorities and are socially, culturally, economically, and educationally disadvantaged (Hill, Corbett, & St. Rose, 2010; O'Brien, Martinez-Pons, & Kopala, 1999; Pollack, 2013; Rosa & Mensah, 2016; Svokos, 2014; Washington, 2011; see also Takaki, 2012).

I argue that given the social injustice factors in education like inequity of resources, ineffective and inexperienced educators, poverty, homelessness, low socioeconomic statuses, immigration, dilapidated schools, and challenges to active parental involvement that persist in urban schools that serve predominantly Black and Brown students (Nieto, 2010; Noguera, 2003; Oakes, Lipton, Anderson, & Stillman, 2013), the education system has contributed to the academic achievement gap between White and Black and Brown students in the United States. Recent data published by the United States Department of Education (2015) reported that Whites perform 16 times better than Blacks and 11 times better than Latinas/os academically (in their core subjects).

I argue that the challenges pertaining to the academic achievement gap (in general) of Native Americans, African Americans (Blacks) and Latinas/os (Browns) are equally layered and dismal, especially with regards to STEM education and careers. A 2011 joint report released by the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine revealed that Latinas/os and African Americans are underrepresented in STEM careers even though they (African Americans and Latinas/os) are the fastest growing demographics in the United States. The report also concluded that Native Americans and Black and Brown people make up only about 9% of the minority college-educated Americans in science and engineering careers.

In a press release by the National Academies in 2011, it was reported that underrepresented minorities in STEM do not meet the national target of 10% of all 24-year-olds



having completed a bachelor's degree in science or engineering careers. McGlynn (2012) reported that for that to happen, "minority representation (in STEM) would have to quadruple or even quintuple" (McGlynn, 2012, p. 8). Dr. Freeman Hrabowski, president of the University of Maryland-Baltimore County and the chair of the committee that wrote the report titled *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* (National Academy of Science, National Academy of Engineering, and Institute of Medicine, 2011) stated the following:

The minds and talents of underrepresented minorities are a great, untapped resource that the nation can no longer afford to squander. Improving STEM education of our diverse citizenry will strengthen the science and engineering workforce and boost the U.S. economy (p. 142).

### **Women of Color in Science**

On May 14, 2012, in New York City, President Barack Obama gave the commencement address at Barnard College (an all-female educational institution) and said, "In fact, more women as a whole now graduate from college than men" (as cited in Jeffrey, 2012, p. 1). In 2015, the latest year that statistical data are available, the Census Bureau concluded that 60% of women and 58% of men had some college or more education. About 33% of women compared to 32% of men had completed at least a bachelor's degree (Ryan & Bauman, 2016). As a result of the Feminist Movement, Title VII of the Civil Rights Act of 1964, Title IX—the Equal Opportunity in Education Act of 1972, the Women's Education Equity Act in 1974, and countless other pieces of legislation – social, political, and educational progress has been made (Kane, 1989; Pryor et al., 2012). However, despite these gains, the struggle for equity for women in many facets of life, including science education, still persists. Pryor et al. (2012) of the Higher

Education Research Institute published a study about college freshmen and their intended majors and reported that 20% of men and only 4% of women planned to major in the sciences.

In addition, a study by Yale researchers titled, “Science Faculty’s Subtle Gender Biases Favor Male Students” (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012) offers staggering statistics about the current state of affairs for female scientists. These authors found that of all the philosophy of science degrees awarded in physics in the United States, only about one in five were awarded to women. Even more alarming is that only 2% of African American women were represented in STEM fields, while women in total made up 24% of the STEM workforce (Valentine, 2012). According to a more recent data report by the US Department of Commerce, Economics and Statistics Administration, the percentage of women in STEM careers has not changed much. It has only increased by 1% from 24% in 2009 to a mere 25% in 2015 (Noonan, 2017). The U.S. Department of Education (1990) reported that the gap in career endeavors between girls and boys in STEM existed as early as the eighth grade.

Several published papers (Hanson, 2008; Jordan, 2006; Museus, Palmer, Davis, & Maramba, 2011) discussed some of the causes for why many Black and Brown girls do not pursue STEM degrees. The reported challenges stemmed from lack of cultural presentation, limited job prospects, lack of encouragement by the educational institutions (teachers, guidance counselors, etc.), negatively perceived self-image and self-esteem, and discouragement from even their parents. Furthermore, Black and Brown girls often do not envision themselves as scientists because they do not have any role models at school (Barton, Tan, & Rivet, 2008; Lee, 1997) or in their communities, and there were no representations of their lives in the text resources that they used to study science (Jordan, 2006; Malcolm, 1989). While making the case for inclusiveness and multicultural education, Takaki (2012) quoting poet Adrienne Rich who

stated the following

What happens when historians leave out many of America's people? When someone with the authority of a teacher describes our society and you are not in it? Such an experience can be disorienting—a moment of psychic disequilibrium, as if you looked into the mirror and saw nothing (p. 16).

Research has shown that high school students who take rigorous science courses like AP biology, math, and physics are more likely to go on to earn STEM degrees in college.

Unfortunately, researchers have also noted that Black and Brown girls are often steered away from such courses (Carnevale, Smith, & Strohl, 2013; Lee, 1997; Washington, 2011). As a result, the opportunities to study STEM in college or enter a STEM profession gravely dwindle for Black and Brown girls (Carnevale et al., 2013; Hanson, 2008; Rosa & Mensah, 2016; Svokos, 2014; Washington, 2011). Much of this is related to the combination of the effects of a lack of representation in STEM courses, the STEM teaching workforce and careers.

Besides the usual case of the prevalence of poverty, low socioeconomic status, lack of role models, and the like that impact the progression of Black and Brown students in science education, there are other vital social injustices equally at play. One example is the lack of effective and experienced STEM teachers in high-minority middle and secondary schools (Fausto-Sterling, 1981; Washington, 2011). Consequently, in high-poverty schools (mostly populated with Black and Brown students) the full range of math and science courses is not offered. As such, these students do not get the proper foundation to succeed in STEM (Barton et al., 2008; Hanson, 2008; Hill et al., 2010).

Another challenge is the lack of resources for STEM education in high-poverty urban schools (Barton et al., 2008; Jordan, 2006). High-poverty urban schools are so often

overwhelmed by high stakes standardized testing in mathematics and literacy that minimum attention and resources are allocated for the sciences (Barton et al., 2008; Hanson, 2008). From a first-hand account, I know how difficult it is to work in a school where science education is an afterthought, and little to no funding is allocated to engage the students in the type of experiential and hands on science that is essential to help them build a strong science foundation (DeBoer, 1991; Dewey, 1902; 2013). For instance, at the school where I am employed, there is no designated lab room (it is also used for other content courses), instruments like microscopes are outdated (over 10 years old), and many other materials for experiential laboratory activities such as gel electrophoresis equipment are unavailable. At this school, there are three full-time (including me) and one part-time science teacher for a population of about 400 students. Out of the three full-time teachers, one is a licensed special education teacher and not a certified science teacher, and the other teacher does not hold an advanced science degree (master's degree or higher).

As another example, on Friday October 21, 2017, the superintendent of my school district (where I am currently employed) released the New York State Regents Constructed Response Performance Summary to my school leader who sent a copy to members of the Instructional Leadership Team via email. The data included vital information that we (the science department) needed to use for an upcoming inquiry analysis in an effort to help the science teachers improve/augment their pedagogical practices. In the email, I received a performance summary report for four out of the five New York State required Regents Examinations (that were offered in June of 2017) except the one for the science examinations. When I inquired (via email) about the whereabouts of the science data, my school leader replied: “I don’t know, good question.” Then, jokingly he went on, “Maybe, they don’t like science. You know, not

everybody does!” My school leader may be lighthearted about the situation; however, the lack of sufficient support for science education is a continual systemic problem in high-poverty urban schools (Emdin, 2010a, 2010b; Jordan, 2006; Lee, 1997; Malcolm, 1989; see also Noguera, 2003; Takaki, 2012).

Among other factors like equitable access to science resources, academic rigor, and choices in science courses, many minority students face challenges integrating their lessons because the current curricula are culturally biased. Not even the pictures in the textbooks are a representation of the student population or the community in which they are used (Lee, 1997; Takaki, 2012). As such, researchers say that these students find it difficult to perform well (Artiles & Harry, 2006). So, how can urban Black and Brown students be well prepared for STEM careers in such a quandary?

As I previously stated, women are lagging behind in STEM education (especially in chemistry, mathematics, and physics related fields). However, minority women face additional barriers in science education (Rosenbloom, Ash, Dupont, & Coder, 2008; Valentine, 2012). My goal with this study was to see what would happen when the rules of engagement in the science classroom are augmented for/by Black and Brown girls in an urban low-income and underserved public school by infusing the hip-hop culture in their science lessons.

In this paper, I explore how the ideologies of culturally relevant pedagogy and Black feminism are expressed in contemporary hip-hop pedagogy like the Science Genius program and also discuss how they may address challenges that are at the core of issues related to girls’ engagement in science. In particular, I explore how these pedagogical approaches serve as tools to boost the self-esteem and self-image of Black and Brown girls to perform in science. From my personal and professional experiences (for 15 years I taught science in a high-poverty urban

public school in the South Bronx, NYC that serves mostly Black and Brown students), I acknowledge that reform in science education curricula is crucial and imminently needed. I believe that the findings from this study may help educators and policymakers alike to continue to carve out new spaces to engage Black and Brown girls in science education.

## **Background**

### **Culture in Education**

In science education, scholars like Mary Atwater (1996) have acknowledged the importance of culture as an integral unit of science teaching and learning. Atwater argues that studies about multicultural science education are impacted by factors like ethnicity, disability, class, and culture. Culture is a term that is frequently used in academia in studies of populations whose ways of knowing and doing do not necessarily align to the norms of schools. Many of the arguments that are made revolve around the need to be culturally competent (learn and be mindful of the cultural nuances of others in one's surroundings) in order not to offend others who may be culturally different. In many domains, (e.g., academia, business, media) there are invisible but understood lists of directives of what to do or not to do in order for people to become culturally competent or literate (Emdin, 2016; Ladson-Billings, 1995). However, culture is not static, it changes (and is shaped by) the way we interact, behave, interpret, and reflect in our lives. Therefore, in relation to culturally relevant pedagogy, Ladson-Billings (1995) argued that there is a skill and facility to help students recognize and appreciate their culture of origin while also learning to develop fluency in at least one other culture this is defined as cultural proficiency. There is no established set of rules for being culturally relevant.

In her book, *Culturally Responsive Teaching: Theory, Research and Practice*, Gay (2010) elaborated on the parameters of culture in addition to race and ethnicity. She claimed that

the social groups or norms that a student adheres to, his or her motivations in life, and last but not the least his or her beliefs define a student's culture. She stated, "Even without consciously being aware of it, culture determines how we think, believe and behave" (Gay, 2010, p. 9). Hewson and Hewson (1984) proposed that when a student enters a classroom with a point of view about the subject, the teacher must take the student's perspective into consideration during the lesson. Hence, a culturally relevant pedagogue must differentiate lessons to satisfy the cultural variations represented in the classroom.

With this understanding, it follows that every child who walks into a classroom has a culture, and the teacher must acknowledge that and use it as the starting point for teaching and learning. As such, the science teacher must acknowledge that every child comes into the classroom with prior knowledge about the understanding of worldly phenomena that is influenced by the student's culture (Dewey, 2013; Emdin, 2016; Hewson & Hewson, 1984). As Dewey (1902) said, "The child is the starting-point, the center and the end" (p. 13) of the curriculum. Other educational researchers have also concluded that a child's prior knowledge is valuable and must be considered in the learning experience (Pintrich, Marx, & Boyle, 1993). Every student must be able to both express and learn about other cultures besides their own, and in a culturally relevant classroom, it is imperative that students and teachers are sociopolitically aware of their circumstances and surroundings. Teachers must encourage, challenge, and empower students not only to learn academic content but also to have an understanding of the importance of knowledge acquisition for their immediate and long-term endeavors (Ladson-Billings, 1995; see also Adjapong & Emdin, 2015; Emdin, 2010a, 2016; Paris & Alim, 2014). Next, I discuss culturally relevant pedagogy and the importance of its ideologies in urban science education.

## **Culturally Relevant Pedagogy**

According to the census and general American consensus, I am Black or an African American. I am Black; however, I am not a full or a "legitimate participant" (Lave & Wenger, 1991, p. 69) in the African American community because I was born in Ghana and adhere to Ghanaian sociocultural norms. I am a Ghanaian American. So, for as long as I have lived in the United States (over 30 years), I am *still* becoming an African American (a "legitimate participant") because I cannot fully tease out the cultural nuances of being African American. I look the part, and I am labeled the part, but I cannot play the part, at least not well.

This identity tension surfaced when I first became a teacher in an urban public school where the majority of the students were either Hispanic or African American. In addition to holding onto my traditional Ghanaian values (my parents made sure of that), I had been exposed to private education in the United States during which I was oblivious to the deep-rooted socioeconomic and social injustices and diversity issues prevalent in urban public educational institutions that serve predominantly Black and Brown students (Nieto, 2010; Noguera, 2003; Oakes, Lipton, Anderson, & Stillman, 2013). I was not totally ignorant of social justice conflicts in the United States, but I was not confronted with them until I began my teaching career in urban public schools.

As a result of our varying experiences, my students' expectations of me and my expectations of them often conflicted. I was insensitive to the sociocultural experiences that they brought to the classroom, and they simply could not comprehend why I didn't fit into their profile of an African American teacher. As a result, my authenticity as a teacher came into question. For many years, I struggled with defining who I was to gain acceptance from my students and to accept my students' cultural beliefs and norms. It is in this light that I believe



that educators must be trained to be able to practice culturally relevant or responsive pedagogy. Dewey (1902) said, “Nothing can be developed from nothing: nothing but the crude can be developed from the crude” (p. 18). As such, it is important that educators are trained to acknowledge the cultural attributes of their students and to use those cultural norms as a baseline on which to build their lessons. For instance, it would have been helpful for my students and me if I had incorporated hip-hop culture into my science lessons to engage my students who adhered to hip-hop culture.

Culturally relevant pedagogy (CRP) is a pedagogical theory that draws on culturally inclusive teaching. Pedagogically, the teacher must consider the diverse cultures of the students in the classroom environment and include this in his or her lessons. This style of teaching enables students to make connections between their everyday lives and the content they are being taught (Gay, 2010; Ladson-Billings, 1995). From a historical perspective, a long-standing goal of science education was to help students find subject matter relevant to their everyday lives. This approach helps students to appreciate science as not only interesting but also socially important. Several scholars (DeBoer, 1991; Eisenhart et al., 1996; Lee, 1997) have argued that students need to understand the NOS and establish scientific literacy. I believe that a culturally responsive pedagogy serves as a powerful way to accomplish these goals.

Gloria Ladson-Billings, an educational researcher and pedagogical theorist, first wrote about culturally relevant pedagogy in the mid 1990s (Ladson-Billings, 1995). Oakes et al. (2013) defined a multicultural education as one in which the formal curriculum and the observed curriculum take into consideration the many cultural facets of the student. Cultural identifiers such as race, ethnicity, language, gender, and the like should be embedded into academic lessons. CRP and culturally responsive teaching (CRT) are both branches of multicultural

education. The idea behind multicultural education is that the teacher must be sensitive to the multiple cultural beliefs and attributes of all the students in the classroom. Appropriately, both the school curriculum and the classroom curriculum must serve the needs of all the varied cultures of the entire student body by affording them opportunities to embrace the curriculum and be successful in the subject matter.

When Ladson-Billings (1995, 2014) introduced the theory of CRP, her focus was primarily on African American students. Consequently, her research on this theory has continued to focus on African American student and teacher experiences in schools and classrooms. Her ideal goal is for the teacher who teaches African American students to embrace the African American culture and integrate it into their lessons while maintaining academic rigor in the classroom. For example, the teacher should acknowledge and encourage the cultural attributes (like style of dressing or mannerisms) of the student rather than try to dim them and to help the student to achieve academically while holding onto his/her (student) core values and culture as an African American. Additionally, she proposed that teachers must teach students to be politically active in their social environments.

### **Culturally Relevant Teaching and Culturally Responsive Teaching**

A culturally relevant pedagogue should adhere to several principles. First, identity development requires teachers to know who they are (what principles they adhere to in life) and to identify with their own culture. Second, equity and excellence means that lessons should include multicultural content and offer all students equal access to resources while maintaining academic rigor. In relation to equity, the teacher should be able to raise the sociopolitical consciousness of the students so that they are aware of the inequities in their communities. Third, the teacher must teach the whole child. This means that the pedagogue should be informed about

the sociocultural attributes that have influenced each student's educational progress prior to that course (Palmer, 1997, 2017). Fourth, the teacher should facilitate student teacher relationships by creating a safe learning environment and exhibiting care and concern for each child's academic and social well-being. Students should be able to feel that the teacher has their best interests at heart (Palmer, 1997, 2017). Fifth, teachers must exhibit developmental appropriateness by differentiating lessons to meet the needs of diverse students across different skill sets and developmental levels. Sixth, teachers need to manage students' emotions and authentically know their students. A culturally relevant teacher should invest sufficient time in getting to know the emotional levels of the students and reinforcing positive emotions to promote and enhance the learning experience (Brown-Jeffy & Cooper, 2011; Ladson-Billings, 1995, 2014).

CRT, similar to CRP, is a methodological approach that focuses on bridging the culture of students' school lives with their home lives. Both of these frameworks are derivatives of the social justice approach to teaching science. In that regard, Mensah (2012) stated, "The science teacher embraces the belief that every child has a right to learn science, deserves free access to science, is empowered by knowing science, and is provided opportunities to advance himself or herself educationally within science" (p. 320).

With these approaches, emphasis is placed on student-centered education. For example, the teacher should ensure that the students take ownership of their learning, and the teacher acts as the facilitator. Additionally, the teacher acknowledges the cultural agencies of the students in his/her lessons (Emdin, 2016; Gay, 2010; Ladson-Billings, 1995, 2014).

### **Criteria for Practice – Culturally Relevant or Responsive Teaching**

In culturally relevant and responsive teaching, a teacher must follow certain criteria to ensure that there are cultural representations of all the students in their lessons. As such, these

theories adhere to the following characteristics: (a) validating and affirming-embraces the diverse cultural agencies of the students; (b) comprehensive-teaches in a way that is inclusive by tapping into many cultural resources; (c) multidimensional-embodies multicultural theory of education; (d) liberating-allows students to be themselves and upholds or celebrates students' culture; (e) empowerment-accepts students' personal culture and helps students feel empowered, confident, and successful; (f) transformative-takes on role of disruptor because they may be going against the norms of the widely accepted dominant culture (Gay, 2010; Ladson-Billings, 1995; see also Castagno & Brayboy, 2008).

It is fairly understandable that CRP and CRT are referred to interchangeably. However, these two concepts have slightly different emphases. From a cultural lens, CRP seeks to inspire students to be academically, emotionally, and socially strong and also to become critical participants of policy decision-making affecting their school community (Ladson-Billings, 1995, 2014; Mensah, 2012). While Gloria Ladson-Billings (1995) focused on empowering racially marginalized student populations through CRP, Geneva Gay (2010) cast a wider net with emphasis on underachieving students from diverse ethnic backgrounds. CRT promotes, as stated by Mensah (2012), “a pedagogical paradigm . . . that teaches *to and through* students’ personal and cultural strengths, intellectual capabilities, and prior accomplishments” (p. 321).

A hip-hop based science approach like the Science Genius program capitalizes on the culture of the students as an avenue of engagement to promote scientific knowledge acquisition. Due to the acknowledgement of culture, participants find relevancy in their learning and are empowered to become socially and politically mindful of their learning environments. Additionally, a fundamental ideology of hip-hop music is that it is an expression of the lived experiences of the rapper, lyricist or both (Chang, 2007, Emdin, 2010a, 2016; Hill, 2009;

Ladson-Billings, 1995). So when hip-hop pedagogy is adhered to in the science classroom, the pedagogue creates an opportunity for the students to enact their emotional and sociopolitical viewpoints (about their everyday lives) along with learning the science content.

### **Black Feminism**

Black female feminists primarily discuss and give insight into the challenges that Black women face and have faced daily in society (Collins, 2002). Black feminist activists like Ida B. Wells-Barnett, Zora Neale Hurston, Toni Morrison, Barbara Smith, Maria Stewart, Sojourner Truth, and Alice Walker have lent their voices to raise awareness to Black female invisibilities and negative stereotypes, and have helped to empower Black females to overcome these obstacles (Collins, 2002). Fannie Barrier Williams (1987) wrote, "The colored girl . . . is not known and hence not believed in; she belongs to a race that is best designated by the term 'problem,' and she lives beneath the shadow of the problem which envelops and obscures her (p. 150). In this statement, she outlines the fact that the disregard of Black and Brown girls in society is at the root of the underachievement (Morris, 2016).

Black feminism was born out of the sexism and racism of the Civil Rights era and the erasure of Black women during the Feminist Movement. According to Omolade (1987), most Blacks believed these Movements highly favored White women over Black and Brown women. As such, the goal of Black feminist pedagogy was to fight for inclusion and expansion against the traditional Western stereotypical definition of a Black female as lazy, aggressive, not beautiful, unintelligible, and the like (Omolade, 1987).

In 1970, the Third World Women's Alliance published the *Black Women's Manifesto* and pointed out that the root cause of the Black female struggle and the breakdown of the Black family was due to Black slavery in America. For example, Lynch, Norton, Williams, Beale, and

La Rue (1970) reported that upon arrival of African slaves on American soil, “the African social order was broken down. Tribes were separated and shipped to different plantations” (p. 9). The Black woman, besides being used and abused by the slave master, had to adapt to taking care of herself and her children without any aid (Lynch et al., 1970). In modern times, instead of slavery as the primary root cause of separating the Black family, it is the long-term imprisonment of Black men (Adimora, Schoenbach, & Doherty, 2007; Holzer, Offner, & Sorensen, 2005).

A profound side effect of the institutional breakdown of the Black family is the neglect of the children. Oftentimes, the children are being raised by a single mother who is emotionally and mentally “tired” due to constantly battling against the negative societal image of her, having to work multiple jobs to care for her children, and struggling to carve out time for her children. More often than not, the children grow up poor and feel abandoned (Adimora et al., 2007; Roberts, 2004).

The Third World Alliance (1970) explains that Black women have suffered from negative self-image and self-esteem due to continued mental, sexual, and physical abuse and body-shaming (labeled less beautiful in comparison to White females) that began during slavery and lingered on post slavery. As a result, Black females need to rise and demand equal treatment. Guy-Sheftall (1995) lamented, "The Black woman is demanding a new set of female definitions and a recognition of herself as a citizen, companion and confidante, not a matriarchal villain or a stepstool baby-maker" (p. 172).

Consequently, I believe that by educating Black and Brown girls and providing them with the space to express and demonstrate their acquired knowledge, they will be empowered to fight against race, gender, and class oppression.

The Science Genius program combines hip-hop and CRP to afford urban Black and Brown girls the space to showcase their scientific knowledge while projecting Black feministic thought (Collins, 2002; Emdin, 2010b; Ladson-Billings, 1995, 2014; Alim, 2007).

### **Historical Dynamics of Hip-Hop**

Hip-hop originated in 1973 in the South Bronx area of New York City, which is the site of this study and the poorest congressional district in the country. Clive Campbell, known by his stage name as DJ Kool Herc, is a Jamaican American disc jockey who is credited as the inventor of hip-hop. He started this style of music and performance at a party (block party) he organized to celebrate his sister's birthday (Chang, 2007, Emdin, 2010a, 2010b; Hill, 2013).

Hip-hop involves four main elements: DJing, B-Boying (breakdancing), MCing (rap lyrics, songs, performances), and Graffiti (graphical illustrations). However, the renowned DJ Kool Herc contends that there is more to hip-hop than the aforementioned elements, namely “the way you walk, the way you talk, the way you look, and the way you communicate” (Chang, 2007, p. xi). The origin of rap lyrics was grounded in the rappers' expression of their sociopolitical viewpoints, frustration with personal and societal struggles, and expression of success and hopes for a better future. Hip-hop is about connecting people, and it has provided an avenue for young people to make sense of their positions and circumstances in their surroundings (Chang, 2007; Emdin, 2010a, 2010b; Emdin, Adjapong, & Levy, 2016; Hill, 2013; Rose, 1994).

Many scholars have argued that the majority of Black and Brown urban youth adhere to hip-hop music and culture. As such, some educational institutions have begun incorporating hip-hop music and culture into their curricula (Banks, 2015, Chang, 2007; Emdin, 2010b, 2016; Hill, 2009; Alim, 2007). As a matter of fact, hip-hop has been incorporated into Sunday school curricula, dramatic church plays and exhibitions, and we find the influence of hip-hop music and

culture in gospel music, coining the term Christian hip-hop or holy hip-hop (Emdin, 2016; Tait, 2006).

Hip-hop based education (HHBE) or hip-hop pedagogy is the use of hip-hop rap songs and lyrics as educational tools in the curricula (Banks, 2015; Emdin, 2010a, 2010b; Hill, 2009; Rose, 1994). Banks (2015) said hip-hop pedagogy "is a total reimagining of the classroom experience and speaks to the cultural intelligences of the students, which include the language, history, rituals, and mores of the 40-year-old, global, youth-oriented, social justice movement known as hip-hop" (p. 2). Proponents of hip-hop pedagogy are confident that the use of hip-hop in the classroom can inspire Black and Brown children to become socially and politically active (Banks, 2015; Dimitriadis, 2009; Hill, 2009; Prier, 2012) and may create a classroom environment that is inclusive. Additionally, some advocates of hip-hop integration into academic curricula argue that not only does hip-hop boost the educational interest of urban Black and Brown students, but it also fosters literacy (Hill, 2009; Morrell, 2002; Morrell & Duncan-Andrade, 2002; Rose, 1994). Hip-hop makes youths of color want to come back to school because anchoring the course instructions in the culture of students allows them to see themselves as part of the learning process (Emdin, 2010b; Hill, 2009; Rice, 1994). Emdin (2010b) proposes that hip-hop is a pedagogical mechanism "which involves a process of learning and or utilizing the complex nuances of communication in hip-hop and a valuing of student culture" (p. 62).

## **Urban**

An urban area is characterized as a densely populated region with city, town or region. In social research, however, the word urban has become synonymous with an inner-city area that is comprised mostly of Black and Brown populations stricken with poverty (Emdin, 2010a; Nieto,



2010; Noguera, 2003). In a personal conversation with Dr. Emdin, the author of *For White Folks Who Teach in the Hood . . . and the Rest of Y'all Too: Reality Pedagogy and Urban Education*, he argued that in a vast urban city like New York City (NYC), where the income differential is a determining factor in where a student resides and attends school, the word urban is oftentimes associated with low- income, poverty-stricken communities where mostly Black and Brown people reside. For instance, public schools in District 2 with mostly White, upper-middle-class students are not referred to as urban while public schools in District 9 in the South Bronx where the students live below the poverty line and the majority of them qualify for free or reduced lunch are characteristically referred to as urban (Christopher Emdin, personal communication, March 9, 2016).

### **My Complex Hip-Hop Identity**

My first introduction, at least as far as I can recollect, to rap music was ironically by the rhythm and blues (R&B) group known as New Edition. New Edition was an all-male African American R&B group. In 1984, they released a song titled “Cool it Now” (Brantley & Timas, 1984). This song captivated my attention because they had infused a few lines of rap lyrics in the song, and it was nothing like I had ever heard before (though I could hardly make out what they were saying at that time).

After the third verse of the song, two members of the group (Michael Bivins and Ronnie DeVoe) rapped the following:

When you got a girl who takes her time  
You must slow the pace, you can't mess with her mind  
If she feels the same, she'll let ya know  
Just prepare yourself or be ready to go

And I hope this message stays in your mind  
'Cause you almost lost a girl who is right on time  
There's one more thing that you got to know  
Just cool it down and stay in control!

Then after a few more lines, another member of the group, Ralph Tresvant rapped these bars  
(versus):

Why you all coming down on me?  
Trying to tell me how my life is supposed to be  
I know you're only trying to help me out  
Trying to show me what life is really about  
But this time I'm gonna make it on my own  
So why don't you fellas just leave me alone  
Ronnie, Bobby, Ricky, and Mike  
If I love the girl who cares who you like

When this song was released, I was in middle school in Ghana, my country of birth. As I insinuated above, I was not intrigued by the message as much as the rapping of the song because it was something new to me. At that time, rap, as a genre of music, was not yet popular in Ghana.

In the Spring of 1986, I moved to the United States. My family moved to the Bronx where I attended an all-girls Catholic high school with a total population of about 300. Of the total student body, about 65% were Hispanic (mostly Puerto Rican), 18% White, and roughly 17% were Black (a mixture of African American, Caribbean, and African).

I describe the demographics of my tiny, one-floor private Catholic high school (located

on the fourth floor of the building) because that is where I got to know more about hip-hop, the music and the culture (the attitude, dressing, hand gestures, the walk, and the like). During homeroom, both in the morning and afternoon, and after school, the Black students (mostly the African Americans), the Caribbean, and a few Hispanic students would gather around in a circle and either take turns rapping or rap in unison to the latest rap music while making the hand gestures and beats and dancing that went along with the rapping. During lunch time, after school hours, or when walking up the four flights of stairs to the school the conversations that my peers had were often about the latest hip-hop artists' fashion, collaborations, or dating lives. As I continued to eavesdrop on these unplanned natural gatherings and dialogues, I got my daily dose of hip-hop music, culture, and news. It was during these impromptu interactions that I learned about the different hip-hop music shows on television, namely Video Music Box, which aired on NYC local public stations; Video Soul, hosted by Donnie Simpson on Black Entertainment Television (BET); and Yo! MTV Raps which of course aired on Music Television (MTV) and a host of rap music that played on radio stations like 98.7 Kiss FM (in the late 1980s and a better part of the 1990s). At the time, there were not as many of radio stations that were dedicated to hip-hop music and culture as there are today. I believe that the increase in airtime devoted to hip-hop music and culture is in itself a testament to the progression and popularity of this genre of music and the cultural dimensions it represents.

It is ironic that it was in a restrictive Catholic school atmosphere where we were forbidden to even chew gum during school hours and where the principal stood outside every morning not necessarily to welcome us but to ensure that we did not get distracted by the boys from our "brother" Catholic high school that was located two blocks down from the girls' campus, I was introduced to hip-hop music and culture. However, this was also the space where

my complex hip-hop identity came to light because inasmuch as some of my classmates were into it, hip-hop music and culture were not openly welcomed at school or at home. This was largely due to the media regularly sensationalizing and publicizing negative news about hip-hop music and culture (Williams, 1995).

Besides the media attacks on hip-hop, parents like mine who were affirmed God-fearing Christians and also immigrants totally dismissed the new wave of music and culture due to their innocent ignorance of the complexities of the culture. At that time, they never had anything positive to utter about hip-hop music and culture. They thought it was an abomination. So, my younger brother (first-generation Ghanaian American) and my other siblings and I had to develop double identities: one for home and another one for outside our home.

At school the Black and Brown students who embraced hip-hop music and culture became “those” kids who rapped those bad songs with the attitude and clothing and hand gestures. Though I was happy that I was not labeled as one of “those” students, secretly, I wished I could do what they did. Regardless of what my school, the media, and my parents were preaching about the negativity of hip-hop music and culture, I believed I had to assimilate because that was the language of my peers—at least the ones that I could most readily relate to or identify with because I “looked” like them. I couldn’t talk like them, I didn’t have the “attitude” to dress like them because I had not yet fully assimilated into the culture (hip-hop) that they adhered to, but there was a strong connection that we had to each other.

My connection with hip-hop music and culture became more pronounced when LL Cool J, my favorite rapper of the 1980s and 1990s, released his song, “Around the Way Girl” from the album, *Mama Said Knock You Out* (Smith, James, & Williams, 1990). In the song, LL Cool J sang the following:

I want a girl with extensions in her hair  
Bamboo earrings, at least two pair  
A Fendi bag and a bad attitude  
That's all I need to get me in a good mood  
**She can walk with a switch and talk with street slang. . . .**  
**She likes to dance to the rap jams. . . .**  
**Your sweet like sugar with your gangster talk. . . .**  
Witcha New Edition Bobby Brown button on your sleeve. . . .  
I need an around the way girl  
That's the one for me  
She's the only one for me

I loved the song so much, but I could not reconcile my image of self with the image of the girl in the song, and this disconnect pained me every time I heard the song played or watched the music video. I didn't fit the profile of "an around the way girl," the type of girl who was described in the lyrics; however, I felt like LL Cool J, the rap artist that I was most impressed with, was talking about my friends—"those" bad kids at my school who listened, rapped, and danced to rap jams.

My personal experiences support what many scholars (Banks, 2015; Chang, 2007; Emdin, 2010a, 2010b, 2016; Hill, 2009; Alim, 2007) have argued about the majority of Black and Brown children responding to hip-hop music and culture. The Black and Brown girls at my high school weren't bothered at all about what was said about hip-hop by the school's administrators or teachers, their parents, or the media. My Black and Brown classmates love and attraction for hip-hop did not dwindle, in fact the opposite was true. Today, "those" students

who were treated like outcasts in high school are doing very well in life. One is the first lady of her church with three children; another is a registered nurse in Virginia; and another is a political scientist residing in New Jersey with her husband, a National Basketball Association (NBA) consultant, and their two children. They are not so bad off after all; they were just guilty of embracing a music culture that resonated with them. They still listen to hip-hop music.

### **The Global Reach of Hip-Hop Music and Culture**

Since the early part of the 21<sup>st</sup> century, hip-hop music and culture have increasingly become a global sensation spanning all seven continents (I no longer have to shy away from loving or embracing the culture though I still cannot rap). Youth in many countries around the world like Japan, Jamaica, Australia, South Africa, the Dominican Republic, England, Nigeria, and of course Ghana are engaged in hip-hop music and culture (Condry, 2013; Chang & Watkins, 2007; Charry, 2012; Jabbaar-Gyambrah, 2015; Liu, 2010; Osumare, 2007). In Ghana, my birthplace, the national music genre is called High-Life. Due to the globalization and influence of hip-hop music, Ghanaian rap musicians have created another genre of music called Hip-Life. When Hip-Life began to take shape, it was mostly a High-Life song with a few lines of rap lyrics. Today, Hip-Life music is essentially a hip-hop song that is rapped in either one of the native tongues or a mixture of our native languages (including English) with a unique style of dance.

In the United States, hip-hop music and culture have also become increasingly accepted since the 1970s when it first began (Emdin, 2010a; Hill, 2013). As rap music and rap artists became increasingly part of the mainstream American culture, many R&B artists and even rock musicians either invited rappers to collaborate with them on their albums and singles or they themselves have started to spit (rap) a few bars (lines) in their songs.

Hip-hop music and culture have also made it to Broadway in New York City. Broadway or The Great White Way (named because it was one of the first streets in the United States to be lit with electric lights) encompasses about 41 professional theatres with about 500 seats for patrons. It is a selective space that spans from 41st Street to about 53rd Street and at Lincoln Center on 66th Street and Broadway and only houses plays/shows that have significant cultural and/or entertainment value (Jackson, Keller, & Flood, 2010).

Lin-Manuel Miranda, the Tony Award winning actor and writer who was born in Puerto Rico but raised in NYC, wrote two famed hip-hop infused Broadway musicals: *In the Heights* and *Hamilton*. *In the Heights* was about immigrants' struggle to succeed in the United States. The backdrop of the musical was set in Washington Heights, an Upper Westside neighborhood of Manhattan that borders the George Washington Bridge. *The Heights*, short for Washington Heights, was about a locality that is mostly characterized by immigrants from the Dominican Republic in New York City. *Hamilton* is a hip-hop musical about Alexander Hamilton, one of the Founding Fathers of America. Though Hamilton was a White male, Lin-Manuel Miranda purposely cast non-White actors to play Hamilton and the other historical American founding members depicted in the show. Interestingly, both of these hip-hop oriented musicals were in high demand on Broadway and commanded very high-ticket prices (Pusateri & Horwitz, 2016).

### **Hip-Hop Pedagogy and the Science Genius Program**

The application of hip-hop into a curriculum provides an opportunity for culturally relevant instruction for youths of color by affirming their urban identities and enhancing deeper learning through connection with something that is relevant to them (Emdin, 2010a, 2016; Alim, 2007). Several researchers argued that school culture that negates the popular culture of the students would ultimately fail the students (Emdin, 2016; Ladson-Billings, 1995; Olneck, 1995;

Ogbu, 1995; see also Dewey, 2013; Sternberg, 2007). Recently, CRP has become an integral focal point in urban science education research. Scholars like Gloria Ladson-Billings (1995), Django Paris (2012), and Samy Alim (2007) have argued for culturally relevant and sustaining pedagogies in urban public schools that are populated with minority students, especially African American students.

Brown, Collins, and Duguid (1989) argued, “school activity too often tends to be hybrid, implicitly framed by one culture, but explicitly attributed to another” (p. 34). For example, from first-hand experience, the current science education curriculum does not effectively address the educational needs of poor urban non-White Americans. As it stands, the culture of my students (African Americans and Latinos/as) in the South Bronx and similar contexts is not represented in the science curriculum.

The mission of the Science Genius program, a hip-hop based science initiative, is to engage urban youth in authentic science activities by infusing hip-hop cultural music. I argue that a hip-hop based science program creates the sociocultural space needed for urban Black and Brown girls to achieve in science while overcoming negative race/gender stereotypes.

Hence, in light of implementing CRP, the Science Genius program uses hip-hop – the culture of many urban youth – to teach science content. The fact is, most urban Black and Brown youths already ascribe to hip-hop culture, so it makes sense for educators to meet them where they are (culturally) and then add the science content (Emdin, 2010a, 2010b, 2016). In so doing, educators demystify science and make it more relative, fun, and accessible for urban Black and Brown youths to engage in science content and take ownership of their learning. Furthermore, many researchers (e.g., Brown et al., 1989; Brown et al., 2005; Duncan & Rivet, 2013; Emdin, 2016; Ladson-Billings, 1995) have argued that when students see the



representation of their culture in their science classrooms, this helps to boost their self-confidence while learning the NOS to become scientifically literate and motivates them to engage in subsequent authentic science activities.

Participation in the Science Genius program requires that students write their own science based rap lyrics and perform the rap at a “science battle” (the Final Battle), whether as individuals or in a group. As the participants create their own lyrics and music, they construct their own scientific knowledge, understanding, and identities. The content becomes more relative and meaningful to their daily lives (Adjapong & Emdin, 2015; Driver, Asoko, Leach, Scott, & Mortimer, 1994; Emdin, 2010a, 2010b; Krajcik & Blumenfeld, 2006).

The topics that the students work on are aligned to the assessment frameworks of the New York State Science Standards, the Common Core Learning Standards, and the Next Generation Science Standards. The overall objective of the Science Genius program parallels that of the New York Young Men’s Initiative and the Expanded Success Initiative (ESI). Emdin (2010a, 2010b) argued that the latter two programs are the nation’s boldest efforts to tackle the educational achievement gap experienced by Black and Latino young men, and these programs are changing the narrative by carving out innovative ways to showcase these minority students’ academic and scientific aptitude. The Science Genius program also started with a focus on young urban African American and Latino males; however, young women have been participants since its inception. Similarly, hip-hop began with males, but females have successfully integrated into the music and culture.

The last phase of the Science Genius program is to have students (either as individuals or groups) representing various high schools across New York City compete at a “Final Battle.” The selection process begins about 4 weeks before the date of the Final Battle and if chosen, the

student(s) will have the opportunity to represent their school at the Final Battle. After the selection process is completed, the individuals or groups representing their local schools are invited to Teachers College, Columbia University for further practice (to receive help with stage performance and to familiarize themselves with the protocol for the upcoming Science Genius Final Battle) with Dr. Emdin, the creator of the Science Genius program and an associate professor of Science Education at Teachers College, Columbia University, and their performance coaches from their local schools.

The road to the Final Battle begins at the various high schools. Students working as groups or individuals compete against each other at their local campuses, and the best group or individual is selected by the school to represent the school at the Final Battle where they will compete against other students from other schools. At the Final Battle, the students are judged based on the strength of their (a) science content lyrics– demonstration of content knowledge and understanding, (b) sociopolitical message tied to their science rap lyrics, and (c) performance aptitude–how well they conveyed both their scientific knowledge and their sociopolitical message to the public. Three individuals are invited to serve as judges at the Final Battle. The judges may include scientists, rap artists, and public or community figures (Emdin, 2010a, 2010b).

The Science Genius program promotes science learning with the practicalities of CRP. As a hip-hop based science program, the Science Genius program provides students with an innovative way to learn science and the latitude to showcase their newly constructed knowledge of science by adhering to a cultural norm that is relevant to their daily lives. Hence, the Science Genius program is at the intersection of scientific knowledge and culture that fosters a new epistemological experience in scientific literacy. Tobin (1993) claimed that in a socially

constructivist classroom, the students take ownership of their learning and construct new knowledge based on their interactions and cultural experiences. This program aligns to a socially constructivist science classroom.

### **Purpose and Research questions**

The current research available does not address how Black and Brown girls enrolled in urban public high schools use spoken-word/poetry or rap to learn science while they push back against or resist negative social stereotypes or gender biases that they may have experienced in science education and beyond. Spoken word and dance performances are part of hip-hop pedagogy. From my own cultural experiences, storytelling, drum beating, and dance performances are common means that both Africans and African Americans use to convey messages of hope and despair. I grew up listening to many proverbial stories like the Anansi—the stories of the “wise” spider who is mischievous and always gets into trouble in his community. These stories are meant to teach children to abstain from deceitful behaviors and to live modestly and told through song and rhyme. Also, during festive occasions, drumbeats and the dances that accompany them are used to convey messages of happiness, reassurance, or sympathy.

Given the ancestral connections of African descent (Black and Brown people) and Blacks in the United States, it makes sense that hip-hop culture (through music, dancing, and spoken-words or poetry) is readily used for the expressions of good fortune, hope, and despair. When Black and Brown girls participate in hip-hop based programs like the Science Genius program, they get the opportunity to create their own lyrics or poems (cultural artifacts) that they must perform either through rap and dance or spoken-word (or both) to reflect their understanding of science content (Emdin, 2010a, 2010b). In these spaces the participants are not confined to express their understandings of the NOS and/or their scientific epistemologies in a regular

laboratory setting or classroom. As such, they have the leeway to become creative and infuse their sociopolitical viewpoints into their lyrics and performances. In fact, the Science Genius program, in utilizing hip-hop pedagogy, creates a platform that encourages participants to reflect on and link science content to various sociopolitical issues in their immediate surroundings and beyond (Adjapong & Emdin, 2015; Emdin, 2010a, 2010b, 2016).

My goal was to conduct a longitudinal critical ethnographical study that looked at how a hip-hop based science program like the Science Genius program empowered urban Black and Brown girls and afforded them the space to achieve in science while resisting negative Black and Brown female stereotypes. My research questions were the following:

1. How does participation in a hip-hop based science program impact Black and Brown girls' scientific content knowledge?
2. How do Black and Brown female participants in the hip-hop based science program construct their science/scientific identity?
3. To what extent does participation in a hip-hop science program afford Black and Brown girls the space to resist negative Black and Brown female stereotypes in STEM and hip-hop?

## Chapter II

### LITERATURE REVIEW

Leonardo and Grubb (2014) argued that, “Race-as-biology has now been replaced with race-as-social construction” (p. 148). That is, race as a genetic identifier has taken on a new meaning and has become a social class identifier that acts as a hurdle in the academic progress of people of color. Leonardo and Grubb stated, “Race is part of how schools perceive students;” “from choosing school class presidents (therefore who is intelligent or popular) to homecoming queens (therefore who is beautiful) to targets of disciplinary policies (therefore who is the troublemaker; p. 149). These scholars argued that “educators invest in race” (Leonardo & Grubb, p. 148) such that educational institutions function to perpetuate the reproduction of the social class status quo which positions certain students as academically deficient based on their race, and not on their identity (Bourdieu, 1986).

In their paper, Barton et al. (2008) looked at African American and Latina students in a high-poverty public middle school in New York City. The girls enrolled in sixth through eighth grade science classes. The authors stated that girls in high-poverty urban school zones “face additional barriers to equitable science education” (Barton et al., 2008, pp. 71-72). The authors realized that, to combat these obstacles, the girls created their own hybrid spaces to enable them to perform academically in their science classes. The hybrid spaces that the girls created allowed them to boost their self-confidence and found new forms of “authority and positionality in the science classroom” (Barton et al., 2008, p. 81). They enacted practices that made it comfortable for them to actively participate in learning science.

The National Women’s Law Center in conjunction with the National Association for the Advancement of Colored People (NAACP) Legal Defense and Educational Fund, Inc., published

a report titled *Unlocking Opportunity for African American Girls: A Call to Action for Educational Equity* (Smith-Evans, George, Graves, Kaufmann, & Frohlich, 2014). In the report, the argument was made that African American girls' performance in science education lagged behind that of their White counterparts due to negative public perception and low self-esteem. It was further argued that negative stereotypes of African American girls led educators and administrators to more harshly discipline these students. This was certainly evident not so long ago when a video from Spring Valley High School in South Carolina surfaced where a young African American high school student was manhandled and dragged out of her chair in a classroom because she refused to put her cellphone away. It was later discovered that the girl was suffering from posttraumatic stress after a series of personal experiences at home (Stelloh & Connor, 2015).

This video and research related to the experiences of girls of color in schools show that it is imperative for educators and administrators alike to become sensitive to the cultural attributes of youth and the environments they come from. Furthermore, educators must address implicit and explicit biases that impact the ways they discourage youth from learning. A report by the National Women's Law Center listed some common biases against Black and Brown girls that impact their self-confidence. Such as, Black and Brown girls are not attractive, they are loud with bad attitudes, are prone to be promiscuous, and are not interested in education. These negative stereotypes keep African American girls from being challenged in the classroom and/or offered more rigorous courses like AP classes that will root their foundation in STEM education (Smith-Evans et al., 2014).

Even though there has been increased research around women in science (Brotman & Moore, 2008; Hanson, 2008; Hill et al., 2010), much of these investigations have been on the

differences between men and women in science education, with not much research exploring the experiences of subgroups of women in science education and science occupations (Hanson & Johnson, 2000; Mau, Domnick, & Ellsworth, 1995; National Science Board, 2000).

Nonetheless, the recent shift in research about African American women's experiences in science education affirms that on average African American women are more interested in science than their White female counterparts (Hanson, 2008; National Center for Education Statistics, 2000). Unfortunately, research also reveals that African American women experience a great deal of racism and sexism in science and are still "underrepresented in science programs and occupations" (Hanson, 2008, p. 2) in comparison to White women.

In her book, *Sisters in Science: Conversations With Black Women Scientists About Race, Gender and Their Passion for Science*, Jordan (2006) interviewed several African American women scientists about their road to success in STEM. Given the climate of sexism, lack of role models, low self-esteem, negative self-image fueled by negative societal images of Black and Brown girls, and the sheer lack of support for Black and Brown girls to succeed in the sciences, these remarkable women fostered an avenue for success. The women talked about what they had to overcome and the support system that empowered them to achieve their goals. Most of the women did not have parents or other family members with higher education to rely on as role models. However, they were fortunate to have met teachers who believed in them and a community of supporters outside school grounds who encouraged them.

To succeed as Black female scientists, they discussed having to rise above the negative societal perceptions of who and what a Black girl is and is capable of (Hanson, 2008; Jordan, 2006). They countered perceptions about their promiscuity, loudness, disrespect, laziness, being unintelligible, or not beautiful enough. They also confessed that even though they were aware

that the odds were stacked against them, they were able to build a strong “inner-self” with the help of their community of supporters and their passion for science. Educators and especially science teachers must find the pedagogical methodologies that will keep the passion burning for future Black and Brown women scientists by explicitly addressing these negative perceptions.

Science learning involves observations and interpretations of information that may be influenced by a person’s sociocultural viewpoints of the world. Research that focuses on sociocultural frameworks like CRP or responsive teaching in education has revealed that culture is an important concept to be considered not only in the science classroom but also in other content areas (Artiles & Harry, 2006; Atwater, 1996; DeBoer, 1991; Dewey, 1992; Gay, 2010; Ladson-Billings, 1995, 2006).

In his paper, “Returning to the Root: A Culturally Relevant Approach to Mathematics Pedagogy,” Tate (1995) argued that African Americans would benefit more from a culturally responsive approach of engagement. Olneck (1995) argues that teaching that ignores student norms of behavior and communication provokes student resistance, while teaching that is responsive prompts student involvement.

A study by Esposito and Swain (2009) reported that teachers who utilized CRP in their classrooms were better able to help their students think critically about social injustice issues in their schools and communities. This finding confirms one of the goals of culturally relevant teaching that Ladson-Billings (1995b, 2006) argued for.

The results of several studies (Duschl, 2008; Lederman, 1999; Sandoval, 2005) showed that one major aspect of a child’s scientific epistemology was that students entered into the classroom with a preconceived notion of natural phenomena that was embedded in their cultural beliefs. As a result, effective teachers must be able to differentiate their lessons to address the



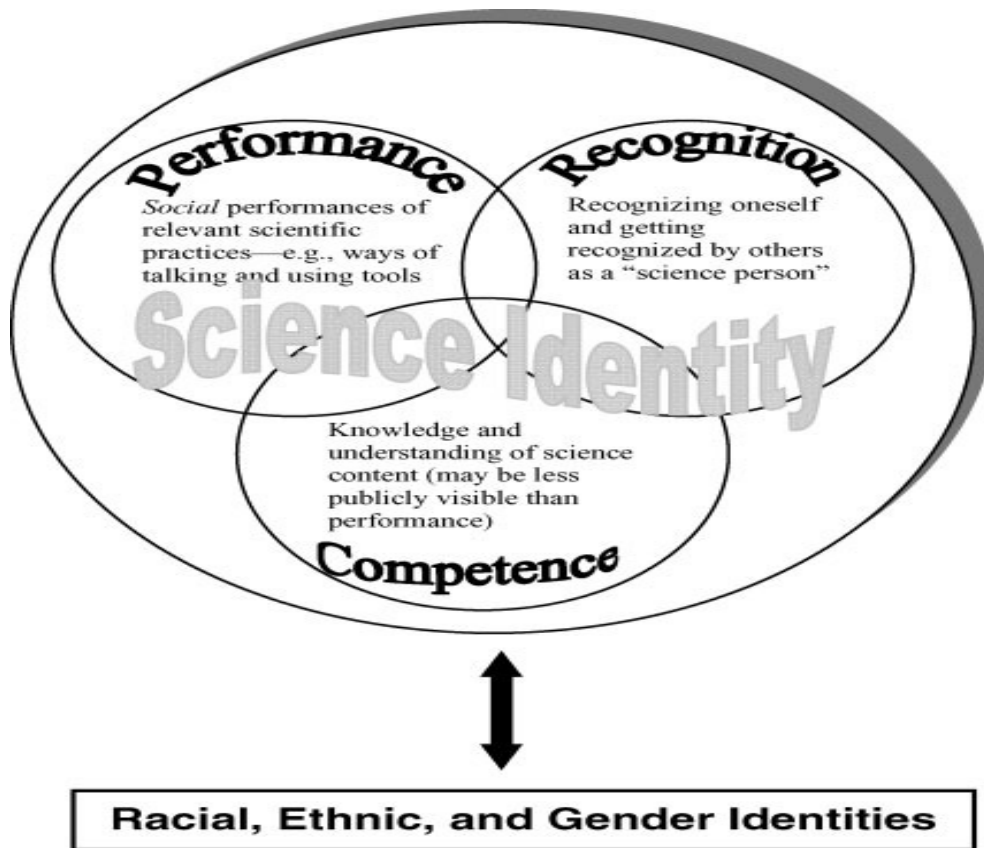
different existing conceptual understandings of the diverse student body in the classroom.

Wlodkowski and Ginsberg (1995) said, “Strong continual engagement among diverse students requires a holistic approach—that is, an approach where the how, what, and why of teaching are unified and meaningful” (p. 1) because “what is intelligible, plausible and fruitful to one student may not automatically be so to another” (Hewson & Hewson, 1984, p. 9).

According to Takaki (2012), most American norms are defined for and by White Americans, and the rest of America is left out. In his call for a more unified America, Takaki (2012) advocated for culturally relevant and multicultural education. He hoped for a curriculum in which the “other” Americans were also considered, including their history, culture, and ways of being.

Like Lee (1997), I am also questioning whether science is really for all Americans? Furthermore, I wrestle with what steps we (society, educators, and policymakers) should take to get the rest of the American people who have been left behind or who reside outside of the mainstream curriculum to engage in learning science and becoming part of the scientific discourse. I suggest that we start by investigating how best to engage children of color in learning science and what devices such as innovative pedagogical methodologies can be utilized to make science education more relevant to these students' everyday lives.

## Defining Science Identities of Black and Brown Girls



*Figure 2.1.* Model of science identity. This figure explains how an individual’s science identity is influenced by three factors (performance, recognition, and competence) and shaped by that person’s racial, ethnic, and gender identities (Carlone & Johnson, 2007).

Many studies (for example, Archer et al., 2012; Calabrese Barton et al., 2013; Carlone, 2004; Carlone & Johnson, 2007; Schreiner & Sjøberg, 2007) have shown that a person’s science identity is not simply defined by how that person describes herself to others about her capabilities in science, her ambitions in relation to science, or how she feels about science. According to Carlone and Johnson (2007), a person’s science identity is influenced by three

factors that overlap (see Figure 1). The first of these three elements is performance–social performances of relevant scientific practices. Examples include the ways in which a person communicates and explains scientific content and the ease with which that person can use scientific tools. The second element is recognition–the ability to recognize oneself as a scientist and also receive recognition by others as a “science person.” The third element is competence–when a person has knowledge and understanding of science content. It is difficult for others to readily spot a person’s science competence like they would their science performance.

In addition to these three factors (performance, recognition, and competence), Carlone and Johnson (2007) argued that a person’s science identity is swayed by her racial, ethnic, and gender identities. Carlone and Johnson further explain that science identity is more complex than how an individual described her relationship to, capabilities in, or ambitions toward science because “it is not purely an emic construct” (p. 1192). Conversely, identity is birthed out of the “constraints and resources available in a local setting” (Carlone & Johnson, 2007, p. 1192). In other words, identity is not simply based on what a person says or does relative to science. Carlone and Johnson (2007) stated, "A science identity is accessible when, as a result of an individual’s competence and performance, she is recognized by meaningful others, people whose acceptance of her matters to her, as a science person" (p. 1192).

For Black and Brown girls, being recognized as a “science person” by the larger society does not come naturally due to negative preconceived notions of who they are (Barton et al., 2008; Brotman & Moore, 2008; Carlone, 2004; Carlone & Johnson, 2007; Carnevale, Smith, & Strohl, 2013; O’Brien et al., 1999; Malcolm, 1989; Washington, 2011). It was evident that an individual’s science identity was also culturally motivated. Eisenhart and Finkel (1998) talked

about cultural production, which is an anthropological phrase that refers to “meanings developed by groups in their everyday activities” (p. 44) to push back against implied labels by the larger social structure.

The designation of a “science person” by society is influenced by the parameters of the cultural norms and the historical perceptions of the society at large. For instance in the United States, the White male identity as a “science person” is still prevalent while Black and Brown people are less likely to be labeled a “science person” even if they are actual scientists (Carlone, 2004; Carlone & Johnson, 2007; Eisenhart, 2001; Eisenhart & Finkel, 1998). This phenomenon is especially true for Black and Brown women due in part to political, historical, and societal meanings of being a woman of color. As such, aspiring Black and Brown scientists must consistently exert themselves to be recognized as science people by the larger social culture (Carlone, 2004; Carlone & Johnson, 2007; Eisenhart, 2001; Eisenhart & Finkel, 1998). Therefore, it is vital to open avenues for Black and Brown girls to create spaces where they are recognized as science people and where they are provided with the opportunities to perform and exhibit their scientific competencies.

### **Drawing a Parallel Between Women in Science and Women in Hip-Hop**

In American history thus far, the image of a scientist has been represented by a White male figure (DeBoer, 1991; Harding, 1986; Jordan, 2006). Many women scientists are continuously marginalized (Catsambis, 1995; Hill et al., 2010; Pollack, 2013) and young aspiring female scientists do not receive the support they need while trying to pursue their degrees (Hill et al., 2010; Pollack, 2013).

Before becoming a science educator, I worked for 7 years as an assistant researcher at a highly competitive research center that focused on genomics. In this position, I witnessed that

out of the eight principal investigators (PIs) on my floor, only one was female and sadly, she had the smallest laboratory space. As basic science researchers, we all worked long hours; however, the lab ran by the female scientist was constantly busy with very little downtime (her laboratory was right next door to mine). I vividly remember having a conversation with my lab PI about the intensity of the lab next door, and he frankly said, “Well, you can’t blame her. She’s working among a lot of men, and she has the pressure of having to constantly prove herself, or she will lose her funding and space.” This experience provided a powerful exemplar of what a female scientist had to endure in order to survive.

As a student, I had the pleasure of discussing my research interest about women in science with Dr. Rivet, an associate professor at Teachers College, Columbia University. As we talked, she began to naturally open up about her personal challenges as a physics graduate student. She relayed stories about the lack of support and encouragement she received from her physics professors and peers, the majority of whom were males. Similarly, in a *New York Times* article, Eileen Pollack (2013) recounted her journey to *almost* receiving a graduate degree in physics at Yale University. Pollack, like Dr. Rivet, claimed that she did not receive much support from the male-dominated physics department faculty while a student and that the school environment became so unbearable that she ended up switching majors.

In her article, Pollack (2013) narrated stories by other women scientists and those of aspiring female scientists at Yale. Similarly, many of them detailed stories about how they had often been marginalized by their male counterparts. Some women in science painfully shared that the university failed to provide them with adequate support as working mothers and scientists. For instance, they grieved that Yale did not provide viable childcare services for working mothers. Comparing the experiences of the women in the Yale study to the female PI

who worked next door to me in my previous work in science research, there were many similarities. For example, many women scientists at Yale also reported that they were usually awarded smaller lab spaces than their male counterparts.

According to Pollack (2013), female STEM students felt the need to conceal their intelligence to feel accepted by their male counterparts. For example, in order not to stand out or intimidate their male peers, the female graduate students would lie about pursuing a STEM degree. In other instances, female scientists reported that they would purposely dress down or appear “unattractive” so that their male peers would approach them as serious scientists (Zuckerman, 2001). Zuckerman (2001) conveyed Dr. Geri Richmond’s (a professor of chemistry) struggle to fit in with the “guys” in graduate school. According to Zuckerman, Dr. Richmond

... spent her high school years as a cheerleader turning cartwheels on a basketball court and dating as much as possible. But in college, she did a complete turnaround. “I dug into science and enjoyed it so much that I didn’t come up for air until I graduated.” To fit in with her male peers, she threw out her dresses, her pumps, her nail polish and makeup. Even her hand lotion was jettisoned because its fragrance was a subtle evocation of her gender. “Socially it was hard, my girlfriends didn’t understand what I was doing. I always had to struggle internally.” (p. 81)

On another note, throughout my years as a student in science education, I was taught that James Watson and Francis Crick discovered the shape of the DNA molecule. I also learned that in 1962, Watson and Crick along with Maurice Wilkins were awarded the Nobel Prize in Physiology or Medicine for their discovery of the structure of the DNA molecule (Lee, 2013). As an educator, I have shared the Watson and Crick narrative to my students. However, I

recently read an article about Rosalind Franklin, a physical chemist who worked as a research associate at Kings College, London. In the article, I learned for the first time that Rosalind Franklin's discovery of the image of DNA (which she termed Photo 51) was instrumental in the discovery of the structure of the DNA molecule. Wilkins, who was Franklin's colleague at the lab, took her Photo 51 without her permission and shared it with Watson and Crick who were doing investigations about DNA at another university. Due to sexism within the male-dominated science research field, the three males later received credit for the discovery of the DNA structure, and Franklin was never awarded any credit. She was not even mentioned in any of the journals or textbooks that were published about this phenomenal discovery that led to a paradigm shift in genomic research (Lee, 2013). To that end, Lee (2013) stated, "Like many women scientists, Franklin was robbed of recognition throughout her career" (p. 1).

Just like in science education, women in hip-hop have faced inequities and gender discrimination. In both of these domains, males are the dominant representative figures while females have lagged behind or not received their due recognition (Carnevale et al., 2013; Harding, 1986; Hill et al., 2010; Washington, 2011).

Nicki Minaj is one of the most renowned female rap lyricists and has been described as the queen of hip-hop. In March of 2017 she exceeded Aretha Franklin's 40-year record for the most appearances (76) by a female artist on the Billboard Hot 100. In an interview with *T Magazine* (part of *The New York Times Style Magazine*), Nicki Minaj shared personal stories of being mistreated and underappreciated in the music industry because she is a woman (Gay, 2017). During the exchange, Nicki Minaj expressed her bitterness and the pain she endured as a Black female artist. She said,

I had so much going against me in the beginning: being Black, being a woman, being a

female rapper. No matter how many times I get on a track with everyone's favorite M.C., and hold my own, the culture [society] never seems to want to give me my props as an M.C., as a lyricist, as a writer. I got to prove myself [a] hundred times, whereas the guys [male artists] that came in around the same time as I did, they were given the title so much quicker without anybody second-guessing [them]. (Gay, 2017, p. 5)

Following the interview with *T Magazine*, Nicki Minaj took to Twitter on October 25, 2017 to rant about her personal struggles and bitterness about not being taken seriously as a hip-hop artist and the gender biases that women in all facets of life confronted on a daily basis. In a series of tweets, she articulated her frustration about why it seemed like women had to work twice as hard as men to receive the same accolades and why female rap artists like her who showed great promise (by winning many awards with huge record sales for more than a decade) were still not respected or put in the same categories as her male counterparts like Kendrick Lamar (Espinoza, 2017).

In a BET documentary about the struggles of female rappers (DuVernay, Lyte, & Chuck, 2010), MC Lyte, a prominent and famed female rap musician, claimed that female rappers had to work twice as hard and/or collaborate with a male rapper to be accepted or taken seriously. The other female rappers (like Queen Latifah, Missy Elliot, Roxanne Shante, Lil' Kim, Monie Love, Salt-N-Pepa, and Lauren Hill to name a few) who were featured in the documentary also talked about being confronted with negative female stereotypes such as questions about their legitimacy as lyricists and their intelligence, and they also discussed dealing with the overly sexualized manner in which females were (and still are) portrayed in hip-hop. In response and to push back, some female artists composed rap songs such as Queen Latifah's "Ladies First" (Owens, 1989) and Lauren Hill's platinum album, *The Miseducation of Lauren Hill* (Hill, 1998), to highlight



negative female stereotypes and promote female empowerment.

Misogyny in both hip-hop and science are serious issues that need to be addressed. This is why it is essential to develop tools to allow both areas to confront and address their biases against women. I argue that CRP in the science classroom helps Black and Brown female students push back against the misogyny in science. Additionally, allowing women to use hip-hop as a tool to showcase their intelligence allows them to repudiate biases in hip-hop. Further along in this document, I address these approaches in more detail. What CRP provides for science and hip-hop is to offer a formal/official pathway/structure so females can push back against negative perceptions about them.

Hip-hop culture, despite criticisms of misogyny and objectifying women, creates an outlet for female artists to voice out against oppressive practices and negative female stereotypes through their lyrics and performances. Similarly, through Science Genius, a pathway towards forging a science identity is also afforded. Additionally, through hip-hop, female rappers were able to promote feministic ideologies and female empowerment (Brown, 2009, 2013; Brown & Kwakye, 2012; Chang, 2007; Collins, 2004, 2006; Emdin, 2013, 2016; Jeffries, 2011; Tyson, 2002) even in the midst of biases against them.

### **Theoretical Framework**

The study was a longitudinal critical ethnographic study that was based on a merging of sociocultural theory, the Pygmalion effect or Rosenthal effect, and Black feminist thought. The dissertation also employs some autoethnography as my experiences are interspersed throughout the work and used as a means to make sense of the experiences of girls in science from both an experiential and research perspective (Camangian, 2010).

Additionally, an interesting phenomenon that emerged was that, the participants of this study also utilized autoethnographic framework (albeit unintentionally) as they each self-reflected and infused their vivid experiences into their science rap song (Camangian, 2010).

### **Sociocultural Framework**

There is a need for educators and educational institutions to create spaces where distinct and diverse voices can be heard in the science classroom. These spaces should promote a sociocultural environment in which all students can learn. Drawing from Vygotsky (1981), a sociocultural framework explains that learning is a social process that involves insight about society and culture (Howe, 1996; Jaramillo, 1996). In a sociocultural approach to pedagogy, a socially rich space should be made available for students to interact with each other and for teachers and their surroundings to foster successful learning (John-Steiner & Mahn, 1996). Bourdieu (1986) argues that every student enters a social field (a science classroom in this case) with their own social capital. Every person's social capital is valuable because it has the potential to augment the social field. *Therefore, every child comes into the classroom with particular assets that have value.* Moreover, several researchers (Dewey, 2013, Duschl, 2008; Lederman, 1999; Sandoval, 2005) have argued that a child walks into the classroom with perceived notions about the world that are engineered by his/her culture and must be taken into consideration when designing a lesson.

### **Pygmalion Effect**

My study interrogated whether young Black and Brown girls who are traditionally marginalized by race and gender in science education (Hill et al., 2010, Jordan, 2006) would perform better when they were provided with different avenues for their expression of content knowledge and challenged to perform well. The concept of the Pygmalion effect has historical

roots in self-fulfilling prophecy. The core argument is that when people, especially children, are expected to perform well by their instructors, they usually live up to such high expectations (Chang, 2011; Eden, 1990; McNatt, 2000). It is the opposite side of which states the Golem effect (also reminiscent of the concept of self-fulfilling prophecy) in that if people are not challenged to perform well, they will usually succumb to lower levels of achievement (Eden, 1990; Hodge & Kemp, 2006; Silverman, 1997; Terrassier, 1981). The overarching understanding is that individuals will meet high expectations if more is expected of them.

Eden (1984, 1990) claimed that productivity rates of workers accelerated when their manager expected them to do well. Research by Rosenthal and Jacobson (1968) showed that children whose teachers held favorable or high expectations of them performed significantly better on a Harvard IQ test than children who were not favored to produce good outcomes. Furthermore, the Rosenthal and Jacobson study revealed that minority children whose teachers expressed high expectations for them performed better than students whose teachers did not express such expectations. In my research study, I considered how this effect could be actualized through the use of hip-hop pedagogy and the principles of CRP to academically challenge and engage my research participants in science learning.

### **Black Feminist Thought**

Proponents of Black feminist thought argue that racism, sexism, class oppression, and gender identity are intimately bound together (Collins, 2002; Guy-Shelftall, 1995; Omolade, 1987). Black feministic thought is a philosophical agenda to raise awareness of the biases that Black and Brown females encounter on a regular basis and to empower women to “push back” against these negative occurrences in order to enable Black and Brown females to achieve their goals in life (Bryson, 2016; Collins, 2002, 2004; Joseph, 1995; Omolade, 1987). Collins (2002)

declared, "When an individual Black woman's consciousness concerning how she understands her everyday life undergoes change, she can become empowered. Such consciousness may stimulate her to embark on a path of personal freedom to achieve her personal best" (p. x).

### **Black and Brown Girls' Resistance and Resilience**

Why would you call fire anything less than fire? Don't call a fire a spark. . . . Why would you let them call you a spark when you're fire?

-Buhle Ngaba, (as cited in Samson, 2017, p. 7).

Born out of the Black feministic ideologies is a new wave of Black empowerment called Black Girl Magic, a term coined by CaShawn Thompson in 2013 as a social media hashtag. She created the phrase to celebrate the beauty, power, steadfastness, and resilience of Black women to succeed regardless of the burdens of negative stereotypes of race and gender that had overwhelmed Black and Brown women for centuries (Prestes, 2013; Souza, 1990; Thomas, 2015; Wilson, 2016). Prestes (2013) defined resilience as "a process of reorganization, reframing, overcoming and transcendence in the face of living in a potentially destructive context. It gives access to personal and collective resources, such as self-confidence, creativity . . . and a meaning for life" (p. 63).

The Black Girl Magic movement has gained momentum across the United States and beyond due to social media. Additionally, more and more young Black and Brown girls have joined this newfound yet not so new revolutionary message of acceptance and empowerment to excel despite the voices of negativity (Thomas, 2015; Wilson, 2016). In response to how she came up with this phrase, CaShawn Thompson expressed that for Black and Brown women to be able to continue to persevere in spite of the severely adverse conditions they encountered every day, she found it to be simply "magic" (Thomas, 2015, p. 1).

Michelle Obama, the former first lady of the United States and the only African American woman to occupy that role, weighed in on the importance of Black and Brown girl resistance and resilience during her speech at the Black Girls Rock awards ceremony in March of 2015. In an effort to encourage young Black and Brown girls to ignore all the labels against their pursuit of success, Mrs. Obama said there are “voices that tell you that you’re not good enough, that you have to look a certain way, act a certain way; that if you speak up, you’re too loud; if you step up to lead, you’re being bossy” (as cited in Thomas, 2015, p.1). Buhle Ngaba, the South African author of *The Girl Without a Sound*, said in an interview, “All you can do is live your life as you and live as best as you can” (Samson, 2017, p. 9).

In her study, Prestes (2013) dissected the plight of Black Brazilian women and their rise against racism and sexism. She concluded that having knowledge of their past and being entrenched in their culture helped these women to formulate a healthy Black identity. As a result of their renewed self-esteem and confidence, the women were able to fight against social injustices that affected Black Brazilian women. In my study, I explored how participation in a hip-hop science program that was aligned with CRP afforded urban Black and Brown girls the cultural space and confidence to resist racism and gender biases in science education.

## **Chapter III**

### **METHODOLOGY**

As an aspiring science student, I was oblivious to any negative stereotypes about Black and Brown girls in science. However, my position as an educator in a high-poverty urban minority school and my current research framework involving women in science awoke my consciousness to discrimination that I experienced in the discipline. The high school that I attended (an all-girls Catholic school) was populated with lower-to-middle-class students, mostly Hispanics, a few Whites, and a small percentage of African Americans. I graduated at the top of my class in mathematics and science, but despite my high grades, NYU denied my college application. I later learned that my chemistry teacher, who was Puerto Rican and a female, wrote negative recommendation letters for all the Black girls (who requested one) in my graduating class. Fortunately, her lack of support did not deter me.

In another instance, when I took my second semester of physics in college, the class size shrank from 35 who initially enrolled to 15 students. Eventually, I ended up being the only female and the only Black student in the class. I vividly remember where I sat every day in the class and the isolation I felt from both my peers and my professor. My classmates never spoke to me and neither did the professor for the entire semester. Not once did the professor ask me what I thought or if I understood the work. As a matter of fact, he directed his attention to the males and engaged in conversations with them the entire semester. To be fair, I never spoke up in class either, but the reason for my silence was that I felt intimidated and unwelcome and so sat in the back of the room every day of class. I have since realized that my experiences as a Black student and as a female in a STEM class were not unique (Barton et al., 2008; Brotman & Moore, 2008; Catsambis, 1995; Hanson, 2008; Hill et al., 2010; Jordan, 2006; Rosa & Mensah,

2016).

Fortunately, in my case, though uncomfortable, these negative instances did not have too serious an effect on me because I had (and still do) a supportive family who believed in my capabilities and more importantly, I also had a role model at home who also pursued a career in STEM. My father, who recently retired as a contractor supervisor with the Metropolitan Transit Authority (MTA) is an alumnus of City College of New York with a degree in civil engineering. He served as a constant reminder that I could accomplish my academic goals, supported my academic endeavors and never doubted me. Unfortunately, for far too many Black and Brown girls in urban high-poverty public schools the necessary support or role models to help them imagine or nurture their interest in a STEM career is absent (Barton et al., 2008; Guy-Shelftall, 1995; Hanson, 2008; Hill et al., 2010; Jordan, 2006).

In the present longitudinal critical ethnographic study, I spent almost 2.5 years supporting four remarkable Black and Brown girls as they engaged in science learning through a nontraditional yet culturally relevant approach to instruction. (My dissertation research involves the investigation of archival data that I collected as a high school science teacher from the Spring Semester of 2015 – 2017 academic years). An ethnographic methodology was employed because of my belief that a qualitative research approach that focuses on exploring the cultural phenomena of a group or subgroup from the perspectives of the participants in the group (Creswell, 2013) would serve as the best approach to gain the type of deep insight into the life experiences of the girls that this area of study requires. A qualitative approach makes it possible for the researcher to not only gain deeper insight into participants' lives, it gives voices to those groups of people (women, the poor, underserved minorities, and the like) who may otherwise not be heard.

An ethnographic approach is used to explore beliefs, behavior, language, or challenges faced by the study group, such as resistance, dominance, and power due to marginalization (Creswell, 2013; Denzin & Lincoln, 1994). A critical ethnographer looks into issues of power, empowerment, inequity, dominance, repression, hegemony and victimization” (Creswell, 2013, p. 94). The researcher hopes to bring awareness to the plight of the participant group (Creswell, 2013).

An ethnographic researcher is required to become a participant observer. In other words, the ethnographer must involve herself in the culture or context being studied and spend a lot of time (from weeks to several years) observing and taking field notes of the participants’ patterns of behavior (Creswell, 2013; Denzin & Lincoln, 1994). As the researcher of this study, I spent a little more than two academic years observing the participants in their natural settings, both in and out of the confines of their high school campus. My goal was to explore if and how these three Black and Brown girls, who represented two traditionally marginalized groups in science education (females and minorities), would be empowered and exude confidence to carve out a space to engage in science.

As part of my exploration into how the girls’ responded to the hip-hop based science program, I used an autoethnographical lens to make sense of and interpret their vivid stories. Autoethnography is a qualitative research methodology in which the author uses self-reflection and writing to examine her personal experience and connect her autobiographical story to wider cultural, political, and social meanings and understandings (Camangian, 2010).

My dissertation research approach was also based on the seven tenets of qualitative narrative research developed by Ely, Vinz, Downing, and Anzul (1997): (1) There are many ways to come to know something and even then such knowing is partial; (2) There are numerous



ways for us to report; (3) All of our messages have agendas; (4) Our language creates reality; (5) The researcher is deeply interrelated with what and who is being studied—research is context-culture bound; (6) Affect and cognition are inextricably united; and (7) What we understand as social reality is multifaceted, sometimes clashing, and often in flux” (p. 60). In an effort to search to identify specific elements aligned with these principles as well as my own personal experience, I utilized principles of the conceptual framework of portraiture to help me to explore, locate patterns in and make meaning of my students’ stories. While most of the strategies for portraiture that Lawrence-Lightfoot (1997) outlines in *The Art and Science of Portraiture* are characteristics of practical qualitative research in general, the ones that align most directly to my work include: (1) the focus on the convergence of narrative and analysis; (2) the goal of speaking to broader audiences beyond the academy; and (3) the inseparable link between my dissertation research and my own life, and the desire not to divorce myself from it but rather situate myself within it (Lawrence-Lightfoot, 1997).

### **Setting**

The study took place in an urban low-income public high school because the study was an extension of an inquiry project that began at the science department at this school. Furthermore, the researcher was and is currently employed at the school. The school is located in the South Bronx area of New York City, the poorest congressional district in the United States. According to the *New York Daily News*, the South Bronx is the poorest district in the nation with 38% of the residents (more than 256, 544) living below the poverty line and 49% of children living in poverty (Sisk, 2010).

The school population included roughly 400 students and was comprised of mostly Hispanics (72%) and African Americans (25%), with 1% Asian and another 1% White according

the school's website. Additionally, 28% of the student body was labeled as English as a New Language (ENL; formerly known as English Language Learners) students, and 26% of the school population was special needs students (students with individualized education programs [IEPs]). Almost all the students qualified for free or reduced-price lunch.

### **Participants**

The initial participants were 2 African American and 2 Hispanic high school girls. This number changed because one of the participants transferred to another school and could no longer participate. However, the findings will reflect her participation for the time she was part of the study. I was not only the PI but also their science teacher and their Science Genius program coach. While there has been some critique of teachers engaging in research on their students, the nature of the student/teacher and researcher/subject relationship in many ways enhances this study. I am upfront about our shared experiences as females of color, and perceive the work we engaged in together much less as research on subjects, but as interrogations with them. As their coach, I worked closely with them and facilitated their Science Genius activities both on and off campus. The girls were enrolled in the same Living Environment course section that met every day of the week. Consequently, it was feasible for the participants to collaborate with each other.

The participants were all born in the United States and spoke English fluently. The Hispanic participants spoke Spanish fairly well. The participants lived in the South Bronx; however, one of them was born in Queens, raised in Philadelphia, and returned to New York City (South Bronx) to reside with her aunt to complete high school. None of the participants lived with their biological fathers and none of them had parents or siblings with a STEM degree or who worked in a STEM related environment. There were originally four participants when

the study began, but one of them (Nani) transferred to another school after a year of participation. The four original participants were Princess, Rebecca, Nani, and Joy. The names of the participants are pseudonyms to protect their identities and privacy. Descriptions of the participants follow:

**Princess.** Princess at the age of 15 was the most extroverted and energetic member of the group who was like the mitochondria of the cell because she brought all the energy to the group. She wrote bars and she was the lead rapper and performer (In addition to their performance at the Final Battle/competition where students from different schools competed against each other, the participants had opportunities to perform at their local school, and several other events in New York City during the course of the study). Princess actually transferred to the school so, unlike the other three girls, it was her first year in the school when the program began in their sophomore year. Due to her high energy and amiable personality, she managed to fit in well within months of her matriculation into the new school. She was born in NYC but her family moved to Southwest Philadelphia where she grew up. She was the middle child of five and the only girl. In Philadelphia, she lived with her brothers, mother, and stepfather. She did not have any relationship with her biological father. An ongoing tension with her mother resulted in Princess being sent back to New York to live with her aunt (her mother's sister). Though her aunt welcomed her with open arms, her move to New York was not without complexities. Her aunt was HIV positive and suffered from chronic epilepsy. Princess's aunt was also a recovering addict and on permanent disability. Princess was constantly worrying about her aunt's health and sometimes left school early to accompany her aunt to the hospital.

At her new home, there were a total of six people in the house. Besides her aunt, there were two other adult women: one was her great aunt and the other was a friend of her aunt's who

came to live with them because she lost her home. Princess had two female cousins in the house. As a result, Princess went from a home with lots of males to one with what she describes as “more females than she could bear.” When describing the conditions of her new home, she said, there were "lots of different emotions [in the house]; I am trying to hold on." Although many women surrounded her in her new home, she still felt isolated because her aunt had a very close relationship with her daughter (Princess’s cousin) that Princess yearned for with her own mother.

Despite her seemingly vicarious and carefree attitude, Princess was actually living in a constant state of fear and uncertainty due to her aunt's illnesses, which could affect her housing should her aunt become incapacitated or pass away. The fact was, Princess did not wish to ever go back to live with her mother (whom she loved but harbored a great deal of anger toward her mother for kicking her out of the family home). Princess considered her aunt to be the only supportive person in her life. She recognized that her aunt’s life was fragile and if anything happened to her, Princess could lose both her emotional support and the roof over her head. She called her aunt every day after school to check in with her and I was privy to many of the light-hearted conversations they had with each other. Her aunt and about six other family and friends attended the Science Genius Final B.A.T.T.L.E.S to cheer Princess and her team on for the final Battle/competition.

Irrespective of her life struggles, Princess was conscientious, reliable and goal driven. She was usually the first to show up at weekly meetings while prepping for the Science Genius Final Battle. Additionally, she was a member of the school's varsity softball team and was chosen out of 100 applicants to intern at a local museum.

Prior to her participation in the Science Genius program, Princess always expressed her love for science even though her grades in science were only slightly above average at about a C+. Moreover, while she claimed science to be her favorite subject, she wrote a lot and “escaped through writing.” It appeared that the Science Genius program offered her the perfect platform to showcase her writing abilities in association with science. She excelled! It was wonderful to witness the level of excitement and enthusiasm she exuded at each meeting. At the end of one of their performance sessions, Princess said, "I felt great about doing something positive, and I was happy to share my rhymes/bars."

**Rebecca.** Rebecca was 16 years old and lived with her younger brother, younger half-sister, mother, and stepfather. She had a close relationship with her biological father who lived in another borough and had two other children with another woman. Though both of her biological parents only had an elementary-level education, Rebecca was focused on her education and wanted to become an elementary school teacher.

Similar to Princess, Rebecca was a member of the campus-wide (the campus comprises of 4 different high schools) varsity softball team, but she was also chosen by her peers to represent them on the student council board as the vice-president. It is worth noting that in her final year of high school (two years after the study began), she was chosen to take two AP courses (US Government and English Language Arts). This was the first time in the school’s history that AP courses were being offered. She confessed that after getting involved in the Science Genius program, “I found a new level of confidence in myself that I never I thought I could gather in school. I feel like I could do anything after that because science was my weakest subject, and if I could perform it, I can do anything.”

Rebecca almost chose not to participate in the Science Genius program because her friends didn't want to participate. But despite this reservation, Rebecca demonstrated great determination and voluntarily joined a group that had already gelled well. This demonstrated the strength of her character and her resilience despite social pressures that often dictate decisions students make. She was soft spoken and an introvert. As such, her decision to join the Science Genius program came as a surprise to me. (I initially assumed that students who identified with hip-hop music/culture [in a questionnaire] and were also struggling in my science classes would be the ones who wanted to participate even though participation in the program was voluntary). Rebecca struggled through science since middle school and said, "I had no one at home to help me." Her decision to participate in the Science Genius program was precipitated by her excitement to do science through music, although she continuously claimed, "Ms. I can't rap, but I will try and write the lyrics."

**Nani.** Nani was 15 years of age and lived with her mother and her four younger brothers. She did not have a good relationship with her biological father and mentioned that she only spoke to him about every two months. According to Nani, her biological father (who had at least 10 other children) was not supportive so she sought moral support from the biological father of one of her younger brothers. She found her home life to be difficult because she was the oldest child and the only girl in the house. She felt a bit isolated because she could not confide in or play with her younger brothers. Her mother was strict but supportive and usually worked long hours. She mentioned that, she "got along well" with her mother even though they barely had time to interact.

In addition to school, Nani was passionate about Tae Kwon Do. She was a first-degree black belt and once went to London, England to compete in a tournament. Although Nani would

not describe herself as a science person, she said, "I enjoy music" and wanted to be part of something that would support her academic growth. She was diligent and excited about the Science Genius program and even brought her mobile speakers to school to help her group during their practice sessions. Nani's perception of science changed as she progressed through the program. She gained a lot of confidence in her science abilities and went on to pass the New York State Living Environment Regents Examination at the end of the academic year. This was a feat for many students in the South Bronx given that the passing rate hovered around 65% [out of 100] and a requirement for graduation. Nani left the program after one year of participation because she transferred to another school.

**Joy.** Joy was 16 years old and had an identical twin. They lived with their mother and their younger brother. In addition, Joy's mother had a friend of hers also living with them. Joy also had an older brother and sister who were in their thirties and lived independently. There was no adult male figure in her home. Joy had an almost nonexistent relationship with her father who lived out of state. She believed that her mother was morally supportive of her life endeavors, and Joy had a good relationship with her.

Joy enjoyed learning science but did not have a good grasp of scientific reasoning skills. The idea of using hip-hop music to deepen science knowledge was new to her, but motivated her to participate in the Science Genius program. She was among the first students to sign up and she never looked back.

Joy, like some of the other girls in her group, said, "I am not a rapper;" however, her self-perceived shortcomings about being a rapper did not deter her or diminish her contribution to the writing of the lyrics nor the performances. She showed up to the weekly meetings ready and eager to participate. On the day of the Final Battle, she canceled a preplanned event at her local

church so that she could be on time to be with her group members for their final practice session and presentation.

The shy, introverted, and soft-spoken girl had blossomed. When the girls took to the stage on the day of the final competition, I saw the rebirth of a new girl with every move and beat of their science rap performance. She inhaled pride and exhaled joy; hence, the essence of her name. It was wonderful to see her come alive with exuberant confidence.

Joy, like Princess, Rebecca, and Nani, was originally unsure about being successful on the New York State Living Environment Regents Examination. However, with her newly found confidence in science knowledge acquisition due to her participation in the Science Genius program, she was successful on the New York State Living Environment Regents Examination. (New York state mandates that students attending public schools in the state must take a minimum of 5 standardized state tests – the Regents Examinations – in each of the following content areas: science, mathematics, English, global history and United States history. Students must score a minimum of 65% on each of the examinations in order to graduate).

### **Data Collection Methods**

This study was a longitudinal critical ethnographic study that examined an all-girl group's participation in a hip-hop based science program, the Science Genius program. The study started during the participants' sophomore year of high school and spanned across 2 academic years. The participants worked together to write and then performed their science rap lyrics based on content that was covered in class. Initially, they had about 6 weeks to collaborate, write their lyrics, and perfect their rap song and performance. The main data sources were obtained from their individual interviews, rap lyrics, video vignettes, journal entries, Likert-scale questionnaire, and focus group interviews. Other data sources were gathered from



participant observations and field notes.

Additionally, the participants were observed during their science classes, and the progression of their science efficacies was noted. The study participants were made aware that they would be observed during their science classes, and they were informed of any audio or video recording before starting such a recording. Finally, both the participants and I kept reflective journals during the entire study as part of the data collection process. Sometimes I gave the participants a prompt to base their reflective writings on.

Table 3.1

*Summary of Data Collection Activities*

Name of activity	# of times the activity occurred	Duration of activity per instance	Total time period of active participation by each student	Data collected
Writing science rap lyrics	1 day/week	30 minutes	6 weeks	Rap lyrics/video vignettes/video recordings
Performing science rap	multiple times	15 minutes	N/A	Video vignettes/video recordings/observational data (field notes)
Survey	1	5 minutes	5 minutes	Survey response
Individual Interview	multiple times	5-30 minutes	N/A	Transcribed audio
Focus group	3	45-80 minutes	45-60 minutes	Transcribed audio
Journal entry	1/wk	5-10 minutes	50 minutes	written notes

Tables 3.2 to 3.4 depict the activities that my research participants engaged in over the course of the 2.5 years that I spent with them respectfully. Please note that the hip-hop based science program began when the participants were enrolled in the Living Environment course and I was their classroom teacher. In the next academic when they entered the eleventh grade, they were enrolled in a chemistry course with another teacher who was gracious enough to allow me to observe the girls during class (once a week) and he also shared their assessments data with me. During their senior year and the final year of data collection, the students were not enrolled in any science course since they finished all their science requirements for graduation by the end of their junior year (consistent with their school’s course planning policy).

Table 3.2

*Student Activities While Enrolled In Living Environment Science Course: Spring Semester 2015*

Date	Activity	Duration
March 5/6	Introduction of the Science Genius program through video and class discussions.	30 minutes
March 2 – April 2	Teacher began the unit on Reproduction and Development.	6 weeks
March 11 – May 6	Participants met after school to collaborate/write science rap lyrics. [Spring recess from April 3 – 10].	45 minutes/weekly
March 26	First scheduled individual interviews	30 minutes each
May 13 – June 11	Participants met to practice their performance of their science rap lyrics.	30 minutes; 2-3 times/week

June 4	Second scheduled individual interviews	30 minutes each
June 12	Participants' performance of their science rap song in the school's auditorium against another group. Participants won so were chosen to represent their school at the Science Genius Final B.A.T.T.L.E.S.	45 minutes
June 16	Participants took the New York State Living Environment Regents Examination ( <i>A New York State mandated exam for graduation</i> ).	3 hours
June 16/17/19	Attended practice sessions at Teachers College.	2 hours/day
June 20	Last Dress Rehearsals at Teachers College	2 hours
June 20	Science Genius Final B.A.T.T.L.E.S event at Teachers College.	4 hours
June 25	Third scheduled individual interviews	30 minutes each

Table 3.3

*Student Activities While Enrolled In Chemistry Course with another teacher: Fall 2015/Spring 2016*

Date	Activity	Duration
October 9	Group reconvened for the first time in for the first time during after school hours ( <i>one participant had transferred to another school</i> ).	20 minutes
October 16 – May 20, 2016.	Observation of students' in their chemistry classes.	20 minutes/weekly

October 23	Fourth scheduled individual interviews	30 minutes each
October 22	Trip to Rockefeller University for DNA Analysis Lab (with researcher).	3 hours
February 29	Practical lab: Cells, Cells, Cells on the BioBase's mobile BioBus (with researcher).	50 minutes
March 31	Performed at a book launching event at the Schomburg for Research in Black Culture, NYC.	
May 20	Attended the Science Genius Final B.A.T.T.L.E.S at the Jarvits Center (with researcher) <i>but</i> did not perform.	3 hours
June 20	Fifth scheduled individual interviews	30 minutes each

Table 3.4

*Participants' Science Activities – They were not enrolled in any academic science course: Fall 2016/Spring 2017*

Date	Activity	Duration
September, 26	3 membered group reconvened for the first time during after school hours	30 minutes
October 13	Trip to Rockefeller University (with researcher) for a practical lab about bacterial immunity and a follow up discussion about CRISPR technology.	4 hours
November 18	Trip to Natural Museum of History' Evolution Wing; engaged in practical lab activity: Biodiversity and evolution (with researcher).	2 hours
December 9	Attended and performed at the Hip-Hop/	3 hours

	STEM Youth Summit at Teachers College Columbia University (with researcher).	
December 20	Practical lab: Particles and properties of food on the BioBase's mobile BioBus (with researcher).	50 minute
February 22 – June 7	Participated in an Afterschool Science Club: High School Science Research Pathways in affiliation with NYC Department of Education STEM programs. (Club was run by researcher).	55 minutes/weekly
March 24	Trip to National Museum of Mathematics.	3 hours
April 21	Trip to Harlem DNA Lab in affiliation With Cold Spring Harbor Laboratory. Practical Lab: Students learned about Polymerase Chain Reaction and Bacterial Transformation.	4 hours
May 26	Attended the Science Genius Final B.A.T.T.L.E.S at the Loews Paradise Theater (with researcher) <i>but</i> did not perform.	3 hours
June 9	Presented their research Posters at Annual High School Science Research Symposium at the Fort Washington Armory in NYC.	3:30pm to 6pm
June 16	Sixth scheduled individual interviews	30 minutes each

---

To sustain the study participants' continued interest and exposure to science, they accompanied me to several STEM oriented activities around NYC (Table 3.4). Furthermore, they joined an afterschool science research club that I initiated in conjunction with the NYC Department of Education, Division of STEM programs (Table 3.4).

**Questionnaire.** Participants completed a questionnaire using a Likert scale ranging from

1 (strongly agree) to 5 (strongly disagree). The participants were allowed to elaborate on their answer choices. The purpose of the questionnaire was to find out whether they appreciated and adhered to hip-hop music and culture (hip-hop pedagogy) and how they felt about the use of hip-hop in the science classroom. The researcher produced the questionnaire (see Appendix A).

**Videotape vignettes/videotape recordings.** The participants were recorded during their group sessions while they were putting together their science bars (rap lyrics). They were also recorded during their practice performance sessions and during their on-stage performances. The recordings provided insight into how well they grasped the science content and how well they worked together as a group. The participants also used the recordings to assess their progress with the science content and how they sounded together. Additionally, I collected all their writings, including drafts and the final product, and analyzed them to assess comprehension of science content and their sociopolitical viewpoints and to further gain insight into their progressive effort to put together their lyrics.

**Individual interviews.** The participants were interviewed at least six times during the course of the study. Each of the major interview sessions ranged from about 25 minutes to half an hour. I also conducted impromptu interviews over the course of the study as a mechanism for understanding events as they unfolded in the lives of the participants. These unplanned interviews took about 3 minutes to complete and typically occurred right after a major performance. Extensive and planned/scheduled interviews normally occurred multiple times over the course of the study. The 3-minute interviews were meant to capture the participants' state of mind right after a major performance or attendance at an important event. I will provide information about the events later on in the findings.

Their first, second, and third individual interviews took place during the third week after

the inception of the study, a week before they were to perform their rap song (at their local school), and within a week after their rap performance at their school and a few days after the Final B.A.T.T.L.E.S – which they had been selected by their peers to represent the school in. (One of the mandates of the Science Genius Program is that, participating groups or individuals must compete with each other at their local schools and their school will determine the winning group or individual to represent at the Final B.A.T.T.L.E.S). The first, second and third planned interviews occurred on March 26, June 4 and June 25, 2015 consecutively (Table 3.2). The purpose of the initial interview was to assess the confidence and excitement level of the participants in relation to science and the use of hip-hop to engage them in science. The first interview also served as a baseline to assess their science content knowledge. The second interview served as a tool to investigate once again the confidence level of the participants with a particular emphasis on the progression of their science content knowledge acquisition and their readiness to showcase their work to the public.

I also inquired about their perspectives on using a hip-hop based science program as a platform (for females, and Black and Brown students) to express their science knowledge and their thoughts on the concept of science for *all* Americans (Lee, 1997). The third interview took place nearly a week (due to scheduling conflicts and availabilities) after their rap performance at the Science Genius Final B.A.T.T.L.E.S (Table 3.2). The intent was to find out how the participants felt about their experience with the Science Genius program so far, their outlook on science in their future, and also their perception about science education through hip-hop in urban high schools.

A fourth interview (Table 3.3) was scheduled on October 23, 2015 after a thorough analysis of the participants' science rap lyrics from the final event (which were infused with a

number of sociopolitical messages). The reason was to find out more about their messages and what they were hoping to convey to their audience or society at large. Subsequent interviews occurred a year (June 20, 2016) and two years (June 16, 2017) after their participation in the Science Genius B.A.T.T.L.E.S (Table 3.3 and 3.4 respectfully). The motivation for these later interviews was to gauge how the girls' perspective on science evolved a year and then two years after their participation in the hip-hop based science program. Furthermore, these interviews were used to assess or affirm the participants' feelings about using hip-hop as a culturally relevant tool to engage urban Black and Brown girls in science education (Alim, 2007; Emdin, 2010a, 2010b, 2016; Ladson-Billings, 1995; Paris & Alim, 2014). The interview questions presented in Appendix B are sample questions that the researcher used as a starting point to conduct the interviews. More questions came about as each interview progressed and new revelations were made as a result of the participants' responses.

**Focus groups.** The purpose of the focus groups was to gain clarification on the students' responses to the Likert-scale questionnaire and their science rap lyrics, as well as the researcher's observations and field notes. The goal was to gain insight into the participants' thought processes as they engaged in this pedagogical space. The focus group sessions were comprised of the three remaining participants with the exception of the first focus group that took place at the end of the first year of the study. To draw a correlation between the struggles of women in hip-hop and women in science, I used this opportunity to have the participants share their perceptions about women in these two dynamic domains.

## **Research Questions**

Table 3.5 lists each Research Question and the sources of the evidence, including qualitative and quantitative methods.



Table 3.5  
*Research Questions and the Evidence Procedures Used to Answer Them*

Research Question	Evidence collection procedure
1. How does participation in a hip-hop based science program impact Black and Brown girls' scientific content knowledge?	Quizzes, test scores, questionnaire, video vignettes rap lyrics, observations
2. How do participants in the hip-hop based science, program construct their science/scientific identity?	Rap lyrics, focus group interviews, journals
3. To what extent does participation in a hip-hop science program afford Black and Brown girls the space to resist negative Black and Brown female stereotypes in STEM and hip-hop?	Rap lyrics, observations, individual interviews, focus group, field notes

### **Consent and Ethical Considerations**

I identified students whom I felt would benefit from the program based on their in class grades and their affinity toward rap music and culture. However, participation in the program was voluntary, and it also involved time after regular school hours. Participants stayed after school for about an hour each week to continue work on their rap lyrics composition and to practice for their performances. Additionally, a week or 2 leading up to the Science Genius Final Battle, the participants and I (their coach) attended a 3-day practice session from 4:30 to 6:30 pm at Teachers College, Columbia University.

Participants were at liberty to drop out of the program at any time with no negative consequences. None of the participants were given any preferential treatment such as extra credit, monetary gifts, and the like. Participation was expected to involve minimal to no risk, with participants not being exposed to anything New York public school students wouldn't be exposed to as part of daily living. For the most part, I used data that I had collected while the

students participated in the Science Genius program as part of the inquiry project by the science department. This was supplemented by subsequent interviews.

Lastly, all video tape recordings, field notes, and interview transcripts were stored on a computer with a secure password, and the participants were given the opportunity to review all collected data (Boeije, 2009; Creswell, 2013; Denzin & Lincoln, 1994).

### **Reliability and Validity**

The study employed multiple qualitative data collection approaches to ensure reliability and validity. The multiple data collection such as focus group interviews, field notes, in class and after school observations, video tape recordings of group sessions, video vignettes, and a questionnaire provided a rich data set for analysis and also substantiated the study results (Boeije, 2009; Creswell, 2013; Denzin & Lincoln, 1994).

### **Process/Procedure**

Much of this study was born out of an inquiry analysis project that I spearheaded as the chairperson for the science department at my current school of employment. The motivation behind the inquiry analysis was to identify hurdles that students encountered in the science classroom and then highlight possible ways to increase students' engagement with science to hopefully improve students' performance on the New York State Living Environment Regents Examination and increase their interest in STEM. Since my longstanding research interest had been to look into the challenges facing women in science, I went a step further (beyond the requirements of the inquiry analysis) by exploring ways to improve Black and Brown girls' participation in science education at an urban public school.

The content focus of the study was centered on a unit from the biology classroom on reproduction and development. From previous years of teaching this unit, I had come to the

realization that although my students were fairly interested in the topic (they asked a lot of questions), they struggled with grasping the content because they held many misconceptions about human reproduction and development. The unit was comprised of six distinct lessons ranging from “What is Reproduction?” What is difference Between Asexual and Sexual Reproduction? What are the Advantages and Disadvantages of Asexual and Sexual Reproduction? What is the Purpose of Mitosis and Meiosis for Multicellular Organisms?; to How do Human Reproduction and Development Take Place? In the unit, there were six quizzes—a quiz was administered at the end of each lesson. In addition, two separate exams were administered: one after the first three lessons and then another at the end of the unit. It took 4 weeks to complete the unit (Table 3.2).

I used the following steps to guide the investigation:

- . I identified the girls who engaged in/with hip-hop music/culture through a Likert scale questionnaire (Appendix A).
- . I identified girls in science (among those enrolled in my science classes).
- . I introduced these girls to a hip-hop based science program (Science Genius program).
- . I identified other students and introduced them to the hip-hop science program.
- . I taught all my students the same science content.
- . As part of their in-class formative assessment, the students interested in the hip-hop based science program (including my targeted girls) created rap lyrics to demonstrate their science content knowledge and understanding.
- . The students with science based rap lyrics were given the opportunity to compete in the Science Genius Final B.A.T.T.L.E.S after an initial competition on campus. The prospect of participating in a rap competition served as an additional motivational factor for the students to

work harder. (The participants of this study, won the initial Science Genius competition at their local school. Consequently, they were chosen to represent their school at the Science Genius Final B.A.T.T.L.E.S). I observed the targeted girls over a period of 2.5 academic years both on and off campus (during their practices/performances outside of the school grounds) and made notes of any changes and/or patterns of behavior that particularly pertained to their science education (Tables 3.1 - 3.4).

### **Data Analysis Methods**

To ensure the effectiveness of the analysis, several qualitative analytical tools were employed. All audio/video recordings during interview sessions were transcribed and coded. Field notes and classroom and group session observations were also coded for recurring themes. All videotaped vignettes were analyzed to track participants' progressive science understanding from creating their science rap lyrics to their stage performances. The rap lyrics served as a cultural artifact that was analyzed for its science content. All interview recordings were coded to show possibly repeated themes. The transcription was initially entered into a Microsoft Word document to categorize the themes, and then the noted categories were further analyzed and organized using NVivo (Boeije, 2009; Creswell, 2013; Denzin & Lincoln, 1994).

## **Chapter IV**

### **FINDINGS**

According to Ogbu (1995), “There is growing evidence that strong, continual engagement among diverse students requires a holistic approach—that is, an approach where the how, what, and why of teaching are unified and meaningful” (p. 584). My first year as a classroom teacher was in an intermediate school in the Washington Heights section of Upper Manhattan. I then transferred to my current school, a high school in the South Bronx. After 15 years of teaching in urban public schools, I have come to realize that Black and Brown public school students love to listen to hip-hop music and they are drawn to the hip-hop culture. The latest hip-hop fashion trends, the music, and the up-and-coming hip-hop artists, consume most of my students’ conversations in and out of the classroom. My dissertation was born out of my consideration of these dynamics and a desire to try something different in my science classroom, that is, a culturally relevant pedagogical teaching mechanism that I believed could excite my students to be more engaged in learning science.

This research undertaking was a continuum of an inquiry project I was entrusted to spearhead as the chairperson of the science department at my current school of employment. The initial objectives of the project were to critically analyze students’ New York State Living Environment Regents scores for the past 3 years at the school. The science department was to (a) examine the performance ranges of the students on a particular topic; (b) identify possible reasons why a very small percentage of students scored low on a particular question (e.g., was the low percentage due to the difficulty of the vocabulary or was the question on an unfamiliar content topic); and (c) come up with possible solutions to increase student science engagement, such as increase project/group based learning, introduce more practical laboratory experiences

for the students, and augment our pedagogical styles to be culturally inclusive. Based on the findings and suggestions that we gathered from the inquiry project, I realized that I needed to not only make changes to my style of teaching, but I also needed to make changes to the curriculum and provide more experiential science opportunities for my students.

Consequently, leaning on my background in basic science research (I spent 7 years conducting research at the Columbia Genome Center with two publications, including one in the journal *Science*) and educational research, I collaborated with the New York Department of Education's division of High School Science Research Pathways (HSSRP) and started an afterschool science research program at my school. I also linked up with the Rockefeller University Science Outreach Program for high school students and sent some students to conduct basic science research with expert scientists both during afterschool hours and over summer breaks. Last Spring (2017), my students in the afterschool science program showcased their research projects at the annual Research Science Symposium in Manhattan. Additionally, for the past few years, my students have been visiting the Harlem DNA Lab (in affiliation with Cold Spring Harbor Laboratories) for experiential DNA analysis activities. More recently, my students visited High-Bridge Park and engaged in outdoor water ecology and STEM activities that were led by NYC H2O.

With my current journey as an educational researcher, I also started to critically look at ways in which I could make my classroom culturally relevant and inclusive for all my students. The majority of my students (99.8%) were Black and Brown children from low-income homes and was traditionally marginalized in STEM education (Barton et al., 2008; Hill et al., 2010; Jordan, 2006; see also Oakes et al., 2013). After much reflection and anxiety, I decided to incorporate hip-hop pedagogy into my classroom curriculum. Although I was anxious (because I

consider myself to be a novice to hip-hop music and culture), I knew it was the right path to take based on personal experience and the research that showed Black and Brown students adhered to hip-hop pedagogy (Banks, 2015; Emdin, 2010a, 2016; Hill, 2009; Paris, 2012; Prier, 2012; Alim, 2007). Researchers have argued that culturally relevant teaching increases student performance in school and in STEM education (Emdin, 2016; Ladson-Billings, 1995; Lee, 1997; Morrell & Duncan-Andrade, 2002; Paris & Alim, 2014; see also Emdin, 2010a, 2010b; Lee, 1997; Mensah, 2012; Nieto, 2010).

Considering my prior research interest in gender biases in science education and my career in science teaching, I started to pay particular attention to the engagement of the girls in my science classroom for this new pedagogical style that I was embarking on. I wanted to find out how the girls in my classroom responded to a hip-hop pedagogy. Instead of reinventing the wheel, I sought help from Dr. Christopher Emdin who assisted me in implementing Science Genius, a hip-hop based science program that he initiated with various urban public schools around New York City. Although the program had involved many urban Black and Brown public school students in the past, Dr. Emdin had not yet specifically looked into how such a program impacted the science knowledge of a group of Black and Brown girls in an urban public school.

I started by conducting a questionnaire to figure out how my students felt about science and the idea of infusing hip-hop (rap) into their science lessons (see Appendix A). Then I identified the girls in my living environment science classroom. The questionnaire was administered to all sophomore students enrolled in my Living Environment classes. I taught a total of 5 courses, and 2 out of the 5 were Living Environment courses. A total of 60 students were enrolled and therefore responded to the questionnaire (Table 4.1).

Table 4.1

*Students' Responses to Likert-Scale Questionnaire*

Question		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Q1. I enjoy learning science	#	10	15	24	4	7
	%	17%	25%	40%	6%	12%
Q2. Hip-hop is my favorite type of music	#	40	13	4	2	1
	%	67%	22%	6%	3%	2%
Q3. I like hip-hop culture	#	37	10	5	7	1
	%	62%	17%	8%	12%	2%
Q4. I can rap in science	#	2	9	20	13	17
	%	3%	15%	33%	22%	28%

According to the responses to the questionnaire, (see Table 4.1), 17% and 25% of my students either strongly agree or agree that they enjoy learning science. Additionally, more than half of my students (67% and 62% respectively) who answered the questionnaire strongly agree that hip-hop is their favorite music and they adhere to hip-hop culture. That is, 89% [either strongly agree or agree to Q2] and 79% [either strongly agree or agree to Q3] of the students in 2 of my science classes were actively engaged in hip-hop music and culture respectively. These results affirm that students in this particular urban public school who enrolled in my science courses related to hip-hop because they identified it as a culture that resonate with them. One student wrote, “Rapping about science could be fun and easier to remember.” However, I realized that their confidence level in science was significantly low (40% were indifferent about



learning science, while 6% disagreed and 12% strongly disagreed about enjoying science).

Relatively speaking, I was not surprised that statistically half of my students (50%) did not feel comfortable with regard to rapping about science because as their teacher and based on their performance in science, their confidence level in the content was poor. A female student wrote; “I don’t really like science, it’s type [demanding] work,” and another student (also a female) responded saying, “I like hip-hop, but I do not like science.” Many studies (Chudowsky & Chudowsky, 2010; Hill et al., 2010; Jeffrey, 2012; Moss-Racusin et al., 2012; U.S. Department of Education, 1990, 2012) have shown that even though girls are increasingly surpassing boys in academic achievement and in college graduation rates, their interests in science and STEM careers begin to dwindle in middle school and through postsecondary school and beyond.

Though some students showed interest in hip-hop and its use in a science classroom, many of them were not aware or just did not think that it was possible to combine hip-hop and science, or did not see how it could help with the acquisition of scientific knowledge. In any event, from the data collected, I narrowed my focus to four girls (one transferred out of the school after the first year of data collection) who showed a liking for hip-hop music and culture and also needed help to improve their science understanding and efficacy (based on their classroom performances).

From initial conversations and observations, I found out that three out of the four girls (Rebecca, Nani, and Joy) liked hip-hop but did not like science. For Q1, Rebecca checked off strongly disagree, both Nani and Joy said that they disagreed while Princess said she strongly enjoyed learning science. However, on Q2 and Q3 all the research participants said they strongly agreed that hip-hop music and culture were their favorites. Princess claimed to like both

science and hip-hop, but her grades in the course were still not strong prior to her participation in the hip-hop based science program.

I realized that their sentiments toward science paralleled their grade point averages in science before the study began. The participants' grades in their science classes were weak prior to their involvement in the hip-hop based science program (see Table 4.2). They had a total mean test score of 68.3. However, they each showed great improvement after participating in the program at which point their total grade point average in science increased to 88.7.

Before the inception of the study, the participants struggled in their science classes even though they showed significant effort in class. However, after engagement in the program, statements like, "After participating in this program, it amazed me how quickly I could remember my lines and the fact that I was rapping [learning] about science . . . in such a different way that it helped me memorize and understand science terms" were made often when they were discussing their science classes.

During their senior year, since they had satisfied all of the science requirements for graduation by their junior year in high school, the students were not enrolled in a science course. As such, I do not have any data on their science performance during their senior and final year of involvement in the program. However, during their senior year, they voluntarily participated in a number of STEM oriented activities like the Youth Summit, visits to science museums (American Museum of National History and the National Museum of Mathematics) and research laboratories to sustain their interest in science.

From firsthand knowledge, the New York State Board of Regents mandates that high school students must satisfactorily complete 3 years of science content for graduation. Most students complete their science prerequisites at the end of their junior year and do not have to

take any more science courses for credit (about 20% of the senior class at my school are enrolled in science enrichment classes to prepare them to take the New York State Science Regents Examination because they have not yet passed it). They must pass a state science examination in order to qualify for graduation) till post secondary school if necessary.

I argue that this one year gap in science learning during senior year and before postsecondary education may prove detrimental to the students' future science achievement. However, most urban poor Black and Brown public schools (of which my current school of employment is a prototype) take advantage of the Board of Regents state mandate and do not allocate the necessary resources (extra teachers and supplies) to offer students (who have completed all their science requirements before their senior year) other science content options like AP courses in biology, physics, or chemistry to continue to enrich their scientific knowledge acquisition to better prepare them for possible STEM studies in college and STEM careers.

Many scholars (e.g., Barton et al., 2008; Jordan, 2006; Washington, 2011) have argued that due to the high level of testing in poor urban public schools with low socioeconomic Black and Brown student populations, advanced science enrichment courses are usually not offered. In that same light, researchers (Duncan & Rivet, 2013; Krajcik & Blumenfeld, 2006; National Science Board, 2010; U.S. Department of Education, 1990; Blummer & Krajcik, 2010; Valentine, 2012) have found that children who engaged in continued STEM activities were more likely to succeed in their postsecondary science courses because they gained more scientific knowledge, understanding, and reasoning skills.

Unlike their peers in their senior class, the study participants were continuously exposed to science content though they were not officially enrolled in a science class. Because of the

quality of their performance during the Science Genius program, they were invited to several STEM oriented events as alumni of the program (Tables 3.3 to 3.4). For example, on December 9, 2016, the participants attended a Science Genius Alumni STEM Summit at Teachers College where they had the chance to hear about opportunities in STEM careers and also about the hurdles that urban Black and Brown students may encounter while pursuing a STEM degree. Among the guest speakers on the panel were scientists and rap artists who spoke to the students about acquiring good life skills and making good decisions to secure a successful future. As part of the closing ceremony, the girls were given the opportunity to perform a science rap.

At the event, the participants had a unique opportunity to hear firsthand accounts from successful individuals, scientists and rap artists alike, who not only looked like them but also grew up in similar low-income communities. The panel included 2 African American scientists, a male and a female, and an African American male rapper. The participants were very inspired by the organization of the event. “We got a lot of information about life, and it was great to hear about how they [the guest speakers] have made it despite all the obstacles they faced growing up.” Dr. Emdin stressed the importance of using the hip-hop based science program as an avenue to not only attract urban youths of color to STEM education and careers but also to “use it as a platform to motivate Black and Brown youths to teach them the skills they need to succeed in their endeavors” (personal communication, February 20, 2017). Scholars like Takaki (2012) and Jordan (2006) have chronicled the importance of role models and race representations in helping Black and Brown students succeed in pursuing STEM careers. Jordan (2006) wrote,

Most young Black girls looked into books and never saw themselves. With the exception of George Washington Carver, most of them never heard their teachers speak of successful Black scientists. If they were fortunate, they may have heard of Madame

Curie, but most never heard of any female scientists. It is as if the world of science as a possible career choice did not exist for them. (p. 9)

The participants were once again invited by Dr. Emdin to the Shomburg Center for Research in Black Culture to perform their updated science rap lyrics at the launching of his latest book *For White Folks Who Teach in the Hood and the Rest of Y'all Too*. At this event, the girls did not only have the opportunity to perform their science rap song (as the opening act), but they also participated in discussions and a question and answer session about how teachers, administrators, and policymakers could make science education more attainable for urban Black and Brown youth in public schools. The girls' performances were so well received by the audience that they gave them a standing ovation. After the event, several audience members mentioned how impressed they were with the girls' poise, stage presence, and most of all their excitement for science. The girls were unabashed about being urban Bronx girls who did not fit the societal stereotype of students who are academically inclined to be "doing" science. It was with this understanding that many of the audience members were pleasantly surprised by their scientific knowledge (Christopher Emdin, personal communication, November 8, 2017). The girls' performances of their science rap and how they presented themselves served as exemplars of what could be possible if the science curricula in poor urban Black and Brown public schools were reflective of the culture of the student population.

The preceding Table (4.2) depicts the research participants' average science (living environment and chemistry) grades and the overall mean of their performances in their respective science classes.

Table 4.2

*Participants' Science Grade Point Average Over 2 Years*

---

Participants	Pre study	First year of study	Second year of study
--------------	-----------	---------------------	----------------------

	average science (living environment) grade point	average science (living environment) grade point	average science (chemistry) grade point
Princess	70.0	80.0	88.0
Rebecca	66.0	78.0	86.0
Nani	68.0	75.0	N/A
Joy	69.0	75.0	85.0
Mean	68.3	77.0	86.3

Table 4.3 shows the average grades for the other girls enrolled in the living environment course with the researcher but did not participate in the hip-hop based science program.

Table 4.3

*Non-Participants' (other girls) Mean Science Grade Point Average For Living Environment*

Other girls	Pre study 75	First year of study 75.5

### **Evaluation of Three Themes**

Upon evaluations of the participants' hip-hop based science rap lyrics, interviews, and observations, three themes emerged that were parallel to my three research questions listed in Table 3.5. I saw significant improvement in their abilities to (a) demonstrate their scientific content knowledge through hip-hop, (b) use hip-hop to redefine their scientific identities, and (c) use hip-hop as a tool to resist race/gender biases in STEM and in hip-hop. 1. How does participation in a hip-hop based science program impact Black and Brown girls' scientific

content knowledge? 2. How do Black and Brown female participants in the hip-hop based science program construct their science/scientific identity? 3. To what extent does participation in a hip-hop science program afford Black and Brown girls the space to resist negative Black and Brown female stereotypes in STEM and hip-hop?

**Impact of hip-hop on scientific content knowledge in the face of adversity.** These results include findings related to Research Question 1. I introduced the hip-hop based science program or the Science Genius program to my students during the Spring semester of their sophomore year. As I have previously mentioned, I wanted to implement a culturally relevant method of teaching in my science classroom in order to boost my students' interest and engagement in anticipation that, along with an increase in their participation in science, their scores on the New York State Living Environment Regents Examination would also increase (in comparison to their scores in previous years). Many scholars from the past to the present have argued that students who find cultural relevancy in their school curricula develop greater affinity toward school (for example, an increase in school attendance) and perform better academically (Dewey, 2013; Emdin, 2010; Gay, 2010; Ladson-Billings, 1995, 2006; Lee, 1997; Mensah, 2012; Sternberg, 2007). Sternberg (2007) stated "When children are taught in a way that better matches their culturally acquired knowledge, their school performance improves" (p. 151).

Additionally, scholars of hip-hop pedagogy and reality pedagogy (Reality pedagogy is a pedagogical and learning approach that was introduced by Dr. Emdin of Teacher's College, Columbia University) employ a style of teaching and learning that focuses on the reality of the students. In this process, the teacher must create a space for the students to bring their realities into the classroom so that they will be able to relate to what the pedagogue teaches. Reality pedagogues have consistently argued that when hip-hop is infused into the science curriculum in

urban public schools that serve predominantly Black and Brown students, their (scholars) self-confidence and science outlook changed for the better (Banks, 2015; Emdin, 2010, 2016; Hill, 2009; Morrel, 2002; Paris, 2012).

Secondarily, my goal for implementing a hip-hop based science program was for the culturally relevant science curriculum to result in a positive shift in my students' science efficacy and confidence and propel them toward a career in a science-oriented field. Studies have shown that individuals who possess negative science efficacy also tend to have unusually low affinity toward science and low performance rates in STEM oriented courses (Gunning & Mensah, 2011; Mensah, 2011; Settlage, Southerland, Smith, & Ceglie, 2009).

From Table 4.2, it is evident that all of the participants in this study had an in-class science grade of "C" (a "C" is a grade of 70 out of a possible 100%) or below prior to their involvement with the hip-hop based science program. However, with continued participation in the program, their science grade point average rose to a "B+" (a grade of 85 or higher but less than a 90 out of a possible 100). In comparison, the participants of the study showed great improvements in their in-class performance while the rest of the girls in the class (who did not participate in the Science Genius program) showed very minimum improvement; from a grade point average of 75 to 75.5 out of a possible 100%, an increase of only 0.5 (Table 4.3). During that same time period, the participants of the study had an increase of 8.7 (Table 4.2) in their grade point averages (in the living environment class) while participating in the hip-hop based science program. This increase in the participants' in-class science scores was indicative of a positive shift in their science efficacy, confidence, and scientific reasoning skills due to their ability to find relevancy in their science classroom experiences.

As part of the program, the participants were responsible for writing their own rap song



or poem based on either a single science topic or a combination of various science topics that they had learned in class (Emdin, 2010a). They wrote their science rap lyrics on the topic of human reproduction and development because that was the unit that I taught when I introduced the hip-hop based science program to them. The science rap lyrics that the participants of this study put together served as a cultural artifact that I further annotated and analyzed. In the first part of their science rap, the participants (who named their group Reaching Capacity) composed lyrics that depicted their understanding of reproduction and development. Below is an excerpt from their Final Battle rap:

If there's no egg  
then there's no baby  
the ovaries is apart of me  
without these you can't proceed  
Egg cells develop when you  
step into puberty  
your cycle lasts about a week

They expressed that an egg cell matures during puberty, and it is needed in order for sexual reproduction to occur. Furthermore, they demonstrated that they (girls) are the bearers of eggs because they have ovaries and that sexual reproduction cannot take place without their (girls') consent. Lastly, the girls talked about the approximate duration of the menstrual cycle.

In the next few lines the girls wrote,

the scrotum holds the testes  
Ejaculation is messy

boys want their sperm cells  
to slide right inside of me  
i'm not with it, i'mma dub it quick  
cause its gonna take my energy  
boys always wanna play games  
but i realized it was just a trick  
something like a counterfeit  
a indicator of a substance.

At this juncture, the participants discussed the male genitalia and the contribution of sperm cells to fertilization. They were empowered to show that they have control over their bodies and are capable of resisting sexual temptations (advances) by boys because they are not promiscuous. I will discuss more about their resistance and resiliency later on in the findings. In a focus group interview session, the girls said, "We wanted people to know that we (Black and Brown girls) do not like to play around with boys like that." One participant, Joy, said, "I am not trying to get pregnant. I want my college degree." Then Princess added, "I don't know why people think girls in the hood just wanna play around and get pregnant. We want to better ourselves just like everybody else, word!" When I asked why she felt that way, she said, "I feel that way because on TV and in the movies, they always playing us like we a bunch of h... (promiscuous individuals). Ain't even like that man, we trynna make it out here."

In the next section of their science rap, the girls linked their content knowledge about reproduction and development to sociocultural issues that were unfortunately quite frequent in their school and immediate surroundings. According to scholars like Gay (2010) and Ladson-Billings, (1995) part of the tenets to ensure a culturally relevant classroom is that the pedagogue must enlighten the students to become politically aware of their surroundings while still

maintaining academic thoroughness. With the following lyrics, the participants used the hip-hop based science program platform to highlight sensitive social science and social justice issues such as teenage pregnancy, incest, drug addiction, and suicide. They wrote,

I know a savage named Amber  
shawty only 14 & ended up with a baby  
rolling around with a stroller  
she can't even hold her  
her father is a predator  
she let the drugs control her  
shawty got a real bad temper  
tried to kill herself, but it didn't work  
herself she couldn't find  
her mother died from suicide

The participants depicted sociocultural challenges that were relevant to them because these issues were commonplace in their immediate surroundings. For instance, they had friends, classmates, neighbors, and even family members who had fallen victim to teenage pregnancy, drug addiction, or suicide. From personal knowledge, the school where the study took place dealt with an average of five teenage pregnancies each year. Consequently, the school building housed a free daycare center that was operated by the New York City Department of Education for teen mothers (the center was not available to teachers or support staff). The teenage mothers were encouraged to bring their infants to school so that they did not stay home and risk falling behind academically. The teen mothers were at liberty during the course of the school day to visit with their children, especially during their lunch periods.

Concerning the issue of incest, Rebecca said, “Last year, there was a girl in the school who was raped by a family member.” Princess disclosed that her aunt (who was a recovering drug addict) was raped in her early 20s during her drug addiction lifestyle. Her aunt became pregnant and had the baby. Princess’s cousin was about 2 years older than her. As the girls continued to talk, they took turns discussing the children in their neighborhoods and in their families who were raising children of their own. As the conversation proceeded, Joy said, “MTV (owned by Viacom Media Networks) has a show called “*Teen Mom*. I feel like they are glorifying teenage pregnancies because these girls are getting famous for something that teenagers shouldn’t be doing.” As I listened to them talk, I was struck by their resiliency and insightfulness about teen pregnancy and teen mothers. Though teenagers themselves, they were displaying resistance to getting pregnant because they did not want to be part of the statistics of teenagers with babies who faced challenges in completing their education (Cunningham, 2014; Hofferth, Hayes, & National Research Council, 1987). Rebecca said, “I’m trying to get ahead, don’t need that [a baby] word,” and they all chuckled. According to a *New York Daily News* report, the Bronx has the highest rate of teenage pregnancies and abortions in NYC (Cunningham, 2014). In 2012, teenagers (ages 15 to 19) accounted for 86.4 of every 1,000 pregnancies in the Bronx (Cunningham, 2014). Kearney and Levine (2014) made the argument that teen birth rates correlate with income inequality because the perception of a bleak future by these teenagers activates a culture of despair. The authors said,

When a poor young woman perceives that socioeconomic success is not achievable to her, she is more likely to embrace motherhood in her current position. . . . When there is relatively more hope of economic advancement, it is relatively more desirable to delay motherhood and invest in human or social capital. (p. 5)

Additionally, even among students with poor academic records, teens with at least one child while in high school tend not to complete their education in comparison to those who delayed having their first child until after secondary school (Hofferth et al., 1987). As their teacher and coach and as the researcher who spent a great deal of time with these girls (the participants), I had a reasonable understanding of their daily circumstances, and I was very pleased with their ambition to abstain from becoming a teen mother and stay laser focused on completing their education.

In their science rap lyrics, the participants talked about “Amber,” a teen mother who became pregnant because her father raped her. The girls described “Amber” as a victim of her past circumstances and she suffered from depression as a result. “Amber” who lost her mother to suicide at a young age, was also suicidal. As such, I was particularly intrigued by the girls’ rather harsh depiction of “Amber.” What follows is an excerpt from a focus group interview at the end of the first year of the study:

Researcher: Why did you refer to “Amber” as a savage? Isn’t she a victim?

Princess: We are all savages. At least that’s what people (society) think of (Black and Brown girls); us. I mean, it is what it is.

Rebecca: Some people think that we have bad attitudes all the time, but that ain't it. We dealing with so much stuff, you know?

Nani: We see so much, and we come to class, and some teachers don’t even wanna give you a break? At least we haven’t given up. . . .

Joy: “Amber” is a victim. We are also victims of our circumstances, but nobody is tryna understand that. They judge us, instead of counseling us, but we ain't quitting!

In the next stanza, they continued to use their understanding of the human body’s defense

mechanism to depict the struggle to survive in the face of adversity. They wrote,

she turned around, she was victimized  
no one knows she was traumatized  
she goes to class with broken pride  
with feelings she couldn't hide  
that's a red cell it's killin time  
i'm not a host, i just went ghost  
see white cell i'll make it mine  
they live off me like a parasite.

By drawing an analogy between the function of the immune system and their social surroundings, the participants described the challenges they encountered as young Black and Brown girls and their willingness to heal their wounds, remain strong, and persevere.

After dissecting the girls' depiction of "Amber," the challenges that she encountered, and her struggle to stay alive, I realized that the participants were depicting a girl (Amber) who was suffering from posttraumatic stress disorder (PTSD). However, rather than embracing her, society labeled her as angry, loud, disrespectful, and unintelligible and more likely than not, she was ostracized. Educational scholars like Emdin (2016) have written extensively about how urban youths of color suffer from PTSD due to their maltreatment within the educational system, negative societal depictions of them, and their daily tussle to survive in dire circumstances of pain and poverty.

Several studies (e.g., Thomas, 2015; Wilson, 2016) have reported that urban Black and Brown girls are resilient. They have an acquired zeal to keep afloat irrespective of any dismal situation that may surround them as depicted in the lyrics of the participants' rap: "No one knows she was traumatized/ she goes to class with broken pride." Although "Amber" was emotionally

and mentally broken, she still made the effort to attend school. Similarly, the participants came to school every day with a “mask” on to shield their pain and suffering because regardless of the difficulties in their lives, these girls were determined to push forward and succeed in school.

*I’m not a host.* Over the span of 2.5 years, I had the privilege of sharing many moments with the girls and in some instances (especially at their performances) I met quiet a few of their family members. From this unique vantage point, I was struck by their description of the symbiotic relationship between a host and a parasite as it related to their lives. In their lyrics they said,

it’s killin time  
i’m not a host, i just went ghost  
see white cell i’ll make it mine  
they live off me like a parasite

Scientifically, the girls correctly demonstrated their understanding that a parasite is a harmful living thing that lives off its host and possibly causes the demise of the host (Miller & Levine, 2010). As such, they resisted the idea of being a host to a “parasite.” In their journals, I asked the girls to elaborate on the significance of the aforementioned lyrics in relation to their personal lives. Princess alluded to the fact that she moved from another state to the Bronx to stay with her aunt because she was not getting along with her biological mother. At her mother’s house, she was the only girl, and she had her own space (bedroom). Conversely, at her aunt’s house she was one of four older females, and she was feeling overwhelmed and always craving space and privacy. To make matters worse, in addition to her aunt and her female cousins, her aunt’s female best friend and her two children also moved into the house. Princess commented, “This lady (her auntie’s friend) doesn’t work and always eating our food.” Princess felt trapped by her

living condition; she could neither find peace at her mother's home nor at her aunt's home.

Rebecca also explained that there is tension in her house between her mother and her stepfather's daughter from a previous relationship. Rebecca wrote, "My mom said that she's (stepfather's daughter) not doing enough to help out at home." Recently, Rebecca told me that her mother's stepdaughter has been sent back overseas to live with her biological mother. While demonstrating a deep scientific understanding through the hip-hop based science program, the participants were therapeutically able to effectively relate their social and relationship challenges to the science content (Emdin, Adjapong, & Levy, 2016; Tyson, 2002). It follows that the participants demonstrated a profound knowledge of parasitism, an example of a symbiotic relationship.

In the next section of their science lyrics, the girls discussed how their perceptions of science evolved from negative to positive. They had finally reckoned with the idea that science was a subject they (Black and Brown girls) were not only capable of doing but were actually enjoying learning. The participants expressed their renewed affinity toward science as follows:

Science ain't the enemy  
it lets me know what's inside of me  
ya watching my complexity  
learning chemistry feels like ecstasy

At the very end of their science rap lyrics, the girls likened the topic of mitosis/asexual reproduction to re-emphasize their resilience to succeed even under adverse conditions. They said,

try to copy me, try to imitate  
we usually procrastinate



if you cut me i'll regenerate  
using DNA like phosphate.

In the upcoming paragraphs, I examine the transformation of the participants' scientific identity following their involvement in the hip-hop based science program.

**Reframing of Scientific Identity Through Hip-Hop Pedagogy: A Culturally Relevant Space.** The following section pertains to findings related to Research Question 2 listed on Table 3.5

To know oneself as a Black woman is to live through the experience of having been massacred in your identity, confused in your views, submitted to demands and forced to adopt alien expectations. But it is also, and above all, the experience of committing yourself to reclaiming your history and recreating yourself in your potential

- Souza (1990, p. 17)

An individual's science identity is comprised of an interconnected web of three elements: performance (social performances of relevant scientific practices), recognition (realization that one is a scientist and is appreciated by other scientists as such) and competence (demonstration of knowledge and understanding of science content). These three factors are further prejudiced by a person's gender, race, and ethnic identity. The study participants, who identified themselves as Black and Brown girls (during the first scheduled 40 minute individual interviews), fell into two subgroups (race and gender) in our society that are traditionally marginalized in STEM education (Hill et al., 2010; Jordan, 2006; Mensah, 2012; Moss-Racusin et al., 2012).

To further complicate matters, the participants attended a poor urban public school where

STEM education, especially science, was not a priority. Scholars like Barton et al. (2008) reported that poor urban public schools that are primarily populated with Black and Brown students are so inundated with mandated statewide testing that the students are usually not provided with the space to collaborate with each other and engage in authentic STEM activities that would affirm and situate their foundation for future success in STEM education and careers. For example, due to over saturation of test prepping or “teaching to the test” mechanisms that are prevalent in these poor urban Black and Brown schools, the students are not given the opportunities to engage in prolonged inquiry or discovery learning (like project-based learning) that would stimulate the students’ imaginations and also affirm their scientific knowledge acquisition (Barton et al., 2008; Duncan & Rivet, 2013; Noguera, 2003; Oaks et al., 2013). In that vein, Hill et al. (2010) reported the following:

Students from historically disadvantaged groups such as African American and Hispanic students, both male and female, are less likely to have access to advanced math and science courses in high school, which negatively affects their ability to enter and successfully complete STEM majors in college. (p. 5)

Other compounding components that negatively affect Black and Brown girls’ scientific identity is the perpetual cultural isolation stemming from being mislabeled as cultural misfits, unintelligible, and incapable of learning and obtaining scientific reasoning skills (Guy-Shetfall, 1995; Hanson, 2008; Hanson & Johnson, 2000; Harding, 1986, 1987; Jordan, 2006; Rosa & Mensah, 2016). Consequently, more often than not, Black and Brown girls are not enrolled in advanced STEM courses that would strengthen their rudimentary scientific knowledge and afford them the possibility of a future STEM career (Hill et al., 2010).

When I decided to implement a culturally relevant science curriculum in my classroom

(in response to the findings of the inquiry project that I conducted with the science department at my current school of employment), I was unaware and equally anxious of how the new approach would be received by my students and the administration. However, after many years of interacting with Black and Brown students in urban public schools and being privy to research findings regarding hip-hop pedagogy in urban public school institutions (Adjapong & Emdin, 2015; Emdin, 2010; Hill, 2009; Morrell, 2002; Morrell & Duncan-Andrade, 2002; Alim, 2007), I was eager to introduce a hip-hop based science program, the Science Genius program, to my students because I believed it was the right step forward.

As depicted in the survey results in Table 3, my students, the majority of whom adhered to hip-hop music and culture (67% and 62% respectively) were not sure about wedding hip-hop and science together. Additionally, they exhibited self-doubt because they could not resolve the idea that they, Black and Brown students, were capable of doing science much less writing rap lyrics about it. They lacked self-confidence because they did not often see images of themselves doing science in their immediate surroundings or in textbooks, print media, or television (Lee, 1997; Leonardo & Grubb, 2013; Takaki, 2012). More importantly, I argue that part of their self-doubt stemmed from the fact that Black and Brown students in poor urban public schools do not believe in their abilities to do science because they are customarily not given the opportunities to experience science with authenticity (Carnevale et al., 2013; Hanson, 2008; Hill et al; 2010; Washington, 2011). Accordingly, the initial lay out and progression of the hip-hop based science program that I implemented was slow. I began by showing my students previous performance videos and recordings of hip-hop based science rap songs from the Science Genius program alumni website to introduce them to how it was possible to infuse hip-hop into science.

Although hesitant at first, with time and persuasion and the elimination of self-doubt, my

students became excited about writing their science rap lyrics. They wrote rap lyrics as part of their in class assessments. At this point, I asked the students I had identified to participate in this study to work together and write science rap lyrics. In an individual scheduled interview (35 minutes) after the Final Battle, Princess said,

Before I became fully committed [to participating in the program], I didn't think much about the program—like how you rap about science, I mean . . . was it something possible? I didn't even think it was a genius idea—how do you rap about science? But now I feel like there are a lot of ways to rap about science and make it popping (wonderful and exciting); also now I feel like it has made me a better person and more mature and open-minded and to be a more intuitive thinker because it (the process) forces me to go deeper in thought rather than just saying something like “you have cells in your body,” you have to explain it. . . . I had to show my knowledge of science by explaining it, and elaborate myself instead of just memorizing stuff. You have to know the information (content), and having “mad” (many) ideas.

As evidenced from personal observations and interviews, the participants slowly transitioned from initially being unsure of themselves to exhibiting self-confidence once they were able to acknowledge that they had a space to do science through a creative process that aligned science with rap music and culture. Therefore, at that critical threshold where they were able to identify hip-hop as a relevant cultural vehicle for them to learn science, they had an epiphany that science was doable, that they too could do science. To emphasize their breakthrough and newfound identity as capable scientists, for their stage name, the girls called themselves Reaching Capacity, and in their rap lyrics they wrote, “Nothing's impossible when your reaching your capacity.”

### ***Science Identity Transformation: Individual Testimonies***

I observed the girls' transition from being shy and uncertain about their capabilities in science to being unapologetically confident young Black and Brown students performing science on stage while highlighting deep social justice challenges that they were confronted with on a daily basis.

Rebecca and Joy were particularly shy and introverted individuals, and Princess was an extroverted person. However, regardless of their discrete personalities, they each distinctively struggled with science knowledge acquisition before they started the Science Genius program. Rebecca said,

Before participating in the Science Genius program, I felt as though the most important thing about science was to have a good memory in order to remember everything. This made science very difficult for me because I could not remember many important science terms. After participating in this program, it amazed me how quickly I could remember my lines and the fact that I was rapping about science in such a different way that it helped me memorize science terms.

With the use of hip-hop as a vehicle to learn science, Rebecca was able to master a content area that was once difficult for her and was better able to understand, absorb, and recall the science content. Science became easier for her because she was able to find cultural relevancy in the hip-hop based science program.

Joy, who was hardworking yet struggled the most out of the three participants, admitted in a journal entry, "I feel like I can learn science now, I think all teachers should try this [using hip-hop to learn the content]. I mean science doesn't seem so weird now." At a later date, I asked Joy to explain why she thought science was peculiar prior to her participation in the hip-

hop based science program, and Joy explained why:

Well Ms., before I use to try my hardest to understand these science ideas and words to make sense to me but it was hard. But when you told us to write bars and add beats to it, they started to make sense to me. I mean, at first it wasn't easy because the rap bars has to make sense scientifically, but I could relate to the whole thing. I felt good about rapping about science.

Princess, who was an extrovert and exuded a natural confidence about her, was equally insecure about her prospects in learning science. Notwithstanding, she often boasted in class about how much she liked science and that it was her favorite subject. She often reminisced about how she used to manage an "A" average in science in elementary school. Unfortunately, she was barely making a "B" average preceding the inception of the hip-hop based science program.

In the case of Princess, there was clearly a missing link between her affinity toward science as a subject matter and her achievement in science in high school. I can, however, attest that, like her co-participants, Princess also put in a good amount of effort in her science class. She completed all her assigned homework and projects and readily contributed to class discussions. As such, she was one of the students I knew I wanted to include when I embarked on the implementation of the hip-hop based science program because I thought that she would benefit from learning science through a different lens.

As time progressed, I realized that Princess's (along with her counterparts) commitment to the hip-hop based science program became increasingly strong. I observed that, as she started gaining more and more understanding of the science content through the use of hip-hop, her insecurities around her ability to perform in science began to dissipate. In her journal she wrote,

“I feel like I can do this now. I mean, I like science and all, but my grades were not cutting it, for real.”

After the first year of her involvement in the hip-hop based science program, I sat down with Princess to inquire about her perspective on science and her progression since the program began.

The SG [Science Genius] program has helped me a lot. I thought I liked science before, but now I can actually understand what I am learning; writing the lyrics forces you to dig deeper with understanding because the bars got to make sense scientifically, you know. I now feel more confident about science.

Prior to her involvement in the hip-hop based science program, Princess would habitually tell any one who would listen that she was a writer and was going to major in English in college. However, in a recent follow-up phone interview, she excitedly said, “Ms., I changed my mind, I am majoring in computer science.” As of the writing of this dissertation, Princess, Joy, and Rebecca were first-year students in college.

*Researcher:* Why the change of major?

*Princess:* Science has become more comfortable for me to learn. Even though I always liked the idea of science, I didn’t think I could actually major in science in the future.

*Researcher:* What changed?

*Princess:* I mean since the whole science with rap program and stage performances about science, I’ve just gotten more and more confidence with it, and now I feel like I can really follow my passion to obtain a science degree. Maybe I would be a science writer in the future.

As a science educator and her teacher/coach for several years, I was thrilled about her

decision to pursue a STEM career. I was even more excited that her participation in the hip-hop based science program had opened new possibilities for her to realize herself as a future scientist. When presented with the opportunity to do science through a new pedagogical format that was also culturally relevant, all three participants gained increased confidence in their abilities to both learn and share their scientific knowledge with various audiences in NYC. The girls became increasingly confident with each subsequent performance of their science rap lyrics. In a focus group interview during the second year after the study began, Rebecca said,

I have a very extreme amount of confidence after my participation in this great program.

My self-esteem was shot up once I realized that I could get up on stage and perform a rap song about science of all things because science used to be hard for me.

Through a revised science curriculum that was adapted to a cultural norm that was familiar to them, these Black and Brown girls who were part of a subgroup of Americans who were traditionally shunned in science education (Barton et al., 2008; Hanson, 2008; Hanson & Johnson, 2000; Harding, 1986; Hill et al., 2010; Jordan, 2006; Rosa & Mensah, 2016; see also Ladson-Billings, 2006; Moss-Racusin, 2012; Svokos, 2014), were able to redefine their individual scientific identities by writing and artistically expressing their scientific knowledge through hip-hop. As demonstrated in their rap lyrics below, they expressed how they had realized that “science” as an academic course was not an adversary to their progress but rather valuable content to help them to learn about who they were:

Science ain't the enemy  
it lets me know what's inside of me  
ya watching my complexity  
learning chemistry feels like ecstasy



**Exhibiting Strength: Resisting Black and Brown Female Stereotypes in STEM and Hip-Hop.** So far in my dissertation, I have discussed the struggles of women scientists in our society, not to mention the racial disparities and biases toward Black and Brown girls in STEM education and not excluding my own personal story. In this section, I address issues related to how the participants overcame stereotypes about Black and Brown girls in STEM and hip-hop (Research Question 3 – Table 3.5).

My focus on Black and Brown girls for this study was by no means an accident. Not only for the obvious reason that I am a Black female scientist who could appreciate the struggles of aspiring Black and Brown women scientists but because there are so few of us in a very vast White male dominated field. Another motivational factor was because as an educator in a poor urban public high school, my motivations have always revolved around what I could do to help young Black and Brown female students to sustain their interest in science from grade school through high school with the hope that they would manage to leverage a career in STEM.

Scholars like Hill et al. (2010), Huang, Taddese, and Walter (2000), and Moss-Racusin et al. (2012) have argued that in elementary school through middle school, girls show a similar or higher interest in science and perform better in science in comparison to boys. However, the reverse is true when the students enter high school and by postsecondary school, many girls have given up on a STEM career. That is, the girls' interest and performance in STEM begin to fall below that of the boys, although studies have shown that more girls, on average, are entering and graduating from college than boys (Hill et al., 2010; Jeffrey, 2012).

Accordingly, with my fervent research interest into Black and Brown girls in STEM education and careers and knowledge of Dr. Emdin's dedication and research into urban Black and Brown youth empowerment in STEM education through hip-hop pedagogy, I was

disappointed to discover that urban Black and Brown male students were his initial target for the hip-hop based science program. That is, his primary goal was to create a culturally relevant program that could help attract and increase the representation of urban Black and Brown male students in STEM education and careers. Nonetheless, this was the impetus for me to find out why he focused exclusively on boys and didn't include urban Black and Brown female students who may equally benefit from such an initiative. Many studies (e.g., Carnevale et al., 2013; Rosenbloom, 2008; Svokos, 2014) have concluded that there is a shortage of Black and Brown people (both males and females) in STEM education and that a degree in STEM may lead to a better financial outlook in life (Hamm, 2014; Noonan, 2017; Washington, 2011).

Therefore, in a personal conversation with Dr. Emdin, I inquired about why he did not originally include Black and Brown females in his mission statement when he began the hip-hop based science program. According to Emdin, he did not set out to create a program to purposely exclude Black and Brown girls. However, his initial focus was on Black and Brown male public school students because "Black and Brown boys are less likely to go to college and are lagging behind Black and Brown females in college graduation and STEM degree attainment" (personal communication, November, 8, 2017). Dr. Emdin also reasoned that since hip-hop was a male-dominated music genre, he believed that the male students would be more motivated to want to try a science program that was infused with hip-hop music (personal communication, November 8, 2017). It is important to note that although Dr. Emdin's original focus was on Black and Brown male students, since 2013 when the Science Genius program first began, many girls (individually or as a group) including the participants of this study, have successfully taken part in the program and that a solo female science rap artist from an inner-city public school earned the first place award at the Final Battle in 2014. These girls used the program to not only learn

science but also reclaim a space in hip-hop.

In a focus group that occurred at the end of the study, I asked the participants to reflect on taking part in a program that was once designated to attract only boys. Rebecca said, “What else is new?” Then Joy said, “Not surprised because we [females] usually the last to be included in anything. Facts! Sad but true.” Princess added, “It don’t matter ‘cause we [an all-girl group] came and crushed the competition anyway, word!” The girls came in second place at the Final Battle.

Throughout my time with the girls, I noticed how they blossomed with increasing confidence in their scientific abilities once they were able to identify themselves as young scientists and had the support and recognition (as scientists) of people who mattered to them. They had supporters like their teacher/coach [the researcher], Dr. Emdin, other Science Genius organizers and staff, and also the other participants in the program from across NYC. This was evident because each time the girls performed their science rap song, they exhibited a higher level of confidence and self-worth in a scientific space where they once wouldn’t have felt welcomed (Barton et al., 2008, Emdin, 2010; Jordan, 2006; Lee, 1997; see also Ladson-Billings, 1995; Lee, 2013; Rosa & Mensah, 2016).

Since the Science Genius Final Battle competition in June of 2015, in which the girls took home the second place trophy, they have been invited to perform at several other events hosted by Dr. Emdin. For example, at the launching and signing event for his latest book, *For White Folks Who Teach in the Hood . . . and the Rest of Y’all Too: Reality Pedagogy and Urban Education*, which took place at the Schomburg Center for Research in Black Culture in Harlem, the girls were in attendance with one other Science Genius program alumnus to be the headlining performance for the event. Dr. Emdin said, “I wanted them to perform because their message is

powerful, and they bring so much energy to their performance” (personal communication, April 3, 2016). On the day of the event, the girls arrived about an hour and a half before the start of the event, and neither Dr. Emdin nor I had arrived at the venue yet. Not only was I enthralled with their due diligence and tenacity, but the program organizers at the Schomburg were equally happy with how they showed up early and handled themselves with seriousness to accomplish their task. The organizers told me, “Your students were here on time and they listened and did everything we told them to do.” It was a wonderful moment to witness three young Black and Brown girls from a traditionally underserved and underrepresented group in STEM exhibit a high level of excitement about doing science.

Unfortunately, due to technical issues during rehearsal, the girls had to resort to rapping their science lyrics a cappella. Despite not having their instrumentals for their performance, the girls remained committed. They received resounding applause and rave reviews following their performance.

Many guests told me that they were impressed with their energy and message. They had not seen neither did they expect girls who did not fit into society’s mold of “nerdy science students” and appear to be unapologetically “ratchet” [edgy] to spit bars about science with a commanding social message. All night long, I had people asking me about them. It was phenomenal! (Dr. Christopher Emdin, personal communication, April 3, 2016).

As their representative at the event, I was equally bombarded with inquiries about the girls, and I received plenty of positive feedback about their presentation of science rap lyrics coupled with their powerful social justice message.

On the Monday following their show at the Schomburg, I met with the participants after

school for a focus group interview to reflect on their shared experiences at the book launch.

*Researcher:* How did you feel about performing your science rap in front of an audience in this space—mostly adults and highly educated people?

*Princess:* We were hype; we felt like celebrities, we felt very proud to show off our knowledge of science. It was still exciting almost a year after our original performance [at the Science Genius Final B.A.T.T.L.E.S]. It was great that our message still has an impact, and people respond very well to it. This program has made us feel so important, we are doing science and we got standing ovation for it. That’s just real cool.

*Researcher:* What is your takeaway message?

*Rebecca:* For people who didn’t even think we could do science, this is so special to be able to rap about it and make sense of it. We feel like we have done something important.

### **Coming of Age**

It is interesting yet rewarding that the girls had come to realize that they had the intelligence and ability to do science without having to hide behind a facade. That is, with subsequent performances, I observed that the participants became increasingly confident with themselves and the intellectual space afforded them to showcase their scientific knowledge. For example, at their very first Science Genius Final Battle performance, the girls came dressed in outfits that could be considered “too sexy.” As their teacher and coach, I wanted to make sure that they dressed appropriately for the show and properly represented themselves for the event. I didn’t want them to be misjudged. The fact is, even though it was an event to display scientific knowledge, there was a rap culture component to it, and the girls’ initial instincts were to mimic female rap artists who often dress in a very racy or risqué way.

It is worth noting that the girls in this study came of age when female rap performers like

Nikki Minaj and Lil' Kim were the iconic representation of female rappers. These artists were very popular not only for their music but because they were notorious for exposing much of their bodies in their rap videos and also during their time on and off stage. The participants, being young, were highly impressionable and likely looked up to these famous female rappers of their generation. As such, the girls mistook the professional female rappers' revealing way of dressing as the reason why they were popular and not because they were effective lyricists. They (girls) certainly had not yet matured enough to accept that these female rappers that they idolized did not need to use their sexuality to be successful. In focus group interviews, all three of the participants agreed that female rappers do not get the same respect as their male counterparts. Princess said, "I mean the female rappers have to work twice as hard to get a little bit of respect that the male rappers like Jay Z will get."

In a recent interview with *T Magazine* in *The New York Times Style Magazine*, Nikki Minaj echoed similar sentiments about the hurdles female rappers must contend with to gain respect for their rap music. Remarkably, the female rappers of my generation like MC Lyte and Queen Latifah also talked about how they were marginalized and mistreated in the male-dominated rap space (Espinoza, 2017; Gay, 2017). However, unlike Nikki Minaj and Lil' Kim, Queen Latifah and MC Lyte used rap music as a vehicle to push back against negative female stereotypes that were (and still are) prevalent in rap culture and society at large (DuVernay et al., 2010).

In contrast, Nikki Minaj and Lil' Kim embraced the misogynistic nature of rap culture as a way to gain notoriety and sell their music but because of their outfits and sexualized performances, they did not receive much credence as effective rap lyricists. Unfortunately, instead of gaining respect for their rap lyrics and music, they were objectified because of their

wardrobe choices and performances. As such, they still did not get the respect that they sought as serious rap artists like their male counterparts. They were still enslaved by the “culture of rape” (in my personal assessment, a “culture of rape” is an accepted core value in society in which women have been marginalized, objectified, and exposed to gender biases and misconduct with very little recourse against the aggressor) that has been prevalent in our society from time immemorial.

Consequently, it was not surprising that the participants, an all-girl group involved in a hip-hop based science competition, felt that they had to objectify themselves like their idols to be accepted. Prior to the day of the Science Genius Final B.A.T.T.L.E.S in June of 2015, the participants and I discussed the types of outfits (pants, skirt, dress) and even the color of their outfits so that they would be in sync as a group. On the day of the event, I realized that they kept their promise about having uniform colors, but they surprised me with their outfit choices. One of the participants in particular wore a skirt and a top that were quite revealing.

Upon my arrival at Teachers College, Columbia University, the venue for the Final B.A.T.T.L.E.S, about 2 hours before the event was to begin, I met with the girls. The girls had arrived at the venue before me for their final dress rehearsal. When we met, I spoke with the girls and asked the one with the most revealing outfit to consider changing, but she refused and provided a number of excuses. Then in a later conversation, I found out that one of the associate producers of the Science Genius program had also approached them to assure them that they did not need to semiexpose themselves to perform. It was a delicate situation because I needed the girls to feel empowered by their choice of clothing; however, like the associate producer, I wanted them to know that unlike the images that they had come to associate with in hip-hop rap videos, they did not have to be subjected to that as female science rap artists in order to be

celebrated. We (the coaches, producers, and directors of the program) were more interested in helping them represent themselves tastefully for their science rap performance. Moreover, we wanted to ensure them that we “saw” them, we "heard" them, and we celebrated them and their intelligence without them succumbing to societal perceptions of inadequate Black and Brown girls or sexy female rap performers.

I found the dress code issue to be a very delicate one to navigate because on the one hand, we wanted them to make their own choices and not feel pressured or even judged by their choices. On the other hand, we realized that they were not yet free from the conundrums of gender biases and negative societal generalizations about Black and Brown girls and female rappers. Besides at that time, the girls were not yet mature enough to muster the courage to push back against a dominant force in society that continuously exerted pressure on the nonmainstream to conform. Rather, they succumbed to and embraced the very same negative stereotypes used by the oppressor to delegitimize and belittle their intelligence and status in society

Dominant society has prescribed norms of behavior that are related to what to wear, how to wear it, the way to speak, and even the language to use in order to determine one’s degree of cultural conformity and acceptance in society (Hoxie, 1984; Laxson, 1991). It was fascinating that the girls chose to dress in a risqué way while having lyrics that spoke to and about rape, abuse and sexual awareness. In many ways, their dress may have been a political statement against the male gaze that positions them only as sexual beings when they had so much more to say, and much more to prove. Many scholars like Emdin (2016) and Hoxie (1984) have written extensively about how the Indigenous people of the United States were maltreated in schools that were characterized by oppressive ideologies in an effort to have them conform to White



American ways of being. Emdin (2016) reported that the Carlisle Indian Industrial School, a boarding school in Carlisle, Pennsylvania, was set up for Indigenous American youth with the goal of making them more American. That is, the administrators wanted to teach the Native Americans how to act like White Americans. By so doing, they hoped to rid them of their Native American cultural identities. According to Emdin's (2016) account, the outcome of this cultural overhaul was disastrous to say the least. Some of the children lost their Native American cultural identity as expected and became outcasts among their own families and communities. The result was that they suffered a long-term isolation and depression because they were also not welcomed as legitimate participants (Lave & Wenger, 1991) in the dominant White American society. The Native American children became culturally displaced with long-lasting negative social and academic effects.

In light of the knowledge about the experiences that Native Americans, Black and Brown people, and other immigrant groups (including myself) have had to endure in trying to adapt to the dominant American culture for acceptance (sort of like *code switching* as discussed by Emdin, 2016), I can sincerely sympathize with the girls' display of empowerment, although their pushback was misplaced. They didn't want anyone to tell them how to dress even though their choices subjected them to and affirmed the very negative stereotypes they were fighting against. I believed that they were still in a state of disillusion and needed time to garner confidence in their ability to free themselves from all harbored negative stereotypes and be truly empowered. It was a journey, a process in which they had not yet triumphed. So at that point, when they resisted my advice, I knew that I had to take a step back and allow them to be able to learn how to align their resistance/resilience in the manner they described in their own science rap lyrics so there was no contradiction between their message and their appearance. Unfortunately, on that

day, their behavior (choice of clothing for the most part) contradicted their stand against being objectified by boys. In their science rap lyrics they said,

boys want their sperm cells

to slide right inside of me

While im tryna fight my anxiety and the rage raising inside of me

i'm not with it, i'mma dub it quick

cause its gonna take my energy

boys always wanna play games

but i realized it was just a trick

something like a counterfeit

a indicator of a substance.

With these lyrics, the girls illustrated their resistance toward unwanted male advances while taking a stand against promiscuity. They expressed maturity in understanding and accepting that most attention from boys is not genuine, so they must fight back against them. Their science rap lyrics described a group of young girls who were frustrated with societal perceptions of them, so they wanted to send a strong message of empowerment over their bodies and opposition against any gender and racial biases toward Black and Brown girls.

Touching back on the girls' initial performance at the Science Genius Final Battle, they were chosen by the judges as one of the top two groups despite all the trouble surrounding their outfits. The judges explained that the top three groups were chosen because they had the strongest science content lyrics in conjunction with a strong sociopolitical message. After a second round of competition, the girls were awarded the second place trophy. Though appreciative, the participants believed that they should have won first place because in their

estimate they had the strongest sociopolitical message in relation to the group that won first place who were a mixed group of boys and girls but mostly boys (four girls and seven boys). To that end, Princess said,

At our performance, we [an all-girl group] had the best science rap lyrics, but we still got second place, so I feel like it's not only about appearance and lyrics but also a lot about perception, how people perceive us [girls], and one person's opinion could affect the whole world's outlook . . . we definitely should've won, our lyrics had a very strong message. They [judges and audience] were not expecting us to come up with strong lyrics and performances. [They did] not expect us to be as dominate, aggressive, and vulgar like a male artist. Females always had to do extra stuff, work twice as hard to get noticed.

At first the girls were shocked they won second place. Then they were disappointed that they did not win it all. However, despite their second place honor, I believe that this achievement was a turning point in how the girls perceived themselves as "scientists" and female "rap artists." They felt validated not only among their peers but they had three reputable judges (one of which was a male scientist, another a female scientist/rapper, and the last one a celebrated male television and big screen actor) recognize their work and award them for their scientific knowledge and sociopolitical stance. Their confidence levels increased tremendously, and they began to realize that yes they can, yes they did that, and yes they were celebrated for their achievements. They said to me, "Ms. we did it!" More importantly, it was at this moment that the girls came to the realization that they were good enough, their science intellect was good enough, and they did not need to physically expose themselves to be admired.

Henceforth, with each performance of their science rap song, the girls appeared more

confident and free. They held onto their edgy attitudes (ratchet), but they made better choices in their wardrobe styles. They were liberated from the psychological paradox and struggle that previously led them to question their science aptitude because of their race, gender, and socioeconomic statuses. They were also free from dressing in a way that confirmed negative stereotypes about what Black and Brown girls should look like or how female rap artists should dress.

The participants now believed that Black and Brown girls from the “hood” could do science too on a “big stage.” Their emotional and psychological transformations were magical. As I mentioned earlier, the next time they performed their science rap lyrics was at the Schomburg Center for Research in Black Culture and this time, their clothing style and performance correctly aligned with their message of science, empowerment, resistance, and Black feministic thought. They wore basic blue jeans, a baseball cap, and matching Science Genius t-shirts. Their outfits were simple but effective, with no pretentiousness.

I would like to point out that I, as their coach and teacher and as a researcher, celebrated their growth not because the girls transformed into a societal norm but because they came to the realization that they can do science like any other kid who does not look like them. They learned that pushing back against negative societal stereotypes does not mean perpetuating those negative behaviors. Sadly, from personal experience as a teacher in a poor urban public high school for over 15 years, I have observed many children repeat negative descriptive words used against them in the mainstream media or act out bad behaviors that the dominant society used to delegitimize them as citizens and global participants. Unfortunately, since high school students often have not yet developed the emotional strength to resist these harmful descriptions, they instead affirm these negativities by behaving badly as “they”– an oppressive school system –

expect them to.

In March of 2017, when the girls participated in the Science Genius Alumni Youth Summit, they were eager to share their scientific knowledge and sociopolitical message with the audience. I was intrigued by the fact that the girls' performance was flawless even though they did not rehearse prior to the event because they didn't know that they were going to perform. As I watched them perform, I couldn't help but draw my attention to what Rebecca once told me in an interview, "I honestly didn't like science because it was hard for me to remember but since it was in a rap song, it made it easier for me to remember." I also couldn't help but acknowledge how far they had come since they volunteered to take part in a program that used rap to teach science to urban Black and Brown youth.

Their level of strength and enthusiasm was infectious, and the audience received them well. It was another great opportunity for them to exude strength and confidence regarding scientific knowledge. After their performance, a local television reporter interviewed the girls. I was very pleased to have witnessed how far they had come, from much trepidation, agitation, and angst about their ability to do science to eagerly writing, rapping, and performing science to various audiences with joy and confidence.

### **Next Steps—Postsecondary School**

The participants transitioned successfully from high school to postsecondary institutions. Joy was majoring in business administration. Rebecca's long-term dream was to become an educator, and she was majoring in early childhood education. After her involvement in the Science Genius program, her outlook on science changed for the better. She said,

It [the Science Genius program] made science easier to understand. I am more comfortable to someday teach science. I feel like I could bring an innovative perspective

to learning science and help students see science differently, maybe create activities that would make science more relatable for children.

This was a wonderful transformation for a student who used to tell me all the time that she liked me as her science teacher but hated learning science.

When I first interviewed Princess about 3 years ago at the beginning of the program at her school, her career choice was to become a writer. Two months ago, I conducted a follow-up interview with her about how she was faring in college and how her life was going after secondary school. With great excitement, she announced that she was now interested in a STEM career, a computer science degree to be exact. I was pleasantly surprised. While still in high school, she wrote in a journal entry that the Rap Genius (Science Genius) program made her think of science in a whole new way. When Princess was enrolled in my Living Environment course in September of 2015, she had always told me how much she had loved science since she was in elementary school. However, her affinity for science and her classroom performance (quizzes, examinations, discussions/scientific reasoning skills) prior to participating in the hip-hop based science program were not in sync. Princess had always wished to have a career in STEM, but her interests continually dwindled as she moved up in her educational career. Hill et al. (2010) concluded, “Among first-year college students, women are much less likely than men to say that they intend to major in STEM” (p. xiv). As a result, by graduation, men surpass women in almost all STEM fields, but the numbers are most pronounced in physics, engineering, and computer science, “with women earning only 20 percent of bachelor’s degrees” (Hill et al., 2010, p. xiv). Fortunately, through her participation and efforts with the hip-hop based science program, Princess is a first-year college student who unlike the reported statistics has faithfully declared computer science as her major.

## **Using Science and Hip-Hop to Push Back Against Sexual Assault–A Sociopolitical Stance**

I would be greatly remiss if I do not touch on the current wave of sexual assault cases against women in our society because the participants raised the topic in their science rap lyrics. Multiple women have finally gathered the courage to speak the truth about a shameful act that was once a secret cancer that was destroying them internally.

According to a report by the National Center for PTSD by the U.S. Department of Veterans Affairs (2015), sexual assault is defined as a sexual encounter between two or multiple people where one of the people involved did not consent. The report also stated that victims of sexual assault may have delayed or quick reactions to their condition. Victims may suffer from a wide range of conditions stemming from major depressive disorder (MDD), guilt and shame, anger, sexual problems, drug and alcohol abuse, PTSD, and social problems to name a few.

The National Center for PTSD lists the following as examples of how females may become victims of sexual assault:

- Taken advantage of by someone who has some form of authority over them (for example doctor, teacher, boss).
- Bribed or manipulated into sexual activity against her will.
- Unable to give her consent because she is under the influence of alcohol or drugs.
- Threatened to be hurt or that people she cares about will be hurt.
- Physical force or violent assault.

Many girls and women, including myself, have experienced sexual harassment and assault, and the majority of us has quietly lived with the guilt and shame like “Amber” (the character from the participants’ science rap lyrics) of an unwarranted and unprovoked sexual advance or attack. In their science rap lyrics, the girls wrote,

I know a savage named Amber  
shawty only 14 & ended up with a baby  
rolling around with a stroller  
she can't even hold her  
her father is a predator  
she let the drugs control her  
shawty got a real bad temper  
tried to kill herself, but it didn't work  
herself she couldn't find. . . .  
she turned around, she was victimized  
no one knows she was traumatized  
she goes to class with broken pride  
with feelings she couldn't hide

At the young age of 14, “Amber” had a baby as a result of being raped by her father. She kept this dark secret to herself and turned to drugs to numb her pain. The shame and the loneliness she felt propelled her into depression, and she tried to kill herself. She felt like an invisible creation, an empty vessel, yet she harbored so much pain, anger, and rage.

In a journal entry, I asked the participants if they knew anyone like “Amber” in their immediate circle. Interestingly enough, they all personalized the question and commented that they themselves had not been victims of sexual assault but that they knew someone who had been victimized. Rebecca wrote, “I do know of a teenager [friend] that used to attend this school who was raped by a family member, but she did not get pregnant as far as I know.” Princess wrote that her aunt, a recovering addict, was impregnated by her rapist, and she had the baby



(who is now Princess's 20-something-year-old cousin). In addition, Princess wrote that her stepfather emotionally and physically abused her estranged mother when Princess used to live with them. According to Princess, as a result of the continued assault on her mother, one day she and her brothers stepped in and attacked their stepfather in defense of their mother. Princess said, "I don't understand why she is still with him."

An interesting fact is that I never equated the story of "Amber" to my own personal story until the hashtag (#)MeToo movement. I am the fifth child but the fourth girl in a family of six children. We all grew up together, but none of us ever talked about our personal experiences with sexual harassment or assault until about 7 years ago when one of my sisters opened up and told me her story. It was an impromptu moment that was triggered by a discussion of another woman's story we had just watched on television. Suddenly, my sister said, "I was also sexually assaulted back home in Ghana around the age of 9 years old." She then went on to tell me who the perpetrator was, what he did, and how she defended herself and ran away from him. Of course, I was shocked and upset. She said, "I was so ashamed that I never told anyone about it because I thought I would be ridiculed or even punished by grandma" (at the time, our maternal grandmother was caring for us because our parents had already moved to New York). After she finished, I shamefully said, "Me too."

Yeah, "me too." Unfortunately, I was also sexually assaulted but by a different man when I was about the same age my sister was when she was assaulted. My sister is a year and a half older than I. Neither my sister nor I was raped, but the violations were painful. I confessed to my sister about the shame I had carried with me concerning the assault, and how I had never felt comfortable to see or be around that man again. Like my sister and countless girls and women, I felt guilty and thought that I would be ridiculed and not be believed if I told someone.

I did not even tell my grandmother with whom I was closest. After the assault, I would always run away from my molester or cross the street to the other side whenever I saw him approaching. Additionally, any time that I would witness him conversing and laughing with a group of people from the neighborhood, I would think that they were all laughing at me. Sadly, the sight of him perpetuated more pain and helplessness because he continued to go about his affairs as if nothing had happened, while I struggled to understand why he touched me the wrong way.

The irony is that the man who assaulted me was supposedly a “wonderful guy” who was very kind to all the neighborhood kids. He usually told funny stories and bought us gifts—a nice camouflage for a pedophile, I thought. Looking back, I wondered how many other girls fell victim to him and were too afraid to speak up. Like “Amber” my sister and I went about our daily lives as if nothing had happened, yet we ached inside. The depression and the psychological isolation were all too real for two (my sister and I) young innocent victims who did not have the capabilities to decipher that they had done nothing wrong. Peters (1976) and Resnick and Walsh (1990) argued that most victims of sexual assault tend to blame themselves and feel helpless, especially if the perpetrator was an authority figure.

Around the time that the participants collaborated on their science rap lyrics, many women were beginning to sound the alarm against sexual misconduct by financially and socially powerful men across the nation. I realized that the resiliency against sexual violations that the participants wrote about in their science rap lyrics echoed what females across the country were beginning to declare out loud. The girls wrote,

boys want their sperm cells  
to slide right inside of me  
i'm not with it, i'mma dub it quick

cause its gonna take my energy  
boys always wanna play games  
but i realized it was just a trick  
something like a counterfeit  
a indicator of a substance.

While dismissing the stereotype of Black and Brown girls as promiscuous, “I’m not with it, i’mma dub it quick,” the girls were also pushing back and taking a stand against unwanted sexual advances: “boys always wanna play games, but I realized it was just a trick, something like a counterfeit.” These Black and Brown girls wanted to dismantle any notion that they frivolously chased after boys for sexual pleasure. Rather they wanted to shout out that they were aware of the games that boys played or had come to realize that boys just wanted to lure them into unwelcome sexual acts, and they were not going to give in to those demands.

Similarly, since the 2016 presidential campaign and the subsequent election of Donald J. Trump, the word *resistance* has taken on a new political meaning. The day after Trump was sworn in as the 45th president of the United States of America, the resistance movement picked up steam. On that fateful day of January 21, 2017, thousands of women (and some men) went on a pilgrimage to Washington, DC to protest Trump's presidency due in part to some sexist and vulgar comments he allegedly made against women during his campaign (Bahadur, 2017). The resistance movement was termed the Women's March partly in response to Donald Trump referring to Hillary Rodham Clinton, his then presidential opponent, as a "nasty woman" during their televised second debate (Bahadur, 2017).

On the day of the march, millions of women and men who were not able to travel to Washington, DC also joined the protest in solidarity in their individual states. For example, my

brother-in-law and my then 5-year-old nephew participated in the march in New York City. Recently, on January 20, 2018, the 1-year anniversary of the original Women's March, thousands of women once again congregated in Washington DC and in cities across the nation to protest the presidency of Donald Trump (Taylor, 2018).

Other factors and perhaps equally volatile ignition for the march were charges of sexual assault and misconduct that were brought against Trump by several women (19 as of December 2017; Ford, 2017). He has since denied these allegations. Additional fuel to the outrage against then candidate Trump was the release of a recorded video of him and Billy Bush, the former anchor and reporter for Access Hollywood (an entertainment television news program) and the contributing host of the Today Show on NBC. In the video, Trump could be heard making very expletive, derogatory, and sexually charged comments against women (Neuman, 2017).

There were many calls for Trump to cease his bid for the presidency of the United States, especially after the release of the infamous Access Hollywood video but to no avail. Trump's continued refusal to end his presidential campaign and his denial of the sexual assault charges infuriated and energized many women to take a stand against sexual harassment and also resist his candidacy, which fueled the Women's March (Bahadur, 2017).

Prior to and surrounding the outrage against Trump, many women publicly accused influential men like Clarence Thomas, Bill O'Reilly, Roger Ailes, Kevin Spacey, Bill Cosby, and Harvey Weinstein, to name a few, of sexual misconduct in the workplace. About a decade and a half ago, Supreme Court Justice Clarence Thomas was accused of sexual assault in the workplace by Anita Hill (currently a law professor at Brandeis University who teaches courses on race, gender equality, social policy, and legal history) during his confirmation hearing before Congress (Elving, 2017). Bill O'Reilly was a television news anchor at the Fox News cable

channel who was fired after multiple employees accused him of sexual assault and harassment. Roger Ailes, the man who was instrumental in creating the Fox News cable channel and served as the executive producer for many years, was also let go by Fox News after allegations of sexual harassment and assault by multiple women surfaced against him (Boucher & Gajewski, 2017). Bill Cosby, is an iconic comedian, entertainer, and actor who famously played the role of Doctor Huxtable, a fun, loving father on the 1980s sitcom, *The Cosby Show*. He became known as “America’s dad” (Walker, 2015). Unlike the loving father figure that he portrayed on television, in 2015 about 50 women accused him of sexual assault and harassment. Although he denied all the allegations, Cosby’s reputation was nonetheless tarnished and his adamant denial amassed an outcry of protest against him. For instance, reruns of *The Cosby Show* were temporarily terminated, he lost endorsement deals, and he was removed from his post as a member of the Board of Trustees at Temple University (Walker, 2015). Due to the statute of limitations, Cosby’s accusers, with the exception of one, could no longer file criminal charges against him. The case that he was indicted for ended up in a hung jury (Walker, 2015), and he has yet to be retried as of the time of this dissertation submission. The publicity of these sexual assault allegations against such influential people in the media greatly contributed to the resistance movement today. The movement was mostly against gender inequality and sexual abuse against women but it is also about helping women who had been abused to tell their stories without fear of repercussions from their predators.

It is safe to say that at the start of the 2016 presidential campaign, America’s sensitivity toward sexual assault and misconduct, especially related to men assaulting women, was heightened due to the Cosby sexual allegation case. Waves of sexual harassment cases surfaced in the media and became commonplace in daily conversations among citizens. However,

Trump's vulgarity and careless demeanor toward Hillary Clinton, Carly Fiorina, former Fox News anchor Megyn Kelly, and actress Rosie O'Donnell along with the Access Hollywood video and the women who accused Trump of inappropriate sexual behavior (Bahadur, 2017), ignited a new level of revolution that empowered countless women who had suffered sexual abuse in silence (like "Amber") to begin to tell their truth about their alleged accusers. To date, more than 84 women have come forward to accuse Weinstein of sexual assault (Moniuszko & Kelly, 2017).

The Weinstein sexual assault cases further propelled the sexual assault resistance movement forward and sparked the #MeToo revolution in October of 2017 (Garcia, 2017) with the help of Hollywood elite female actresses like Alyssa Milano, Amber Anderson, Lupita Nyong'o, Angelica Jolie, Gwyneth Paltrow and many, many more who had shamelessly told of their individual sexually violent encounters with men in powerful positions like Harvey Weinstein and countless other predators. The #MeToo movement was originally started by the civil rights activist Tarana Burke in 2006 as an innovative manner to raise awareness of the prevalence of sexual abuse and harassment in our society. Due to the #MeToo movement, which was rekindled in October of 2017 by actress Alyssa Milano in response to the Weinstein sexual assault cases, some of my female friends also took to social media outlets and courageously shared their #MeToo stories that they had endured in silence (like "Amber") for many years. Like many other sexual assault victims, they too feared being ridiculed and not believed and even worried about encountering retaliation by their predators (Garcia, 2017; Peters, 1976; Resnick, 1990).

*Time* magazine honored all the women behind the #MeToo revolution by giving them its coveted annual award, Person of the Year, in 2017 (Zacharek, Dockterman, & Edwards, 2017).

To continue the battle cry against inappropriate sexual behavior against women, the #Time's Up campaign was created in January of 2018 right before Hollywood was to celebrate the Golden Globe Awards. The mission of the Time's Up campaign was to provide grant money and free legal advice for victims of sexual abuse who may not be able to afford legal representation. One aim of #Time's Up movement was to ensure that all women, regardless of their socioeconomic status, race, or creed have access to tell their stories of sexual assault without the fear of retaliation by their powerful assailants who may seek tactical means to silence them. Another goal of the aforementioned movement was to completely put an end to these violations (Buckley, 2018).

Coincidentally, before the #MeToo and #Time's Up movements began to capture the nation's attention in October of 2017, I asked the participants in June of 2017 to express how they felt about having the hip-hop based science program's platform to talk about sexual abuse and harassment. Interestingly enough, one girl, Princess, wrote the following:

It made me feel like I actually had a voice because a lot of people go through mad stuff, a lot of people especially girls or women are subjected to this [sexual assault] the most. We are prone to this all the time and we do not even have a choice. They [girls/women] don't feel like they have the voice to speak up. It [story about "Amber"] wasn't even personalized but it was OD [very much] generalized. A lot of girls go through sexual abuse, but they don't have the parents to talk to, and they want to kill themselves [but then they] act like they are okay, but they really dying inside, like the whole Amber part. So we helped to bring reality to the whole sexual abuse thing. I feel like our rap brought a lot of awareness. I feel like when we performed, our message was received well. Overall, the Science Genius program was a great experience.

It affirmed what Dewey (1902) said about the child “and not the subject-matter which determines both quality and quantity of learning” (p. 9) and that for the child, “things hardly come within his experience unless they touch, intimately and obviously, his own well-being, or that of his family and friends” (Dewey, 1902, p. 5).



## Chapter V

### DISCUSSION AND IMPLICATIONS

Teaching that ignores student norms of behavior and communication provokes student resistance, while teaching that is responsive prompts student involvement

Michael Olneck (cited by Wages, 2014, p.12).

In this longitudinal critical ethnographic study, infused with my personal narratives/experiences and truths, I explored how a hip-hop based science program—the Science Genius program—made an indelible impact on the science education of three urban Black and Brown female students from the South Bronx. Through the implementation of the culturally relevant program, I was fortunate to spend ample time (about 2.5 years) with Princess, Rebecca, and Joy, three remarkable Black and Brown young girls who were able to frame their scientific identities and acquire scientific knowledge because the parameters of science education were redefined.

The hip-hop based science program was effective because the participants found relevancy in the curriculum and were empowered and took ownership of their science knowledge acquisition. In addition, the rap component of the program provided the girls with necessary latitude to therapeutically voice their internal frustrations (Emdin et al., 2016; Tyson, 2002) about the sociopolitical issues that afflict them like race/gender inequalities, sexual assault, depression, and disparaging imagery of the intellectual abilities of Black and Brown girls. In her final journal entry, Rebecca, the girl who initially disliked science because she found the content to be extremely difficult to absorb wrote the following:

I have very extreme amount of confidence after my participation in this great program, my self-esteem was brought up once I realized that I could get up on stage and perform a rap song about science of all things because science used to be hard for me.

I feel like more teachers should get more involve into this program and create more publicity to get more kids aware of it because I feel like it will help kids like me who may not like or understand science at first to really see science in a different way—like some fun and that they can do [it].

Joy who worked hard but struggled the most in her science classes wrote, "I started off saying it was wack and I can't rap. [Now] I will tell people that it is a great program and it allows you to see how talented and knowledgeable you are."

Princess expressed that,

It [Science Genius program] is a good way to learn science because some people find it hard to articulate themselves in science but if they create a rap about it, then it would make it easier for them; I mean, it worked for me.

She also touched on an unspoken yet disturbing phenomenon that was far too prevalent in poor urban Black and Brown schools. Unfortunately, for the past 15 years that I worked as an educator in such communities, I witnessed many occurrences of the sort outlined below, but I never actually considered them to be a hindrance in the science classroom. Princess wrote, "The program is good because nobody expects a girl, especially popular girl like me, to do something related to intelligence like learning science." I was intrigued by her honesty and revelation so I asked her to explain herself, "I mean, popular people around here are not supposed to be nerdy, like learning science."

I intend to explore this dichotomy and tension further in a follow-up paper. That is, the

perceived notion that popularity (or the social hierarchy) within a poor urban public school may deter a student from learning science because they do not want to be perceived as intelligent and giving into a system that is deemed racist/oppressive (Emdin, 2016; Hanson & Johnson, 2000). It was noteworthy that even though she was popular, she did not shy away from immersing herself in learning science because it was culturally relevant. The infusion of hip-hop pedagogy in the science classroom erased any underlining notion of being nerdy or “not cool” because hip-hop was the most popular genre of music and culture among my students and other urban public school students (Adjapong & Emdin, 2015; Banks, 2015; Chang, 2007; Emdin, 2010a, 2010b, 2016; see also Alim, 2007; Paris, 2012).

The current Western educational system must do better to serve the educational needs of urban minority students. The fact is, Black and Brown students do not “see” themselves in any aspect of the current curricula, neither in the “operational” nor in the “performance” curricula (Doyle, 1992; Lee, 1997). While making the case for the importance of science education in the early part of the 20th century, the Committee on Science chaired by Caldwell proposed that the application of science “will be of value to many students if properly adapted to their needs” (DeBoer, 1991, p. 70).

With the introduction of hip-hop pedagogy into the science classroom, the participants were able to create a space that enabled them to learn and exhibit their scientific knowledge in a nontraditional way. Nonetheless, it was effective because it was culturally relevant. A culturally relevant pedagogue taps into the cultural experiences of the student and uses that as a baseline to teach the child content. Within this pedagogical style, the teacher must continuously maintain the rigor of the content and, in addition, empower the students to be politically aware of any social injustices in their surroundings (Gay, 2010; Ladson-Billings, 1995). Therefore, by

redefining the rules of engagement in science teaching and learning through the infusion of hip-hop music, a culture that resonates with urban Black and Brown students, the participants in this study were able to reconstruct their scientific identities with the recognition that they too *can do science*.

The results of the study have implications for ongoing professional development for both preservice and in-service science teachers on how best to engage urban Black and Brown students with respect to science and their cultural norms. Furthermore, several researchers have argued that a child walks into the classroom with perceived notions about the world that are engrained in his/her culture and must be taken into consideration when designing a lesson (Dewey, 1902; Duschl, 2008; Lederman, 1999; Sandoval, 2005). Educators need to work with policymakers and curriculum designers to ensure that the curricula put forth meet the needs of *all Americans* (Lee, 1997). I also urge policymakers and curriculum designers to mandate that all high school students, especially Black and Brown students that are disproportionately underrepresented in STEM education and careers, are offered STEM courses in their senior year to sustain and root their foundation in STEM for post secondary school.

Admittedly, it is a challenge to not overlook the cultural backgrounds that students bring to the science classroom. It is equally challenging for educators to let go of their personal cultural, gender, race, class (socioeconomic status), and sexual orientation biases that they carry into the classroom (Emdin, 2016; Harding, 1986; McGlynn, 2012). So teachers need more professional development in learning new and innovative strategies to enable them to develop culturally relevant or responsive teaching mechanisms (Gay, 2006; Ladson-Billings, 1995).

The contribution of my dissertation research to the ongoing investigation into Black and

Brown girls in STEM education and careers was that when these girls are challenged and encouraged, they perform well. Also by employing hip-hop pedagogy in the curriculum, the girls were afforded the cultural space to take ownership of their science learning. Therefore, educators must continuously ensure that all students especially Black and Brown girls are equally challenged academically and supported to better prepare them for high-level science reasoning skills that will help them succeed in STEM education and/or careers.

## CONCLUSION

Black girl, life is short. Don't let them tell you how to do it. They'll try and define you, they're going to tell you all the things you're doing wrong. All you can do is live your life as you and live as best you can. Just keep trying. Sometimes they'll shut the door—find the window. If they shut the window, find the crack. If they shut the crack, find a new space. When they say no, it's

fine, just take over the Milky Way. At night, we rearrange the stars

Buhle Ngaba (as cited in Samson, 2017, pp. 8 – 9).

Lee (1997) and Duschl (2008) discussed in their respective papers that the current definition and perspective of science is not culturally inclusive. Western ideologies of science have dominated the field of science teaching and learning. As a result, many people have been left out. The groups of people who are disproportionately falling behind in scientific knowledge are mostly poor urban Black and Brown male and female students (Adjapong & Emdin, 2015; Emdin, 2016; Hill et al., 2010; Ladson-Billings, 2006; Svokos, 2014).

Through the hip-hop based science program, the participants gained confidence to learn science because it had become socially and culturally relatable. The program afforded them the space to express their hidden frustrations with race/gender, self-esteem, sexual assault/

harassment, and other social challenges that may have created barriers against Black and Brown girls in the science classroom. With their newfound understanding and self-awareness, the girls reconciled that “science ain’t the enemy” but rather “it lets me know what’s inside of me.” They came to the realization that as a content matter, science was not the real “enemy.” However, their real nemesis was the delivery of the content with its sociocultural and gender biases that students had to overcome in the process of acquiring scientific knowledge or becoming scientific literate. One participant, Rebecca, said, “Ever since I participated in the SG [Science Genius] program, I’ve looked at science differently, mostly because I realized that science can be fun and an interesting subject as well as educational.”

In this vein, I argue that educators, policymakers, and all other education stakeholders must formulate innovative ways to combat the lack of diversity in science education. One does not have to use rap, but I encourage *all* teachers, especially those who teach in urban Black and Brown public schools, to embrace the culture of their students to provide the students with opportunities to take ownership of their learning and succeed to the best of their ability in the science classroom. Numerous researchers (DeBoer, 1991; Dewey, 1902; Emdin, 2010a, 2010b, 2016; see also Artiles & Harry, 2008; Gay, 2010; Ladson-Billings, 1995, 2006; Lee, 1997) have argued that an integral part of educating a child in science is considering his/her culture because the child’s outlook on life phenomena is heavily influenced by his/her culture.

Other researchers have shown that when the culture of the students is embedded in the curricula or is represented in classroom lessons, the students are increasingly engaged in the learning process and become more successful in their education (Banks, 2015; Emdin, 2016; Hill, 2009; Ladson-Billings, 1995, Lee, 1997; Tate, 1995). The underlying message is that educators have a responsibility to explore the culture of their students and infuse it into their

lessons to get students, especially Black and Brown girls (who are marginalized and traditionally underrepresented in science education), engaged with the content. The bottom line is that *culture matters in science education*.

### **LIMITATIONS**

The most obvious limitation in the study was that I was the researcher as well as the Science Genius coach and the classroom teacher of the participants. Consequently, I already had an established relationship with the students that may have influenced their ease of participation and my outlook of them. Another probable limitation was that I was not (and still not) an expert on hip-hop pedagogy and was continuously learning about the hip-hop culture and developing hip-hop sensibility (Emdin, 2010). My novice stance on hip-hop music and culture could have put me at a disadvantage as I was only beginning to learn about the nuances of the hip-hop cultural terminologies at the inception of the hip-hop based science program. The students from my school unlike other Science Genius participants [from other schools] were invited to other events [in addition to the Final Battle] like the Youth Summit for example that gave them more opportunities to perform and showcase their science rap lyrics. These unique opportunities may have further stimulated my 3 participants to gain more time, understanding, and insight into STEM education than the other Science Genius program participants during the same time frame.

## References

- Adimora, A. A., Schoenbach, V. J., & Doherty, I. A. (2007). Concurrent sexual partnerships among men in the United States. *American Journal of Public Health, 97*(12), 2230-2237.
- Adjapong, E. S., & Emdin, C. (2015). Rethinking pedagogy in urban spaces: Implementing hip-hop pedagogy in the urban science classroom. *Journal of Urban Learning, Teaching, and Research, 11*, 66-77.
- Alim, H. S. (2007). Critical hip-hop language pedagogies: Combat, consciousness, and the cultural politics of communication. *Journal of Language, Identity, and Education, 6*(2), 161-176.
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). "Balancing acts": Elementary school girls' negotiations of femininity, achievement, and science. *Science Education, 96*(6), 967-989.
- Artiles, A. J., & Harry, B. (2006). Addressing culturally and linguistically diverse student overrepresentation in special education: Guidelines for parents. Retrieved from [http://www.nccrest.org/Briefs/Parent\\_Brief.pdf](http://www.nccrest.org/Briefs/Parent_Brief.pdf)
- Atwater, M. M. (1996). Social constructivism: Infusion into the multicultural science education research agenda. *Journal of Research in Science Teaching, 33*(8), 821-837.
- Bahadur, N. (2017, June 29). 22 sexist things President Donald Trump has said about women. *SELF*. Retrieved from <https://www.self.com/story/sexist-president-donald-trump-comments>
- Banks, D. (2015). Hip hop as pedagogy: Something from something. *Theatre Topics, 25*(3), 243-259.
- Barton, A. C., Tan, E., & Rivet, A. (2008). Creating hybrid spaces for engaging school science among urban middle school girls. *American Educational Research Journal, 45*(1), 68-103.
- Blumenfeld, P. C., Marx, R. W., Patrick, H., Krajcik, J., & Soloway, E. (1997). Teaching for understanding. In B. J. Biddle, T. L. Good, & I. F. Goodson (Eds.), *International handbook of teachers and teaching* (Vol. 2, pp. 819-878). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Boeije, H. (2009). *Analysis in qualitative research*. Thousand Oaks, CA: Sage.
- Boucher, A., & Gajewski, R. (2017). *Timeline of Fox sexual harassment and other scandals, from Roger Ailes to Bill O'Reilly*. Retrieved from The Wrap website: <https://www.thewrap.com/fox-sexual-harassment-scandals-from-roger-ailes-to-bill-oreilly-photos/>



- Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241-258). Westport, CT: Greenwood.
- Bourdieu, P., & Passeron, J. C. (1990). *Reproduction in education, society and culture* (Vol. 4). Thousand Oaks, CA: Sage
- Brantley, V., & Timas, R. (1984). Cool it now. [Recorded by New Edition]. On *New Edition [CD]*. . Nashville, TN: MCA.
- Brotman, J. S., & Moore, F. M. (2008). Girls and science: A review of four themes in the science education literature. *Journal of Research in Science Teaching*, 45(9), 971-1002.
- Brown, B., Reveles, J., & Kelly, G. (2005). Scientific literacy and discursive identity: A theoretical framework for understanding science learning. *Science Education*, 88, 779-802.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.
- Brown, R. N. (2009). *Black girlhood celebration: Toward a hip-hop feminist pedagogy*. New York, NY: Lang.
- Brown, R. N. (2013). *Hear our truths: The creative potential of Black girlhood*. Champaign, IL: University of Illinois Press.
- Brown, R. N., & Kwakye, C. J. (2012). *Wish to live: The hip-hop feminist pedagogy reader*. New York, NY: Peter Lang.
- Brown-Jeffy, S., & Cooper, J. E. (2011). Toward a conceptual framework of culturally relevant pedagogy: An overview of the conceptual and theoretical literature. *Teacher Education Quarterly*, 38(1), 65-84.
- Bryson, V. (2016). *Feminist political theory*. New York, NY: Palgrave Macmillan.
- Buckley, C. (2018, Month #). Powerful Hollywood women unveil anti-harassment action plan. *The New York Times*. Retrieved from <https://www.nytimes.com>
- Calabrese Barton, A., Kang, H., Tan, E., O'Neill, T. B., Bautista-Guerra, J., & Brecklin, C. (2013). Crafting a future in science: Tracing middle school girls' identity work over time and space. *American Educational Research Journal*, 50(1), 37-75.
- Camangian, P. (2010) Starting with self: Teaching autoethnography to foster critically caring literacies. *Research in the Teaching of English*, 45(2), 179-204.

- Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392-414.
- Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, 44(8), 1187-1218.
- Carnevale, A. P., Smith, N., & Strohl, J. (2013). Recovery: Job growth and education requirements through 2020. Where was this published or retrieved from?
- Castagno, A. E., & Brayboy, B. M. J. (2008). Culturally responsive schooling for indigenous youth: A review of the literature. *Review of Educational Research*, 78(4), 941-993.
- Catsambis, S. (1995). Gender, race, ethnicity, and science education in the middle grades. *Journal of Research in Science Teaching*, 32(3), 243-257.
- Ceci, S. J., & Williams, W. M. (2007). Why aren't more women in science? *Top researchers debate the evidence*. Washington, DC: American Psychological Association.
- Chang, J. (2007). *Can't stop won't stop: A history of the hip-hop generation*. New York, NY: St. Martin's Press.
- Chang, J. (2011). A case study of the "Pygmalion Effect": Teacher expectations and student achievement. *International education studies*, 4(1), 198.
- Chang, J., & Watkins, S. C. (2007). It's a hip-hop world. *Foreign Policy*, 163(4), 58-65.
- Charry, E. (Ed.). (2012). *Hip hop Africa: New African music in a globalizing world*. Bloomington, IN: Indiana University Press.
- Chudowsky, N., & Chudowsky, V. (2010). *State test score trends through 2007-08, part 5: Are there differences in achievement between boys and girls?* Retrieved from Center on Education Policy website: List web address here
- Collins, P. H. (2002). *Black feminist thought: Knowledge, consciousness, and the politics of empowerment*. New York, NY: Routledge.
- Collins, P. H. (2004). *Black sexual politics: African Americans, gender, and the new racism*. New York, NY: Routledge.
- Collins, P. H. (2006). *From Black power to hip hop: Racism, nationalism, and feminism*. Philadelphia, PA: Temple University Press.
- Condry, I. (2013). Japanese hip-hop and the globalization of popular culture. *Introductory Readings in Anthropology*, 241.
- Creswell, J. (2013). *Qualitative inquiry & research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: Sage.

- Cunningham, J., H. (2014, March, 3). Pregnancy and abortion rates among Bronx teens is highest in the city, new report says. *The New York Daily News*. Retrieved from <http://www.nydailynews.com/new-york/bronx/bronx-teens-highest-rate-teen-pregnancy-nyc-city-health-department-article-1.1709511>
- DeBoer, G. (1991). *A history of ideas in science education: Implications for practice*. New York, NY: Teachers College.
- Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.
- Dewey, J. (1902). *The child and the curriculum*. Chicago, IL: University of Chicago.
- Dewey, J. (2013). *The school and society and the child and the curriculum*. Chicago, IL: University of Chicago Press.
- Dimitriadis, G. (2009). *Performing identity/performing culture: Hip hop as text, pedagogy, and lived practice* (Vol. 1). New York, NY: Lang.
- Doyle, W. (1992). Curriculum and pedagogy. In P. Jackson (Ed.), *Handbook for research on curriculum* (pp. 486-516). New York, NY: MacMillian.
- Driver, R., Asoko, H., Leach, J., & Scott, P., & Mortimer, E. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher*, 23(7), 5-12.
- Duncan, R., & Rivet, A. (2013). Science learning progressions. *Science*, 339(6118), 396-397.
- Duschl, R. (2008). Science in three-part harmony: Balancing conceptual, epistemic, and social learning goals. *Review of Research in Education*, 32(1), 268-291.
- DuVernay, E., Lyte, MC., Chuck, D. (Writers), & DuVernay, E. (Director). (2010). *My mic sounds nice: The truth about women in hip hop* [Television broadcast]. Washington, DC: Black Entertainment Television.
- Eden, D. (1984). Self-fulfilling prophecy as a management tool: Harnessing Pygmalion. *Academy of Management Review*, 9(1), 64-73.
- Eden, D. (1990). *Pygmalion in management: Productivity as a self-fulfilling prophecy*. Lexington, MA: Lexington Books/Daniel Collamore Heath and Company.
- Eisenhart, M. (2001). Changing conceptions of culture and ethnographic methodology: Recent thematic shifts and their implications for research on teaching. *Handbook of Research on Teaching*, 4, 209-225.

- Eisenhart, M. A., & Finkel, E. (1998). *Women's science: Learning and succeeding from the margins*. Chicago, IL: University of Chicago.
- Eisenhart, M., Finkel, E., & Marion, S. (1996). Creating the conditions for scientific literacy: A re-examination. *American Educational Research Journal*, 33(2), 261-295.
- Ely, M., Vinz, R., Downing, M., & Anzul, M. (1997). *On writing qualitative research: Living by words*. Washington, DC: Falmer Press
- Elving, R. (Producer). (2017, December, 10). A refresher on Anita Hill and Clarence Thomas [Audio podcast]. Washington, DC: National Public Radio. Retrieved from <https://www.npr.org/2017/12/10/569716802/a-refresher-on-anita-hill-and-clarence-thomas>
- Emdin, C. (2010a). Affiliation and alienation: Hip-hop, rap, and urban science education. *Journal of Curriculum Studies*, 42(1), 1-25.
- Emdin, C. (2010b). *Urban science education for the hip-hop generation*. Rotterdam, The Netherlands: Sense.
- Emdin, C. (2013). The rap cypher, the battle, and reality pedagogy: Developing communication and argumentation in urban science education. In M. L. Hill & E. Petchauer (Eds.), *Schooling hip-hop: Expanding hip-hop based education across the curriculum* (pp. 11-27). New York, NY: Teachers College Press.
- Emdin, C. (2016). *For White folks who teach in the hood . . . and the rest of y'all too: Reality pedagogy and urban education*. Boston, MA: Beacon.
- Emdin, C., Adjapong, E., & Levy, I. (2016). Hip-hop based interventions as pedagogy/therapy in STEM: A model from urban science education. *Journal for Multicultural Education*, 10(3), 307-321.
- Espinoza, J (2017). Nicki Minaj addresses sexism in the industry and says she deserves more respect. Retrieved from Complex Music website <http://www.complex.com/music/2017/10/nicki-minaj-wants-tweets-about-respecting-women-for-hard-work>
- Esposito, J., & Swain, A. N. (2009). Pathways to social justice: Urban teachers' uses of culturally relevant pedagogy as a conduit for teaching for social justice. *Penn GSE Perspectives on Urban Education*, 6(1), 38-48.
- Williams, F. B., & Washington, M. H. (1987). *Invented Lives: Narratives of Black Women 1860–1960*. Norwell, MA: Anchor Press.
- Fausto-Sterling, A. (1981). Women and science. *Women's Studies International Quarterly*, 4(1), 41-50.

- Ford, M. (2017, December, 7). The 19 women who accused president Trump of sexual misconduct. *The Atlantic*. Retrieved from <https://www.theatlantic.com/politics/archive/2017/12/what-about-the-19-women-who-accused-trump/547724/>
- Garcia, S. (2017, October 20). The woman who created #METOO long before hashtags. *The New York Times*. Retrieved from <https://www.nytimes.com/2017/10/20/us/me-too-movement-tarana-burke.html>
- Gay, G. (2010). *Culturally responsive teaching: Theory, research, and practice*. New York, NY: Teachers College.
- Gay, R. (2017, October 16). Nicki Minaj, always in control. The queen of hip-hop has fought her way to the top of the music industry—and never made compromises. *The New York Times Style Magazine*. Retrieved from <https://www.nytimes.com/2017/10/16/t-magazine/nicki-minaj.html>
- Gelder, T. V. (2005). Teaching critical thinking: Some lessons from cognitive science. *College Teaching*, 53(1), 41-48.
- Graff, N., Fry, R., & Funk, Cary. (2018). 7 Facts about the STEM workforce. Retrieved from Pew Research Center website: <http://www.pewresearch.org/fact-tank/2018/01/09/7-facts-about-the-stem-workforce/>
- Gunning, A. M., & Mensah, F. M. (2011). Preservice elementary teachers' development of self-efficacy and confidence to teach science: A case study. *Journal of Science Teacher Education*, 22(2), 171-185.
- Guy-Sheftall, B. (1995). *Words of fire: An anthology of African-American feminist thought*. New York, NY: The New Press.
- Hamm, T. (2014). *A dose of financial reality*. Retrieved from The Simple Dollar website: <http://www.thesimpledollar.com/a-dose-of-financial-reality/>
- Hanson, S. (2008). *Swimming against the tide: African American girls and science education*. Philadelphia, PA: Temple University.
- Hanson, S. L., & Johnson, E. P. (2000). Expecting the unexpected: A comparative study of African-American women's experiences in science during the high school years. *Journal of Women and Minorities in Science and Engineering*, 6(4).
- Harding, S. G. (1986). *The science question in feminism*. Ithaca, NY: Cornell University.
- Harding, S. G. (Ed.). (1987). *Feminism and methodology: Social science issues*. Bloomington, IN: Indiana University.

- Hewson, P., & Hewson, M. (1984). The role of conceptual conflict in conceptual change and the design of science instruction. *Instructional Science*, 13, 1-13.
- Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. Washington, DC: American Association of University Women.
- Hill, L. (1998). The miseducation of Lauren Hill. . On The miseducation of Lauren Hill. [Vinyl] Philadelphia, PA: Ruffhouse Records.
- Hill, L. C. (2013). *When the Beat was Born: DJ Kool Herc and the Creation of Hip Hop*. Roaring Brook Press.
- Hill, M. L. (2009). *Beats, rhymes, and classroom life: Hip-hop pedagogy and the politics of identity*. New York, NY: Teachers College.
- Hodge, K. A., & Kemp, C. R. (2006). Recognition of giftedness in the early years of school: Perspectives of teachers, parents, and children. *Journal for the Education of the Gifted*, 30(2), 164-204.
- Hofferth, S. L., Hayes, C. D., & National Research Council. (1987). Social and economic consequences of teenage childbearing. Washington, DC: National Academies Press.
- Holzer, H. J., Offner, P., & Sorensen, E. (2005). Declining employment among young Black less-educated men: The role of incarceration and child support. *Journal of Policy Analysis and Management*, 24(2), 329-350.
- Howe, A. C. (1996). Development of science concepts within a Vygotskian framework. *Science Education*, 80(1), 35-51.
- Hoxie, F. E. (1984). *A final promise: The campaign to assimilate the Indians, 1880-1920*. Lincoln, Nebraska: University of Nebraska.
- Huang, G., Taddese, N., & Walter, E. (2000). *Entry and persistence of women and minorities in college science and engineering education* (Research Report No. 2000-601). Retrieved from National Center for Education Statistics website: List web address here.
- Jabbaar-Gyambrah, T. (2015). Gender politics of hip-hop and hip-life music in New York and Ghana. *Afro-Americans in New York Life and History*, 39(1), 7.
- Jackson, K. T., Keller, L., & Flood, N. (Eds.). (2010). *The encyclopedia of New York City*. New Haven, CT: Yale University.
- Jaramillo, J. A. (1996). Vygotsky's sociocultural theory and contributions to the development of constructivist curricula. *Education*, 117(1), 133.
- Jeffrey, T. P. (2012). 25% fewer men than women graduate from college; Obama: It's a great accomplishment . . . for America. *CNSnews.com*. Retrieved from

<https://www.cnsnews.com/news/article/25-fewer-men-women-graduate-college-obama-its-great-accomplishment-america>

- Jeffries, M. P. (2011). *Thug life: Race, gender, and the meaning of hip-hop*. Chicago, IL: University of Chicago.
- John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A Vygotskian framework. *Educational Psychologist, 31*(3-4), 191-206.
- Jordan, D. (2006). *Sisters in science: Conversations with Black women scientists about race, gender, and their passion for science*. West Lafayette, IN: Purdue University.
- Joseph, G. (1995). Black feminist pedagogy. In B. Guy-Sheftall (Eds.), *Words of fire: An anthology of African-American feminist thought* (pp. 462-472). New York, NY: The New Press.
- Kane, M. J. (1989). The post Title IX female athlete in the media: Things are changing, but how much? *Journal of Physical Education, Recreation & Dance, 60*(3), 58-62.
- Kearney, M. S., & Levine, P. B. (2014). Income inequality and early nonmarital childbearing. *Journal of Human Resources, 49*(1), 1-31.
- Kirschner, P. A. (1992). Epistemology, practical work and academic skills in science education. *Science & Education, 1*(3), 273-299.
- Krajcik, J., & Blumenfeld, P. (2006). Project-based learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 317-333). New York, NY: Cambridge University.
- Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465-491.
- Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in US schools. *Educational Researcher, 35*(7), 3-12.
- Ladson-Billings, G. (2010). Making the book talk: Literacy in successful urban classrooms and communities. In K. Dunsmore & D. Fisher (Eds.). *Bringing Literacy Home. Newark, DE: International Reading Association, 226-244.*
- Ladson-Billings, G. (2014). Culturally relevant pedagogy 2.0 a.k.a. the Remix. *Harvard Educational Review, 84*, 74-84.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York, NY: Cambridge University.

- Lawrence-Lightfoot, S., & Davis, J. H. (1997). *The Art and Science of Portraiture*. San Francisco: Jossey-Bass.
- Lawson, A. E. (1995). *Science teaching and the development of thinking*. Belmont, CA: Wadsworth Publishing
- Laxson, J. D. (1991). How “we” see “them” tourism and Native Americans. *Annals of Tourism Research*, 18(3), 365-391.
- Lederman, N. (1999). Teachers’ understanding of the nature of science and classroom practice: Factors that facilitate or impede the relationship. *Journal of Research in Science Teaching*, 36(8), 916-929.
- Lee, J. (2013, May, 19). 6 women scientists who were snubbed due to sexism. *National Geographic*. Retrieved from <https://news.nationalgeographic.com/news/2013/13/130519-women-scientists-overlooked-dna-history-science/>
- Lee, O. (1997). Scientific literacy for all: What is it, and how can we achieve it? *Journal of Research in Science Teaching*, 34(3), 219-222.
- Lee, T. F. (2013). *The Human Genome Project: Cracking the genetic code of life*. Berlin, Germany: Springer.
- Leonardo, Z., & Grubb, W. N. (2013). *Education and racism: A primer on issues and dilemmas*. New York, NY: Routledge.
- Leonardo, Z., & Grubb, W. N. (2014). *Education and racism: A primer on issues and dilemmas*. New York, NY: Routledge.
- Liu, X. (2010). Across the borders: Hip hop’s influence on Chinese youth culture. *Southeast Review of Asian Studies*, 32, 146-153.
- Lynch, G., Norton, E. H., Williams, M., Beale, F. M., & La Rue, L. (1970). *Black woman’s manifesto*. New York City, NY: Third World Woman’s Alliance.
- Malcolm, S. (1989). Increasing the participation of Black women in science and technology. *Sage: A Scholarly Journal on Black Women*, 6(2), 15-17.
- Mau, W. C., Domnick, M., & Ellsworth, R. A. (1995). Characteristics of female students who aspire to science and engineering or homemaking occupations. *The Career Development Quarterly*, 43(4), 323-337.
- McGlynn, A. P. (2012). Minority student shortage in science and technology. *The Hispanic Outlook in Higher Education Magazine*, 22(14), 8-9.
- McNatt, D. B. (2000). Ancient Pygmalion joins contemporary management: A meta-analysis of the result. *Journal of Applied Psychology*, 85(2), 314-322.



- Mensah, F. M. (2011). The Destin: Preservice teachers' drawings of the ideal elementary science teacher. *School Science and Mathematics, 111*(8), 379-388.
- Mensah, F. M. (2012). Retrospective accounts in the formation of an agenda for diversity, equity and social justice for science education. In J. A. Bianchini, V. L. Akerson, A. Calabrese Barton, O. Lee, & A. J. Rodriguez (Eds.), *Moving the equity agenda forward: Equity research, practice, and policy in science education* (pp. 317-336). New York, NY: Springer.
- Miller, K. R., & Levine, J. (2010). *Prentice Hall biology*. Upper Saddle River, NJ: Prentice Hall.
- Moniuszko, S., & Kelly, C. (2017, Month #). Harvey Weinstein scandal: A complete list of the 84 accusers. *USA Today*. Retrieved from <https://www.usatoday.com/story/life/people/2017/10/27/weinstein-scandal-complete-list-accusers/804663001/>
- Morrell, E. (2002). Towards a critical pedagogy of popular culture: Literacy development among urban youth. *Journal of Adolescence & Adults, 46*(1), 72-77.
- Morrell, E., & Duncan-Andrade, J. (2002). Toward a critical classroom discourse: Promoting academic literacy through engaging hip-hop culture with urban youth. *English Journal, 91*(6), 88-94.
- Morris, M. (2016). *Pushout: The criminalization of Black girls in schools*. New York, NY: The New Press,
- Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences, 109*(41), 16474-16479.
- Museus, S. D., Palmer, R. T., Davis, R. J., & Maramba, D. (2011). *Racial and ethnic minority student success in STEM education: ASHE higher education report*. Hoboken, NJ: Wiley & Sons.
- National Academy of Sciences, National Academy of Engineering, & Institute of Medicine. (2011). *Expanding underrepresented minority participation: America's science and technology talent at the crossroads*. Washington, DC: National Academies Press.
- NAS, NAE and IOM 2011
- National Center for Educational Statistics 2000
- National Center for PTSD. (2015). *Sexual assault against females*. Retrieved from [https://www.ptsd.va.gov/professional/trauma/other/sexual\\_assault\\_against\\_females.asp](https://www.ptsd.va.gov/professional/trauma/other/sexual_assault_against_females.asp)

- National Science Board. (2010). *Science and engineering indicators*. Arlington, VA: National Science Foundation.
- Neuman, S. (Producer) (2017, December 4). Billy Bush: 'Of course' it's Trump's voice on 'Access Hollywood' tape. *National Public Radio*. Retrieved from <https://www.npr.org/sections/thetwo-way/2017/12/04/568255700/billy-bush-of-course-its-trumps-voice-on-access-hollywood-tape>
- Nieto, S. (2010). *Language, culture, and teaching: Critical perspectives* (2nd ed.). New York, NY: Routledge.
- Noguera, P. (2003). *City schools and the American dream: Reclaiming the promise of public education*. (Vol. 17). New York, NY: Teachers College Press.
- Noonan, R. (2017). *Women in STEM: 2017 update (ESA issue brief #06-17)*. Retrieved from United States Department of Commerce, Economics and Statistics Administration. Office of the Chief Economist website: <https://www.esa.gov/reports/women-stem-2017-update>.
- Oakes, J., Lipton, M., Anderson, L., & Stillman, J. (2013). *Teaching to change the world* (4th ed.). New York, NY: Paradigm.
- O'Brien, V., Martinez-Pons, M., & Kopala, M. (1999). Mathematics self-efficacy, ethnic identity, gender, and career interests related to mathematics and science. *The Journal of Educational Research*, 92(4), 231-235.
- Ogbu, J. U. (1995). Understanding cultural diversity and learning. In J. A. Banks & C. A. M. Banks (Eds.), *Handbook of research on multicultural education* (pp. 582-593). New York, NY: Macmillan.
- Olneck, M. R. (1995). Immigrants and education. In J.A. Banks (Eds.), *Handbook of research on multicultural education* (pp. 310-327). San Francisco, CA: Jossey-Bass.
- Omolade, B. (1987). A Black feminist pedagogy. *Women's Studies Quarterly*, 15(3/4), 32-39.
- Osumare, H. (2007). *The Africanist aesthetic in global hip-hop: Power moves*. New York, NY: Springer.
- Owens. (1989). Ladies first [Recorded by Queen Latiffa]. On *All hail the Queen* [CD]. New York, NY: Tommy Boy Records. (October 1988 – September 1989).
- Palmer, P. J. (1997). The heart of a teacher identity and integrity in teaching. *Change: The Magazine of Higher Learning*, 29(6), 14-21.
- Palmer, P. J. (2017). *The courage to teach: Exploring the inner landscape of a teacher's life*. Hoboken, NJ: John Wiley & Sons.

- Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher*, 41(3), 93-97.
- Paris, D., & Alim, H. S. (2014). What are we seeking to sustain through culturally sustaining pedagogy? A loving critique forward. *Harvard Educational Review*, 84(1), 85-100.
- Peters, J. J. (1976). Children who are victims of sexual assault and the psychology of offenders. *American Journal of Psychotherapy*, 30, 398 – 421.
- Pintrich, P., Marx, R., & Boyle, R. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research*, 63(2), 167-199.
- Plummer, J. D., & Krajcik, J. (2010). Building a learning progression for celestial motion: Elementary levels from an earth-based perspective. *Journal of Research in Science Teaching*, 47(7), 768-787.
- Pollack, E. (2013, October 3). Why are there still so few women in science? *The New York Times*, Retrieved from <http://www.nytimes.com/2013/10/06/magazine/why-arethere-still-so-few-women-in-science.html>
- Prestes, C. R. D. S. (2013). *Feridas até o coração, erguem-se negras guerreiras. Resiliência em mulheres negras: transmissão psíquica e pertencimentos* [Wounds to the heart, rose black warriors. Resilience in black women: psychic transmission and belongings] (English translation here) (Published Doctoral dissertation).
- Prier, D. D. (2012). *Culturally relevant teaching: Hip-Hop pedagogy in urban schools. Counterpoints: Studies in the Postmodern Theory of Education. Volume 396*. New York, NY: Peter Lang.
- Pryor, J. H., Eagan, K., Blake, L. P., Hurtado, S., Berdan, J., & Case, M. H. (2012). *The American freshman: National norms fall 2012*. Retrieved from <https://www.heri.ucla.edu/monographs/TheAmericanFreshman2012-Expanded.pdf>
- Pusateri, N. (Producer), & Horwitz, A. (Director). (2016). *Hamilton's America* [Motion picture]. New York, NY: Public Broadcasting Service.
- Resick, P. A. (1990). Victims of sexual assault. In A. J. Lurigio, W. G. Skogan, & R. C. Davis (Eds.), *Victims of crime: Problems, policies, and programs* (pp. 69-86). Newbury Park, CA: Sage.
- Rich, A. (1994). *Blood, bread, and poetry: Selected prose 1979-1985*. New York, NY: WW Norton & Company.

- Roberts, D. E. (2004). The social and moral cost of mass incarceration in African American communities. *Stanford Law Review*, 56, 1271-1305.
- Rosa, K., & Mensah, F. M. (2016). Educational pathways of Black women physicists: Stories of experiencing and overcoming obstacles in life. *Physical Review Physics Education Research*, 12(2), 020113.
- Rose, T. (1994). *Black noise: Rap music and Black culture in contemporary America*. Middletown, CT: Wesleyan.
- Rosenbloom, J. L., Ash, R. A., Dupont, B., & Coder, L. (2008). Why are there so few women in information technology? Assessing the role of personality in career choices. *Journal of Economic Psychology*, 29(4), 543-554.
- Rosenthal, R., & Jacobson, L. (1968). Pygmalion in the classroom. *The Urban Review*, 3(1), 16-20.
- Rossi, A. S. (1965). Women in science: Why so few? *Science*, 148(3674), 1196-1202.
- Ryan, C. L., & Bauman, K. (2016). Educational Attainment in the United States: 2015. Population Characteristics. Current Population Reports. P20-578. *US Census Bureau*. Retrieved from <https://www.census.gov/content/dam/Census/library/publications/2016/demo/p20-578.pdf>
- Samson, L. (2017). *Buhle Ngaba on resilience, trusting herself and why it's time for Black women to flourish*. Retrieved from <http://www.designindaba.com/articles/creative-work/buhle-ngaba-resilience-trusting-herself-and-why-its-time-black-women-flourish>
- Sandoval, W. (2005). Understanding students' practical epistemologies and their influence on learning through inquiry. *Science Education*, 89, 634-656.
- Schreiner, C., & Sjøberg, S. (2007). Science education and youth's identity construction—Two incompatible projects? In D. Corrigan, J. Dillon, & R. Gunstone (Eds.), *The re-emergence of values in the science curriculum* (pp. 231 – 247). Rotterdam, The Netherlands: SensePublishers.
- Settlage, J., Southerland, S. A., Smith, L. K., & Ceglie, R. (2009). Constructing a doubt-free teaching self: Self-efficacy, teacher identity, and science instruction within diverse settings. *Journal of Research in Science Teaching*, 46(1), 102-125.
- Silverman, L. K. (1997). The construct of asynchronous development. *Peabody Journal of Education*, 72(3-4), 36-58.
- Sisk, R. (2010, September, 29). South Bronx is poorest district in nation, US Census Bureau finds: 38% live below poverty line. *New York Daily News*, p. 29. Retrieved from

- <http://www.nydailynews.com/new-york/south-bronx-poorest-district-nation-u-s-census-bureau-finds-38-live-poverty-line-article-1.438344>
- Smith, J., James, R., & Williams, M. (1990). Around the way girl [Recorded by LL Cool J]. On *Mama said knock you out* [cassette, vinyl]. New York City, NY: Def Jam Recordings.
- Smith-Evans, L., George, J., Graves, F. G., Kaufmann, L. S., & Frohlich, L. (2014). *Unlocking opportunity for African American girls: A call to action for educational equity*. Washington, DC: National Women's Law Center.
- Souza, N. S. (1990). *Tornar-se negro, ou, As vicissitudes da identidade do negro brasileiro em ascensão social [To become black, or, the vicissitudes of the identity of the Brazilian negro in social ascension]* (2nd edition). Rio de Janeiro, Brazil: Graal.
- Stelloh, T., & Connor, T. (2015). *Video shows cop slamming high school girl in S.C. classroom*. Retrieved from <http://www.nbcnews.com/news/us-news/video-appears-show-cop-body-slamming-student-s-c-classroom-n451896>
- Sternberg, R. J. (2007). Who are the bright children? The cultural context of being and acting intelligent. *Educational Researcher*, 36(3), 148-155.
- Svokos, A. (2014). *Neil deGrasse Tyson sums up exactly why there are so few Black scientists*. *Mic Network Inc*. Retrieved from <https://mic.com/articles/88057/neil-degrasse-tyson-sum-up-exactly-why-there-are-so-few-black-scientists#vznCTKo0r>
- Tait, E. V. (Producer). (2006, December, 19). Kurtis Blow, worshipping through hip-hop [Audio podcast]. Washington, DC: National Public Radio. Retrieved from <https://www.npr.org/templates/story/story.php?storyId=6646367>
- Takaki, R. (2012). *A different mirror: A history of multicultural America* (rev. ed.). Boston, Massachusetts: Little, Brown and Company.
- Tate, W. F. (1995). Returning to the root: A culturally relevant approach to mathematics pedagogy. *Theory Into Practice*, 34(3), 166-173.
- Taylor, A. (2018). Photos of women's march weekend. *The Atlantic*. Retrieved from <https://www.theatlantic.com/photo/2018/01/photos-of-a-womens-march-weekend/551141/>
- Terrassier, J. C. (1981). The negative Pygmalion effect. *Gifted children: Challenging their potential: New Perspectives and Alternatives*, 82-84. New York, NY: Trillium.
- Thomas, D. (2015, September, 09). Why everyone's saying 'Black girls are magic.' *Los Angeles Times*. Retrieved from <http://www.latimes.com/nation/nationnow/la-na-nn-everyones-saying-black-girls-are-magic-20150909-htmstory.html>

- Tobin, K. G. (1993). *The practice of constructivism in science education*. Park Drive, United Kingdom: Psychology Press.
- Turner, C. S. V. (2002). Women of color in academe: Living with multiple marginality. *The Journal of Higher Education*, 73(1), 74-93.
- Tyson, E. H. (2002). Hip hop therapy: An exploratory study of a rap music intervention with at-risk and delinquent youth. *Journal of Poetry Therapy*, 15(3), 131-144.
- United States Department of Education, National Center for Education Statistics. (1990). *A profile of the American eighth-grader: NELS:88 student descriptive summary*. Washington, DC: Hafner, A..
- United States Department of Education, Office of Civil Rights Data Collection. (2012). *Gender equity in education: A data snapshot*. Washington, DC: Author.
- Valentine, K. (2012). *Closing the pay gap in STEM fields starts with education*. Retrieved from <https://www.americanprogress.org/issues/general/news/2012/10/26/43242/closing-the-pay-gap-in-stem-fields-starts-with-education/>
- Vygotsky, L. S. (1981). The genesis of higher mental functions. In J. V Wertsch (Ed.), *The concept of activity in Soviet psychology* (pp. 144- 188). Armonk, NY: Sharpe.
- Wages, M. (2014). *Engaging the Hispanic Learner: Ten Strategies for Using Culture to Increase Achievement*. New York, NY: Rowman & Littlefield.
- Walker, T. (2015, December, 30). Bill Cosby: The rise and fall of America's dad. *Independent*. Retrieved from <http://www.independent.co.uk/news/people/bill-cosby-the-rise-and-fall-of-america-s-dad-a6791381.html>
- Washington, J. (2011, October, 25). *STEM education and jobs: Declining numbers of Blacks seen in math, science*. Retrieved from [http://www.huffingtonpost.com/2011/10/24/stem-education-and-jobs-d\\_n\\_1028998.html](http://www.huffingtonpost.com/2011/10/24/stem-education-and-jobs-d_n_1028998.html)
- Williams, F. B. (1995, January, 13). How rap music got its bad rap: Violence: Experts blame the change in the genre partly on newer performers' lifestyles. *Los Angeles Times*. Retrieved from [http://articles.latimes.com/1995-01-13/local/me-19713\\_1\\_bad-rap](http://articles.latimes.com/1995-01-13/local/me-19713_1_bad-rap)
- Wilson, J. (2016, January, 13). *The meaning of #BlackGirlMagic and how you can get some*. Retrieved from [https://www.huffingtonpost.com/entry/what-is-black-girl-magic-video\\_us\\_5694dad4e4b086bc1cd517f4](https://www.huffingtonpost.com/entry/what-is-black-girl-magic-video_us_5694dad4e4b086bc1cd517f4)
- Wlodkowski, R. J., & Ginsberg, M. B. (1995). A framework for culturally responsive teaching. *Educational Leadership*, 53(1), 17-21.

Zacharek, S., Dockterman, E., & Edwards, H. S. (2017, December, 18). Person of the year: The silence breakers. *Time*. Retrieved from <http://time.com/time-person-of-the-year-2017-silence-breakers/>

Zuckerman, H. (2001). The careers of men and women scientists: Gender differences in career attainment. In M. Wyer (Ed.), *Women, science, and technology: A reader in feminist science studies* (pp. 69-78). Abingdon, United Kingdom: Routledge.

Appendix A

Use of Hip-Hop in Science Education Questionnaire

Directions: Check one answer for each question.

1. I enjoy learning science

Strongly agree  Agree  Neutral  Disagree  Strongly Disagree

2. Hip-hop is my favorite type of music

Strongly agree  Agree  Neutral  Disagree  Strongly Disagree

3. I like hip-hop culture

Strongly agree  Agree  Neutral  Disagree  Strongly Disagree

4. I can rap in science

Strongly agree  Agree  Neutral  Disagree  Strongly Disagree

5. Please elaborate on your answers to the above questions:

---

---

---

---



## Appendix B

### Sample Interview Questions

1. How do you feel about learning science? Do you think it's important?
2. How are you doing in your current science class?
3. What can teachers do to encourage more students to do better in science?
4. For as far back as you can remember, do you think that boys are expected to achieve better in school over girls?
5. What about in science? Do you think that any of your science teachers encouraged the boys over the girls?
6. What about your family members, were the boys encouraged more than the girls?
7. What instances or examples justify your viewpoint?
8. Have you had a science teacher who was sexist?
9. Did you believe you could exert yourself against the teacher?
10. Did you exert yourself? Explain (What did you do specifically?).
11. Since participating in the Science Genius program, has there been a change in your outlook toward science? School? Social outlook due to performing in front of a crowd?
12. Do you feel more confident doing science since your participation? In what way?
13. What do plan to do in college or after high school?
14. How do you feel about using hip-hop to promote science knowledge?
15. What would you tell people about the Science Genius program?