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## A Multi-Level Discourse Analysis of African American, Middle School Girls? Science Identity Development

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This dissertation, A MULTI-LEVEL DISCOURSE ANALYSIS OF AFRICAN AMERICAN, MIDDLE SCHOOL GIRLS' SCIENCE IDENTITY DEVELOPMENT, by KATHERINE WADE, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education and Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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# A MULTI-LEVEL DISCOURSE ANALYSIS OF AFRICAN AMERICAN, MIDDLE SCHOOL GIRLS' SCIENCE IDENTITY DEVELOPMENT

by

KATHERINE WADE

Under the Direction of Dr. Renee Schwartz

This research argues that the lack of African American women in science careers is the result of a nuanced and complicated process and can only be adequately addressed through consideration of multiple levels of discourse. Specifically, a better understanding of macro level discourses that are present in and circulated through schools and work to position African American girls in ways that are outside of science learning is necessary. This research used a critical ethnographic approach to explore the science experiences of African American middle school girls. Data were collected on the macro (school wide), meso (classroom and after school program), and micro (individual) level. Critical discourse analysis was used to explore what macro-level discourses were circulated at the school, how these discourses impacted the seventh grade science class and after school program, and how individual students negotiated these discourses. Results indicated that the privileged Discourses (identities) in the classroom actually worked to position students outside of science and that a focus on accountability, control, and order, with a lack of discourses of authentic engagement in science, led to students equating a science person with a good student.

INDEX WORDS: Science education, Race, Gender

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## 1. THE PROBLEM

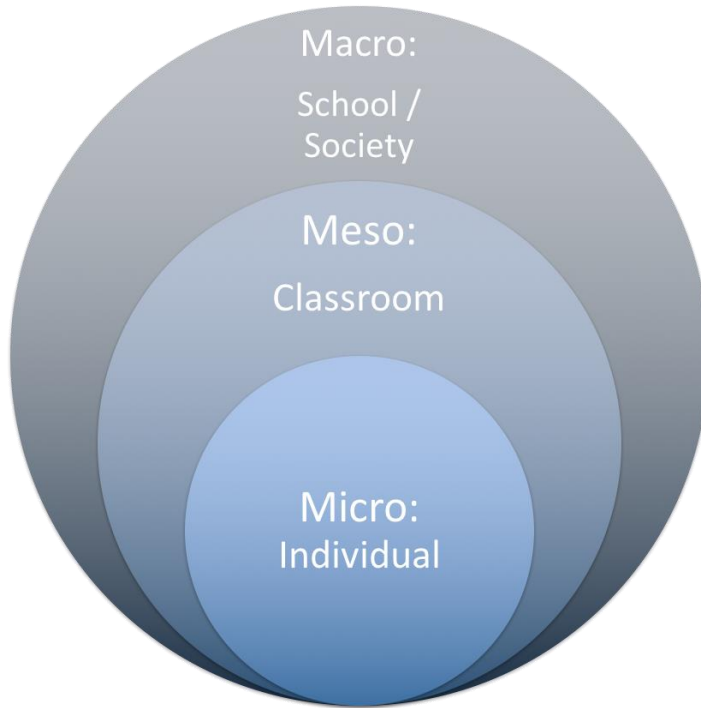
### Background

Historically, women and people of color have held fewer jobs and pursued fewer degrees in science and engineering than males and White people (Lewis, 2003; National Science Foundation, 2014; Powell, 1990). Women of color are particularly underrepresented in science and engineering fields. According to a National Science Foundation (NSF) report, in 2012, African American women accounted for 6.6% of the adult population (18-65) in the U.S., but only earned 3% of the doctoral degrees in science and engineering fields (NSF, 2014). Additionally, women are outnumbered 2 to 1 in science and engineering jobs, with African American women only holding 2% of those jobs. By contrast, over 50% of science and engineering jobs are held by white men (NSF, 2014). These statistics are particularly alarming considering African American middle school girls express high levels of engagement and interest in, as well as knowledge about, science, but do not express interest in pursuing science-related careers (Hanson, 2008; Olitsky, Flohr, Gardner, & Billups, 2010). Although research has focused on increasing exposure to science, for example in the form of after school clubs (Gonsalves, 2011; Rahm, 2014) or creating new spaces and ways of engaging in science (Seiler, 2001), the underrepresentation of African American women in science persists. Because science, including science learning, is situated in specific social and cultural contexts, it is necessary to explore the impact of these contexts, and the discourses circulating within them, on science education to fully understand why African American women are pursuing science careers at such low rates.

## The Role of Discourse

This research illustrates a particular need to consider the larger societal forces that may be working to position African American women as non-scientists, as well as the ways those forces impact schools, classrooms, and students. This entails an examination of multiple levels of discourse (Figure 1). Two separate, but interrelated, definitions of discourse are used in this research to describe both macro and micro levels of discourse, which are connected through a meso level. Each level, and the connections between, are described below.

**Multi-Level discourse.** At the macro-level, societal ideologies about education, science, race, and gender are circulated in schools and position students in specific ways. At the meso-level, these discourses influence the types of people that are privileged and marginalized in school classrooms and out of school time science spaces. At the micro-level, individual students must negotiate the macro-level discourses as well as their positioning as certain types of people in classrooms and out of school time programs. More details on each level of discourse follow.



*Figure 1.* Embedded nature of multiple layers of discourse.

*Macro-Level discourse.* Based on Foucault’s (1976) notion of discourses as rules and conventions that control what one can say or know (i.e., the discursive practices of education frame who can be considered a student), in U.S. society, African American women are not congruent with discourses surrounding who can be a scientist. Judith Butler (1994) describes these discourses as not merely theoretical constructs, but “fully embedded organizing principles of material practices and institutional arrangements” (p.42). In particular, Butler highlights the role of “exclusion and differentiation” (p. 45) in creating a subject and argues that a subject is not simply placed into any given context, but the cultural context of the subject is part of the subject’s formation.

Previous research has shown the influence of discourses of race and femininity in education. These discourses are based on middle class, white standards that define appropriate women as nice, polite, quiet, and passive (West & Zimmerman, 1987). For example, Renold

(2006) examined high achieving girls and identified tension between the roles of “being bright” and “doing girl” (p. 460). In this work, teachers were more likely to recognize a “being nice” (p. 462) as a good student, particularly when the student was working class and non-white. Even for girls who are trying to position themselves as feminine and clever, both teachers and peers often undermined their efforts, describing the girls as bossy, selfish, or arrogant. This tension is amplified when focusing specifically on African American girls, who, when compared to the middle class, white discourses of femininity, are viewed as too loud or aggressive to be proper women and, therefore, cannot be viewed as proper students. For example, Fordham (1993) describes how African American high school girls must “learn silence” (p. 14) in order to be taken seriously as students. Morris (2007) shows how African American female students are encouraged to be more feminine, or lady-like, at the expense of academic achievement. The teachers in this study described the students as being too loud and wearing inappropriate clothing and sought to control the bodies of these students, encouraging them to be more quiet, passive learners. Morris points out that many of the teachers in this study were African American females, but were from a different social class than the students, suggesting that the teachers may have seen importance in helping the girls learn social skills or overcome stereotypes to better compete in a middle-class, white world. Youdell (2003) also examined how institutional discourses of ability and race, examined through the “minutia of everyday life in schools” (p. 5), created “identity traps” for students: students who successfully developed African American youth / street culture identities were seen as anti-school. In the study, teachers and staff of the school saw African American bodies as needing additional surveillance and bodily control.

These discourses of race, gender, and education are circulating simultaneously alongside discourses of science and science education (or STEM education – Science, Technology,

Engineering, and Math) within schools. Bazzul (2012) warns that teachers should “never assume that we can talk about science and science education outside of ideology” (p. 15). In addition to the traditional discourse of science as an elite, specialized field (Aikenhead, 1996; Lemke, 1990), recent research has focused on the role of neoliberalism in science education. Tobin (2011) describes a neoliberal framework as focusing on private property rights, free markets, and free trade. For example, Tobin (2011) examines how the discourse of neoliberalism, in particular the role of accountability, which is evident in school structures such as teacher evaluations and standardized testing, controls students’ uses of both space and time, presumably to improve academic achievement (i.e., test scores). Tobin notes how this has led to “scant evidence of inquiry about the science” in science classes, as “most students expressed a preference to know and memorize facts rather than ask and answer questions” (p. 11). Tobin also argues that neoliberal emphasis on control and accountability has led to disciplinary solutions for education, seen most dramatically in the focus on discipline and punishment in low-income schools with students of color.

*Micro-level Discourses.* At the micro level, individuals perform and recognize ways of being particular types of people in specific contexts, i.e., different identities. This performance and recognition is related to macro level discourses because those discourses control the combinations of being, doing, and saying that are recognized as indicating a certain type of person in a given context. Gee (2001) refers to these combinations as big-D Discourse (little-d discourses, part of big-D Discourse, refers specifically to language in Gee’s framework). A Discourse is defined as a characteristic set of actions, including ways of being and talking, that an individual would engage in to be recognized as a specific identity. For example, to indicate

an identity as a student, an individual might use a textbook, take notes, study, and pay attention in class. This combination is then recognizable to the teacher as the identity of a student.

*Meso-level discourses.* The macro- and micro-levels of D/discourse are mediated through the meso level of figured worlds. Gee (2014b) refers to figured worlds as cultural models that support specific Discourses. Holland, Lachicotte, Skinner, and Cain (1998) describe a figured world as a “realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). For Gee, figured worlds, also referred to as cultural models, are simplified versions of the world that define what combinations of Discourses are recognized as legitimate identities and which are marginalized in specific contexts. For example, the cultural models of school and school science in a given context, which are influenced by macro level discourses, define who can be seen as a “good student” or a “good scientist.” Research has examined how students participate in various ways in different figured worlds, including the figured worlds of school science (Calabrese Barton, 2009), as well as how positioning in figured worlds can impact identity development (Cook, 2014) and whether students are marginalized from science (Gonsalves, 2013). The interplay of multiple figured worlds has also been examined, such as how figured worlds of school, science, and family impact students’ scientific identities (Carlone, Scott, & Lowder, 2014) and how participation in different figured worlds offers multiple ways for students to position themselves (Barton & Tan, 2010).

In this research, the term discourses (with a lower case d) is used to refer to macro level ideologies that position students in specific ways. The term Discourses (with an upper case D) is used to refer to the combinations of saying, doing, and being that are used to indicate, and be

recognized as, certain “types” of people; i.e., Discourses are used to perform and recognize specific identities.

### **Statement of the Problem**

Although research that explicitly discusses how macro level discourses impact African American girls in science education is limited, there is research that investigates the positioning of African American girls, by their teachers, their peers, and themselves, in science and mathematics. Pringle, Brkich, Adams, West-Olatunii, and Archer-Banks (2012) examined how teachers positioned African American girls in math and science classes and found that a focus on standardized testing and managing behavior led to a lack of rigor, disconnections with students’ lives, and teachers knowingly choosing teaching methods that were not pedagogically sound. The authors connected this to positioning of the students by the teachers, who did not see the African American girls as students who could or would pursue math and science careers. Brickhouse, Lowery, and Schultz (2000) and Brickhouse and Potter (2001) also found that positioning by teachers and school structures, as well as student agency, were important in whether African American girls saw themselves as the type of students who could do science, and whether they pursued scientific trajectories into high school. Olitsky et al. (2010) examined student agency and school structures and found that classroom and school discourses created obstacles to science identity development for some students. In particular, a “smart student” (p. 1217) discourse, connected to race through segregated and unequally resourced elementary schools, worked to marginalize middle school, African American girls from science.

West-Olatunji et al. (2008) examined how African American girls positioned themselves as science and mathematics learners, and found that while the students were aware of their positions, parents and educators were not aware of the impact of how they positioned students

relative to science and mathematics learning. In examining a mathematics classroom, Gholson and Martin (2014) found that positioning by other students in the class had more of an impact on African American girls' learning than did positioning by the teacher. In particular, the girls' positioning by their peers as smart girls, Black girls<sup>1</sup>, mean girls, and bullies largely determined whether they had "inbound" or "outbound" trajectories in the community of the classroom.

There are several areas that need further exploration in this area. First, although there are many studies that explore the experiences of girls in science classes and out of school programs, including examining identity development, there is minimal research focused on African American girls. As Atwater (2000) points out, the norm for science education research around girls focuses on white girls. Even in studies that include non-white populations, participants from different ethnic and racial backgrounds are often viewed as one homogeneous group, with no attention given to the unique sociohistorical considerations of ethnicity and race. Mutegi (2013) calls this "invisibility literature," which avoids issues of race by labeling students as "urban" or "underserved" (p. 85). As Mutegi explains, "by mischaracterizing the population of African Americans as "urban," issues unique and salient to African Americans are masked. They are rendered invisible" (p. 86). Pinder and Blackwell (2014) argue that research is needed to explore how African American girls uniquely construct meaning from their perspective, focusing on the daily interactions and experiences that shape identity development, particularly for younger students as early experiences with science play a crucial role in scientific identity development throughout the school years.

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<sup>1</sup> The term African American is primarily used in this work to refer to individuals of African descent living in the United States, based on the preference of the participants. In a few instances, the term Black is used when referencing other work that used this term.

Additionally, few studies have examined how these experiences are shaped by macro-level educational structures. In particular, the intersection of and interplay between the discourses of education, race, gender, and science have yet to be considered. More information on how these discourses work to position individuals as particular kinds of students is needed, as well as how these macro-level discourses are perpetuated through meso- and micro-level processes. Gee (2000) suggests that the macro processes of identity formation be examined through asking:

What institution or institutions, or which group or groups of people, work to construct and sustain a given Discourse – that is, work to ensure that a certain combination, at a given time and place, is recognized as coming from a certain kind of person? (p. 211)

Additionally, the role of micro level process on identity formation should also be addressed by asking:

How, on the grounds of moment-by-moment interaction, does recognition work such that some specific combination is recognized (or not) in a certain way, or contested or negotiated over in a certain way? (Gee, 2000, p. 211)

This research seeks to address the identified gaps of a lack of research that focuses on African American girls' experiences in science and the need to examine the impact of multiple levels of D/discourse in education. In particular, it explores how multiple levels of D/discourse work to position African American girls in unique ways in science.

The purpose of this research is to identify the ways in which macro-level educational, scientific, and race and gender based discourses are circulated through schools and impact science classrooms and other science spaces. It is also to explore how African American, middle

school girls ascribe to, resist, or negotiate these discourses. This research is guided by an overarching research question and three sub-questions:

How do multiple levels of discourse impact African American, middle school girls' science identity development?

1. Macro-Level: What are the macro-level educational, scientific, and gender and racial discourses circulated at an all-girls, primarily African American middle school?
2. Meso-Level: How do these discourses impact the figured worlds of science at the school and in an after school science club?
3. Micro-Level: How do students ascribe to, resist, and negotiate these Discourses in different contexts (i.e., classrooms, informal spaces, after school)?

### **Theoretical Framework**

This research is based on the assumption that the macro-level discourses that influence science and education are inherently unjust and intertwined with racist and sexist discourses. For this reason, a combined framework of Critical Race Theory (CRT) and Black Feminism was used. As Ladson-Billings (1998) explains, CRT provides tools for the, “deconstruction of oppressive discourses” and tasks researchers with, “unmasking and exposing racism in its various permutations” (p. 17). CRT is used in this research to deconstruct oppressive discourses of science and education and expose racism inherent in the positioning of students in science. Black feminism argues that the major systems of oppression, including race, class, and gender, are interlocking and lead to the unique positioning of African American women (COMBAHEE). Both frameworks are described in detail below.

**Critical Race Theory.** Critical Race Theory (CRT) evolved from Critical Legal Studies (Delgado, 1988) and an analysis of the role of race in law (Delgado & Stefancic, 1991). Delgado and Stefancic (1993) defined 10 themes of Critical Race thought: critique of liberalism, storytelling, critique of civil rights law, consideration of the basis of race and racism, the role of structures in maintaining the status quo, the intersection of race, sex, and class, essentialism/anti-

essentialism, cultural nationalism and separatism, representation of people of color in law, and criticisms of previous work. Many of these themes are reflected in Critical Race Theory, which is based on the belief that race is the most significant factor in inequality in U.S. Society and includes several assumptions about race and identity (Strayhorn & Johnson, 2015). Identity is viewed as socially constructed through discursive practices that both shape and constrain identity in inequitable ways. CRT also assumes identity is experienced in inequitable ways, particularly by different races. Institutions, practices, and policies are complicit in how individuals are subjected to these inequalities. CRT is therefore conceptualized as a social and intellectual tool for “deconstruction of oppressive structures and discourses, reconstruction of human agency, and construction of equitable and socially just relations of power” (Ladson-Billings, 1998, p. 9).

Ladson-Billings (1995), who introduced CRT to educational research, argued that examinations of class and gender were not enough to explain inequality and that race had to be centered in any examination of inequality in U.S. society. One of the central propositions of CRT is that U.S. society is based on property rights, not human rights, and whiteness can be viewed as the ultimate property. This is because possession of whiteness confers certain privileges and rights, including, importantly, the right to exclude. This highlights another proposition of CRT, that although race is a social construct, its effect is real and damaging (Strayhorn & Johnson, 2015). Ladson-Billings and Tate (1995) further argued that the voice of oppressed people is critical to understanding oppression, which is referred to as “counter storytelling,” or speaking against dominant narratives of society. Finally, CRT also maintains that civil rights are only advanced when there is some type of interest convergence – when a given advancement is just as, or more, beneficial to whites as it is to people of color (Ladson-Billings, 1998).

Five tenets of CRT were used to guide this research: permanence of racism, centrality of experience, commitment to social justice, challenge of ahistoricism, challenge of dominant ideologies (Delgado, 1995). CRT views racism as a natural and permanent feature of U.S. society, it is not aberrant or unusual, and it permeates all aspects of society. CRT is seen as an analytic tool to unmask and expose this racism (Ladson Billings, 1998). In challenging dominant ideologies, and in particular is a critique of liberal and neoliberal ideals, CRT counters ideals of colorblindness and post-racialism. CRT scholars also argue that liberalism has no true mechanism for social change. In addition to challenging ideologies, CRT challenges ahistoricism – the notion that one can ignore the affects of history in an analysis of present circumstances. For example, CRT views the “achievement gap” between white students and students of color as the expected outcome of unjust but intentional educational policies and practices (Taylor, Gillborn, & Ladson-Billings, 2009). CRT also centers the experiences of oppressed populations, which is seen in the use of storytelling and personal narratives. Ladson-Billings (1998) argues that there are three benefits of this focus on the voice of the oppressed: it highlights the idea that reality is socially constructed; it allows for “psychic self-preservation” (p. 13) through the sharing and legitimizing of oppressive experiences, which can help in healing the self-condemnation many oppressed people feel; and being exposed to alternative perspectives can help overcome the ethnocentrism of the oppressors. Ladson Billings argues that the voice of the oppressed is necessary in order to gain a deep understanding of systems of oppression. From an analytical perspective, Strayhorn and Johnson (2015) purport that researchers need the experience and perspectives of the oppressed to make sense of data. Finally, CRT maintains a commitment to social justice. Ladson-Billings and Tate (1995) indicate that this is one of the primary ways that CRT differs from previous multicultural approaches to educational research.

While multiculturalism calls for appreciation of difference, CRT is a radical critique of the status quo, including actions to promote change.

**Black Feminism.** Arising partly as a response to perceived racism in the second wave feminism of the 1960's, which was viewed to represent white women's struggles as universal without consideration for differences among women, Black Feminism views the major systems of oppression as interlocking and argues that, "The synthesis of these oppressions creates the conditions of our lives" (Combahee River Collective, 1977). These interlocking oppressions create a unique life situation for African American women.

Black Feminism supports an intersectional approach to analysis of social problems. Kimberle Crenshaw (1989) explains that using a single axis, i.e., only race or only gender, distorts the experiences of African American women in particular, and that considering the interaction between race and gender provides a more useful analytical structure. She argues, "Any analysis that does not take intersectionality into account cannot sufficiently address the particular manner in which Black women are subordinated" (Crenshaw, 1989, p. 140). Furthermore, it is not enough to simply consider the additive properties of gender and race discrimination; the specific experiences of African American women are a unique phenomenon that cannot be deconstructed into separate oppressions. Patricia Hill Collins (1991) also argues that African American women experience a unique form of oppression, different from that of African American men or White women, who experience their own unique oppressions. In particular, Collins (1991) describes unique portrayals of African American women through stereotypes or controlling images that serve to justify their oppression. These controlling images are, "Designed to make racism, sexism, poverty, and other forms of social injustice appear to be natural, normal, and inevitable part of everyday life" (p. 77). Collins (1991) describes four

controlling images: the mammy, or the nice, submissive woman; the matriarch, the strong, assertive woman; the welfare mother, the poor woman reliant on assistance; and the jezebel, the sexually deviant woman. These images are externally applied to African American women to control and dehumanize them. Collins (1991) argues that African American women need to be able to internally self-define in order to escape this control.

More recently, Black feminist researchers such as Brittney Cooper (2015) caution against oversimplifying the identities of African American women, suggesting that simply identifying controlling images in today's society has the danger of leading to a "culture of justification" (p.7). As researchers, we need to move beyond the process of identification to expose the limitations on African American women's lives that occur as a result of the persistence of controlling images. Cooper (2015, 2016) also argues that today, intersectionality should be viewed not just as an account of personal identity but as a power structure. This means that instead of exploring race, class, and gender, we need to first understand racism, classism, and sexism. As Cooper, Morris, and Boylorn (2017) state, "Who we are is not simply located within us, it is also located around us" (p. 250), arguing that African American women are "routinely negotiating who they know and believe themselves to be with the ascribed identity cast on them by outsiders and bystanders" (p. 250). Cooper et al. (2017) argue that although African American women are in new terrain now, with increased empowerment and visibility, they face the same discrimination and the labels previously defined by Collins (1991) and others are still relevant, just expanded in the 21<sup>st</sup> century. This research seeks to both identify the use of controlling images in science education and to examine how these images are used to position African American women outside of science.

**Combined Framework.** The research presented here is based on the belief that the experience of African American girls is unique and inequitable, compared to their white and/or male counterparts. Mutegi (2013) argues that there is a need for “a research agenda that accounts for the sociocultural construction of race in explaining African American underrepresentation specifically and African American science education generally” (p. 84). The five tenets of CRT, as well as consideration of intersectionality, was especially useful for framing this research. The centrality of the participants’ race, and its intersection with gender (Collins, 1991), guided the research. Data collection focused on understanding African American girls’ experiences, and their descriptions of their experiences, which provided counternarratives to dominant depictions of science classrooms and controlling images of African American girls. However, Strayhorn and Johnson (2015) argue that not all stories from oppressed people are “counter-stories” and highlights the need to critically examine these stories by using the other tenets of CRT. In particular, the experiences of the participants were viewed as the results of inherently racist educational discourses, reflected in meso level structures and policies perpetuated through school and classroom figured worlds and the Discourses they enable and constrain. On a macro level, CRT allows one to challenge dominant ideologies leading to Discourses of “good students” and “good science students,” which may be portrayed as colorblind but in fact serve to marginalize African American girls from authentic science participation. Finally, CRT’s commitment to social justice was also attended to as this research sought not just to expose racist educational structures, but also to develop ways to support students’ resistance of these structures as well as to imagine new ways to improvise science identities.

### **Significance**

There is a need for research that focuses specifically on the experiences of African American girls. This is of utmost importance to understand why African American girls are not pursuing science careers. Research focusing only on micro level interventions, such as after school programs, has been shown to have limited or short-term impacts only (Gonsalves, 2011; Rahm, 2008). It is clear that a multi-level analysis is needed to understand the larger societal discourses that impact African American girls science experiences by positioning them as non-scientists. It is equally important to understand how these discourses are perpetuated through school and classroom structures. Lee and Anderson (2009) argue, “We need thicker descriptions of how students are sorted as certain kinds of people and where they learn to make choices about their identities. Thus, we need more in-depth study of everyday lives in schools that illustrate the nuanced contexts and consequences of identity negotiation for learning in their complex environments” (p. 204). This research significantly adds to the understanding of how African American girls are “sorted” into, and out of, science.

In practice, this study also has significant implications for teachers and schools. As research has shown, teachers and other educators are unaware of the impact of their views of students on the students’ future educational and career choices. Many well-intentioned teachers and schools are inadvertently positioning African American girls in ways that marginalize them from science because of a lack of awareness of the societal forces that impact the students’ lives, as well as the role of teachers and schools in perpetuating or, potentially, resisting those forces.

## 2. REVIEW OF THE LITERATURE

Frameworks of identity and scientific identity development have been used in various ways to understand the experiences of students in science classrooms as well as to explore how students come to see themselves as a “science person,” which is believed to be a necessary step to pursuing science in future educational and career trajectories. This is particularly important for populations who been underrepresented in scientific careers; for example, African American girls are likely to report a high level of interest and engagement in science during middle school, but are unlikely to want to pursue science as a career (Hanson, 2008). This research argues that identity development should be understood on multiple levels: the macro level or ideological discourses that define who can be recognized as a certain type of person; the meso level or structural forces that circulate and maintain the macro level discourses; and the micro level or individual interactions and experiences through which individuals position themselves in specific ways in response to the macro and meso levels, performing certain identities. In particular, this research seeks to understand how macro level discourses of education, science, race, and gender influence the Discourses (or combinations of saying, doing, and being certain types of people) that are privileged and disprivileged, i.e., not recognized or recognized in negative ways (punishment) in science classrooms. It also seeks to explore how African American, middle schools ascribe to, resist, or negotiate the Discourses of the science classroom.

### **Identity**

Identity has been used in many contexts in sometimes vague and undefined ways. In education research, identity is generally conceptualized as having two principal components, performance and recognition (Gee, 2001). In addition to these components, the role of agency and power is often included in conceptualizations of identity. This section will synthesize

relevant and commonly used theories of identity and present a working conception of scientific identity.

The first component of identity, performance, indicates that one must engage in actions that are representative of an identity or type of person. Lave and Wenger (1991) refer to this as participation in authentic activities representative of a given community of practice. For example, a student engaged in a classroom community of practice, would participate in authentic activities of that community, such as taking notes, reading a textbook, and completing typical assignments. By participating in these activities, i.e., “performing” the identity of a student, an individual gradually learns what being a student means and adopts the “master identity” of a student. Holland et al. (1998) build on this conceptualization of identity building through communities of practice to describe “identity-in-practice.” An identity-in-practice is formed through participation not in communities of practice, but in figured worlds. While a community of practice generally implies a community in which learning and adopting given master identities is the primary goal, a figured world is a more nebulous “realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). While Holland et. al. compare figured worlds to communities of practice, they stress the importance of power in determining who is entitled to, as well as disqualified from, a specific identity in a given figured world. For example, a classroom can be considered a figured world where certain ways of being a student are recognized, such as raising one’s hand to speak in class, and others are not, such as calling out answers. Gee (2001) also highlights the importance of performance and participation in developing identities, describing how certain combinations of saying and doing (i.e., language, gestures, clothing, etc.) are recognized in certain ways, i.e., signify certain identities. Gee refers

to the recognition of these performative combinations as Discourses; the Discourse of a student might include wearing a school uniform, raising one's hand to speak, and using non-vernacular forms of English.

The second component of identity is that of recognition. It is not enough for a person to engage in the performance of an identity, it has to be recognized by others as representing that identity as well. Lave and Wenger (1991) refer to this recognition as the legitimacy of the type of participation that individuals have in communities of practice. To be legitimate, the activities need to be authentic to the community and recognized as such by both community members and outsiders in order for a master identity to develop. Holland et al. (1998) refer to a similar type of recognition in their conception of figured worlds; the rules of a figured world determine who can and cannot be recognized as a given identity. They discuss the role of positionality and how power, status, and relative privilege are negotiated within figured worlds to determine the distinction between acceptable and unacceptable identities. Gee (2000) also includes recognition with the concept of figured worlds, arguing that recognition within a figured world is the key to identity development.

Finally, the role of agency is also discussed in most theories of identity. Although Lave and Wenger (1991) acknowledge the sociocultural context of communities of practice, recognizing the role of power to limit some individuals' participation in communities of practice either through access to resources or legitimation of the individual's participation, they do not address or describe this process in detail. This creates no means for new types of identities, those not already conceptualized in a community of practice, to be produced. Holland et al. (1998) argue that the role of individual agency in identity development is not given enough attention when there is too great a focus on social constraints. Holland et. al. argue that identities

are authored through an ongoing process of improvisation, where both culture and subject positioning impact individual's actions and identity development. Improvisation occurs when one uses the resources available to them, in a given figured world, to achieve a specific goal that might not be assumed possible in that figured world. For example, in the figured world of a classroom, it might not seem possible for an individual who calls out answers instead of raising their hand to be recognized as a good student. However, that student might use other resources, such as intelligence, charm, or humor, to both call out answers and gain recognition from the teacher as a good student. Gee (2000, 2001) also focuses on the macro level processes that construct and sustain given Discourses as indicative of specific identities, as well as the micro level interactions through which certain combinations are recognized, contested, and negotiated. Similar to Holland et. al.'s improvisation, which can lead to the recognition of new identities for individuals, this negotiation process can also, in time, lead to the recognition of new Discourses on a macro level. Carlone, Johnson, and Scott (2015) refer to this as the agency – structure dialectic, and demonstrate how agency is, influenced by structures, which can, in turn, be changed and shapes by the actions of individuals and groups.

In this study, the performance and recognition aspects of identity, as well as the interplay between structure and agency, are considered important; however, it is also important to consider the larger societal forces, i.e., the macro level or ideological discourses, that are often unnoticed and unquestioned but still define who and what things are considered significant in society.

### **Scientific Identity**

Using the conceptions of identity described above, a scientific identity can be defined as being recognized as a “science person” through full participation in a scientific community of practice where one develops a scientific identity by engaging in authentic scientific activities to

learn and use scientific Discourse. Although “authentic scientific activities” can be interpreted in many ways, in this work the scientific and engineering practices detailed in the Next Generation Science Standards (NGSS Lead States, 2013) are considered to be indicators of authentic engagement in scientific activity. The scientific and engineering practices listed in the NGSS include: asking questions/ defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations/ designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information.

Carlone and Johnson (2007) developed a model for scientific identity based on Gee’s conception of identity and Discourse. Their model includes performance, recognition by meaningful others, and competence; they argue that all three are necessary to be a “science person.” They also argue that scientific identities (which can be understood as socially situated identities) are influenced by racial, ethnic, and gender identities (core identities). Because of the cultural production of identities, and the macro level discourses defining how individuals should perform certain identities, including what it means to be a “science person,” a woman, or a person of color, certain identities are not available to certain people because of conflict created between identities; for example, a woman of color may perform a science identity and may be scientifically competent, but unless they gain recognition from meaningful others (i.e., other scientists, potential employers), they cannot fully develop a scientific identity. Viewed another way, an individual’s figured world of science may only include white males as prototypical scientists, marginalizing women of color and preventing them from developing science identities. A description of the ideals that create a figured world of science, and therefore detail who can be recognized as a “science person” are detailed in the first section.

## **Criteria and Organization**

This review focuses on the recent research on science identity in science classrooms. Although the focus of this study is on the multiple levels of discourse (and the Discourses) that influence middle school, African American girls, there is no research that specifically focuses on this topic. As such, this review focuses on three related areas. First, it explores literature describing the culture and discourse (and Discourse) of science and how it marginalizes specific groups of students. The next section considers out of school science experiences that aim to support science identity development for marginalized populations. The final section examines the in-school science identity development of marginalized populations, and is divided into three sub sections: middle school students of color, middle school girls, and middle school, African American girls. Although the term African American is used in this study (based on participant preference), in this review of literature, the terminology selected by the authors of each study are used.

### **Section 1: Marginalization of Students through the Culture and Discourse of Science**

Many researchers have argued that science should be thought of as its own culture, with its own rules, language, and practices – i.e., its own Discourses or combinations that are recognized as being a scientist. Aikenhead (1996) discusses how when students enter a science classroom, they are in essence border crossing from one culture (a personal or home culture) to another (the culture of science). Meyer and Crawford (2011) also adopt this analogy, referring to learning science as cross cultural education that is “laden with cultural understandings, interpretations, and a language of its own” and describing the science classroom as a “borderland of cultural interaction” (p. 531). However, these researchers often privilege the culture of

science over home cultures, viewing home culture as an obstacle to overcome in science class. Aikenhead and Jegede (1999) explain it as, “whenever pupils enter the world of school science, it soon becomes evident that science too is another culture with which s/he has to interact, bringing with him/her the other baggage of cultures s/he already carries” (p. 45).

This section first describes the culture of science, including macro level discourses of what science is and looks like, and the Discourses (combinations of saying, being, and doing) that are privileged by this culture. It then examines how the culture of science intersects with personal and cultural Discourses in ways that create tension and limit scientific identity development as well as ways that could support scientific identity development.

### **Culture of Science**

Although the NRC (1996) states that science is practiced by many cultures, science itself is often presented as not influenced by these cultures and as “culture-less” itself Lemke (1990). For example, the National Science Education Standards define science as a “Science is a way of knowing that is characterized by empirical criteria, logical argument, and skeptical review” (National Research Council, 1996, p. 21), and do not mention any non-objective components of practicing science. Focusing on scientific practices as objective ignores the cultural values and beliefs that have impacted science throughout history as well as presently.

Despite the common perception of science, research has recognized that science can be viewed as distinct culture (e.g., Cobern & Aikenhead, 1996; Maddock, 1981). Aikenhead (1996) describes the culture of science as a well defined system of meanings and symbols that became institutionalized in Europe in the 17<sup>th</sup> century as a predominantly white, male, middle class system, referred to today as Western Modern Science (WMS). He summarizes the cultural features of WMS as being “mechanistic, materialistic, masculine, reductionistic, mathematically

idealized, pragmatic, empirical, exploitive, elitist, ideological, inquisitive, objective, impersonal, rational, universal, decontextualized, communal, violent, value-free, and embracing disinterestedness, suspension of belief, and parsimony” (1996, p. 9). Aikenhead argues that the goal of traditional science instruction is cultural assimilation of WMS, which leads to a culture of school science that perpetuates stereotypic images of science as “socially sterile, authoritarian, non-humanistic, positivistic, and absolute truth” (1996, p. 9).

Lemke (1990) also describes the discourse of school science as the view that science is a powerful and specialized way of talking about the world, which he refers to as the “mystique” of science. This mystique includes myths like science is much more complex and difficult than other subjects, science is in conflict with common sense, and scientists are superhuman elites. Lemke argues that these myths are perpetuated through the unwritten rules of science taught in science classrooms. Scientific knowledge is often presented as if there were one right way to know the world, where people disappear as actors. Science then becomes a description of the way the world is as opposed to the views of humans trying to make sense of the world. This discourse is perpetuated in science classrooms through the use of abstract, decontextualized, technical language. Emotion, values, and humor are all left out of scientific language, which is presented as serious and dignified. Another discourse that Lemke identifies is the authoritative and difficult nature of science, conveyed through objective, special truths that are only available to select experts. Students are taught not to trust their common sense ability to figure things out and instead rely on knowledge conveyed through textbooks and other authorities. Like Aikenhead (1996), Lemke argues that the discourse of school science is defined by white, male, middle class, native English speakers who are committed to the values of middle class culture: emotional control, orderliness, rationalism, achievement, punctuality, and social hierarchy. This

perception of science is so prevalent in society that it can be considered an ideological or macro level discourse that is circulated through school and other educational structures. This discourse serves to influence what combinations of saying, doing, or being, i.e., what Discourses, are recognized as a “scientist” or “science student” in society.

### **Intersection of Science and Personal/Cultural Identities**

Both Lemke (1990) and Aikenhead (1996) argue that the culture of WMS and school science are often foreign to students and conflict with their other subcultures, such as family or peer cultures. Because of this, Aikenhead argues that all students must cross borders when they enter science classrooms. However, it is easier for students who are already familiar with the discourses of WMS and school science (i.e., white, male, middle class students) to make this crossing. Meyer and Crawford (2011) also adopt this analogy, referring to learning science as cross cultural education that is “laden with cultural understandings, interpretations, and a language of its own” and describing the science classroom as a “borderland of cultural interaction” (p. 531).

Recent research has shown that minority students and females are often unable or unwilling to cross this border and therefore are excluded from the culture of science. Despite both populations having high interest in science during school, both women and minorities are less likely than white males to pursue science as a career, indicating that because the culture of science is foreign to them, it is difficult to participate in it fully and develop a scientific identity. Archer, Dewitt, and Osborne (2015) demonstrated that Black students and parents in the UK are less likely than white students and parents to consider scientific careers as “thinkable” options, indicating that science identities are not forming for these students. For these students, a figured world of science does not include people who look or act like them as scientists; they are unable

or unwilling to engage in the Discourses that would lead to a scientific identity. Many of the macro level discourses of science described above were found to be influential in parents' and students' views of science. Black students and parents had narrow, stereotypical conceptions of scientists as wearing white lab coats and goggles, images that were incompatible with students' views of themselves. Additionally, Black parents and students were more likely to see science as particularly difficult and only for very intelligent, sometimes geeky, students. Black parents were also more likely to see science as a white, masculine undertaking, describing daughters as "girly girls" who were not as likely to be interested in science. Archer et al. (2015) also point out that Black families have less "science capital" than white families, i.e., they are less likely to have access to scientific activities outside of school.

Using Gee's framework of Discourse and identity, other research has focused specifically on tensions between the culture of science and science identities and students' personal or social identities within classrooms. Brown (2004) showed that African American students experienced cultural conflict in science classrooms, recognizing that there was a stigma and cost to engaging in scientific Discourse. Even when students were struggling to acquire scientific content knowledge, they resisted engaging in scientific Discourses. Students demonstrated resistance to scientific Discourse by withholding knowledge, refusing to participate in activities or discussions in class even when they had valuable, scientific contributions to make. Yerrick and Gilbert (2011) also found tension between scientific and cultural Discourses for lower track, minority students. In this study, the role of the teacher and "implicit science curriculum," i.e., macro level discourses of science, perpetuating low expectations and little real participation in scientific practices, are cited as reasons for students' marginalization from science identities.

Recent research has also examined how various Discourses can be used together to enhance students' learning instead of creating tension. Also using Gee's framework, Moje, Collazo, Carrillo, and Marx (2001) examined the conflict between teacher and student Discourses in a science classroom, suggesting students need an opportunity to merge scientific and popular Discourses productively. In later work, Moje et al. (2004) investigated how students use personal funds of knowledge, i.e., personal Discourses, in science. The authors found that while students were using family, community, peer, and popular culture funds of knowledge and Discourses, they were doing so privately and their use was not leveraged in the classroom. The authors suggest that creating hybrid spaces where students are encouraged to access multiple Discourses is necessary to support scientific Discourse use and, therefore, identity development. Using the same framework, Ramnarain and de Beer (2013), examined how participation in a science expo allowed high school students in South Africa to use science and non-science identities to select topics and work on science projects. For example, a student with an identity of an "activist" chose to do a project on HIV and a student with an identity of "environmentalist" chose a project about water availability. Although all of these studies referenced Gee's theory of Discourse and identity, the focus was largely on language use, not the other aspects of Discourses that indicate identities, and no consideration was given to macro level discourses that impact recognition of specific scientific Discourses.

Other research has examined on a micro level how students can merge Discourses or switch between Discourses on a micro level. Kamberelis and Wehunt (2012) call this discursive hybridity, and examined how students appropriated and redeployed various Discourses in a science classroom. Examining two white, male student who described as alienated from the classroom, the authors showed how the students merged popular culture Discourses with

scientific Discourses to gain acceptance into the class. In a similar study, Charteris (2014) examined how students enact hybrid discourses to create identity and agency in science classrooms. In this study of Maori students in New Zealand, the author identified three Discourses that were recognized in the science classroom: the teacher's science classroom Discourse, participatory Discourse, and teenage counterscript. However, despite the use of Gee's definition of Discourses as encompassing ALL ways of saying, doing, and being, this study focused primarily on language use. Additionally, although both of these studies are valuable for their focus on micro-level Discourse use, neither focuses explicitly on the role of cultural Discourses.

### **Areas for Future Research**

Considering science as a unique culture, and identifying the macro level discourses that are circulated as part of this culture, demonstrates the conflicts as well as potential that exist when other cultures intersect with the culture of science. This is particularly relevant when considering identity development through practice and recognition. It is obvious from the studies reviewed here that conflict exists between school science Discourse and students' personal or cultural Discourses. Each study gives clear examples of how student Discourse is not valued in science classrooms, either purposefully (i.e., Yerrick & Gilbert, 2011) or accidentally (i.e., Moje et al., 2001), leading to students feeling marginalized and alienated from science.

However, even when explicitly using Gee's definition of Discourse as combinations of saying, doing, and being, the studies presented here focus on Discourse mainly as language. Attention to other forms of Discourse would provide a more complete picture of how students develop and enact identities. Additionally, none of these studies use an explicitly critical view,

or critique of the macro level discourses influence science classrooms, which would help explain why certain Discourses are privileged or disprivileged.

Another interesting gap in this literature is the voice of the student. These studies could be stronger if the participants were allowed to comment on their own words and actions. The studies presented here privilege the researcher's voice and interpretation of the students' experiences. A richer picture could be painted if the participants were asked to comment their own experiences and Discourse use in science.

## **Section 2: Identity Focused OST Science Programs**

Out of School Time (OST) science programs are programs that occur outside of regular school hours, i.e., after school or during the summer, that aim to support or enhance classroom science learning. Although the focus of many of these programs is content or skill acquisition, others are focused on identity building and providing multiple ways for students to engage in science, particularly for populations that have been marginalized from science. These programs are generally designed around Lave and Wenger's (1991) model of communities of practice, stressing the importance of multiple ways of participating and being recognized in science

Most of the identity focused OST programs considered here are also situated in a critical theoretical framework: they assume that certain populations have been marginalized from science learning based on race and/or gender, and view this marginalization as a result of inherently biased structures in society and education (e.g., Basu and Calabrese Barton, 2007; Seiler, 2001). One purpose of these OST programs is to provide opportunities for marginalized students to engage in authentic science activities and develop science identities that are not available to them in the classroom. In other words, these programs are providing spaces for students to challenge and negotiate traditional science discourses.

This section summarizes recent research on identity-focused OST science programs. First, it describes the design of these programs, including the goals, curriculum, participants, and learning environments. Next, it summarizes the results of the programs, as reported in the literature. Finally, it highlights limitations of these programs and suggests areas for improvement through future research.

### **Program Design**

**Goals.** Instead of content knowledge, the goal of identify focused OST science programs is to re-imagine science as a more inclusive space, often focusing on participation and identity. Hughes, Nzekwe, and Molyneaux (2013) argue that trends in OST STEM programs have evolved as researchers realize that “competency does not equal identity and access does not equal persistence” (p. 1982). Hughes et al. (2013) argue that improving access to science does not equate to challenging the underlying structures preventing marginalized groups from persisting in science. Several of the studies considered here explicitly address the role of power, viewing the goal of OST science programs as providing spaces to question existing power structures Adams and Gupta (2013) or “reverse the power structure of the school, which has been oppressive to African American students” (Seiler, 2001, p. 1001). For identity focused OST programs the goal is to create spaces where participants’ own views and experiences are valued in order to foster sustained scientific interest and identities (Basu & Barton, 2007; Eisenhart, 2008; Rahm, 2008; Rahm & Moore, 2016).

**Participants.** Because of the focus on disrupting the existing power structure in science and providing spaces to legitimize non-dominant ways of knowing science, identity focused OST science programs are developed for specific populations that have traditionally been marginalized from science; i.e, women (Eisenhart, 2008; Gonsalves, 2014; Hughes et al., 2013);

students of color (Adams & Gupta, 2013; Basu & Barton, 2007; Hargrave, 2015; Vakil, 2014); or women of color (Davis, 2002; Rahm, 2008; Rahm, 2012). Participants in these programs were generally volunteers who had an interest in science before beginning the program (Adams & Gupta, 2013; Basu & Barton, 2007; Rahm, 2012). In some cases, participants also were high achieving students (Basu & Barton, 2007; Rahm, 2012). One exception to this was an after school program established by Eisenhart and Edwards (2004), where participants were volunteers but not necessarily interested in science; many of the participants were persuaded to attend the program by their mothers or friends and many participants had low grades. Something similar was seen by Rahm, Martel Reny, and Moore (2005) where friends of participants, who did not have a strong interest in science, were invited to attend an after school program.

**Curriculum.** Unlike the content focused programs, the identity focused programs generally did not start with pre-determined activities. Instead, student and community interests were used as the basis for program content, with researchers designing the program explicitly placing an emphasis on the funds of knowledge of the communities of the participants as part of the design for the OST program. For example, in an after school program for girls in a low-income area, researchers first spent months getting to know potential participants, their families, and their community in order to find out what was of interest and important to the local community (Eisenhart, 2008; Eisenhart & Edwards, 2004). The after school program they developed focused on technology and digital resources, which was identified repeatedly as important to the community, through activities of interest to the participants, such as graphic design and printing t-shirts. In a similar approach, Gonsalves (2013) first joined an existing after school program for a semester to learn about the participants and their interests. Activities were planned based on what was observed and discussed in the first semester, leading to the

participants creating their own documentaries of science topics they identified as important. As researchers collected field notes during the program, they used those notes to plan what would happen the next week. Seiler (2001) started a science lunch club for African American young men and also used their interests as starting points for discussion and investigation. The format of the club was flexible, with students bringing up topics of interest to them and the group discussing how science related to the topic. The planning for the club was conducted jointly between the researcher / teacher and the participants as they kept a running list of topics to consider and decided when and how to explore them.

Some identify focused OST science programs began with more structured plans, but still stressed the importance of youth voice and control over the program. For example, (Basu & Barton, 2007) developed an after school program with a theme of invention and exploration and presented students with several project ideas, such as reverse engineering, natural dyes, bacteria, or student films, but allowed student to retain control over their own work and projects. Rahm (2008) also stressed the importance of participants having control over their work as they engaged in science fair projects in an after school program. In an after school program for app development, Vakil (2014) highlighted the importance of listening deeply to participants and getting to know their interests as part of the implementation of the program, allowing students to chose to explore sociopolitical issues that impact their own lives.

**Learning Environment.** Identity focused OST science programs also included hands-on, student centered activities, described, for instance, as inquiry based (Vakil, 2014), and science as practice (Rahm, 2008). However, an important addition to these programs is the view that knowledge is socially constructed through communities of practice. In the identity focused OST programs, students were able to participate peripherally, i.e., in different ways with

different levels of engagement, and their activities were legitimated within and outside of the community, i.e., the results of the program activities were presented to other community members as well as to outsiders. For example, Rahm (2008) describes the importance of “science as practice” (p. 116) as it helps participants’ identity work and sociocultural positioning as scientists, arguing that it is important to “produce, not just consume” science (p. 118). In this program, the production of science fair projects represents peripheral participation in the community of science, as students have multiple ways to participate, while the presentation of those projects to other members of the community as well as outsiders offered legitimation of the scientific activities. Vakil (2014) also allowed multiple pathways for participation in the app development (i.e., research, code-writing, marketing) while situating the activities in the real world context of the participants’ lives. The final app was presented to the larger community as a useful, working product, legitimating the participants’ participation in the community of practice. The after school program described by Eisenhart (2008) and Eisenhart and Edwards (2004) also allowed students to participate in multiple ways, as well as in multiple contexts. For example, one participant used the skills learned in the after school program to create a multi-media presentation to convince her grandmother to allow her to get a pet turtle. The students’ work was legitimated as she shared her presentation with other after school participants as well as with her grandmother.

***Third/Hybrid spaces.*** A common theme in the description of the learning environments of identity focused OST science programs was the development of hybrid or third spaces, based on Bhabha’s (1994) post colonial description of cultural hybridity where identities are formed in in-between spaces called third spaces:

These “in-between” spaces provide the terrain for elaborating strategies of selfhood – singular or communal – that initiate new signs of identity, and innovative sites of collaboration, and contestation, in the act of defining the idea of society itself. (Bhabha, 1994, p. 2)

This concept has been applied to education to describe students’ identity forming process when their cultural and personal resources intersect and interact with school resources (Moje et al., 2004). Many of the researchers considering identity focused OST science programs present them as natural and important places where third spaces are formed, supporting students’ hybrid identity development. For example, Basu and Calabrese Barton (2007) describe an after school program as a third space because it is the location of the intersection of students’ science experiences and funds of knowledge. They argue that both types of knowledge are integral and relevant to learning and, in the after school space, participants are empowered to draw on both without privileging one over the other. Eisenhart and Edwards (2004) argue that a third space develops when participants appropriate science knowledge to accomplish their own goals, i.e., using knowledge of animals as well as technological skills to create a multimedia presentation to convince a grandmother to get a new pet. Rahm et al. (2005) also acknowledges youth appropriation of scientific resources as an important piece of the development of third spaces, which she argues shapes the participants’ identity work. In order for students in the after school program to participate more fully in science, they had to develop hybrid identities where home and school selves were not in tension with each other, shaped by the existence of the third space created in the after school program. Finally, Gonsalves (2013) described the after school program as a “de facto hybrid space” (p. 1072), where participants were expected to draw on experiences from multiple contexts (i.e., school, home, community) in order to make sense of the

world. In all of these studies, the OST science program was seen as unique in its role as both a science space and a youth space, and researchers valued and used that hybridity to support students' learning and identity work.

## **Results**

All of the identity focused studies described new types of communities of science and new ways for participation in science, as discussed above. For example, Seiler (2001) described the science lunch club as a “community that would allow science to emerge from and respond to students' lives” (p. 1002). Several important themes were noted across the results of these studies. The role of relationships in forming these communities was highlighted in most studies. Eisenhart (2008) describes how different interactions can develop in an after school program than in a classroom and Rahm et. al. (2014) described the respect for participants and supportive relationships formed in the after school program as crucial to participants' identity development. Some researchers also underscored the importance of respectful teacher student relationships as crucial to emancipatory education (e.g., Seiler, 2001; Vakil, 2014), which they viewed as a goal of their OST science programs.

Multiple studies also reported positive science identity building (Adams and Gupta, 2013; Gonsalves, 2013; Rahm 2012; Rahm, et. al., 2014) and engagement with science (Gonsalves, 2014; Seiler, 2001) as a result of participation in the OST science programs. However, results on the impact of the programs in other contexts were mixed. Rahm (2008) found that some students were able to maintain hybrid identities developed after school in school settings, but only if they were recognized and legitimated by outsiders. Basu and Calabrese Barton (2007) found that sustained interest in science developed in the after school program only if students could connect it to their visions of the future and felt they had agency. The transition from after school to

school science was also noted by several researchers as an obstacle. Although Adams and Gupta (2013) demonstrated that student participants in an after school museum program were able to access identities developed in the program during school, Gonsalves (2014) indicated that any positive emotional agency around science that students developed in the after school program did not cross over to school spaces because of the tension participants felt between everyday science and school science. She argues that not only are the students' science identities not legitimated in the science class, the hybrid spaces created in after school programs are not sustainable if they do nothing to disrupt the hegemony of traditional school science (Gonsalves, 2013). Similarly, Rahm (2008) demonstrated that although students identified with science during the OST program, they distanced themselves from school science.

### **Areas for Future Research**

These identity focused OST science programs successfully created and supported new types of spaces for traditionally marginalized students to engage in scientific communities of practice. However, participants in the identity focused OST science programs were largely voluntary. With one exception (Eisenhart, 2013), the students were generally predisposed to science and already good students, indicating that science identity formation could be possible with or without the OST science program. Additional research with students not already predisposed to science or successful at school is needed. As discussed above, several researchers specifically noted that the OST science programs were unlikely to impact participants' experiences with school science. The studies presented here were not able to work with classroom teachers or schools, which is an important step to legitimate and build on students' identity development in OST science programs in school spaces.

Additionally, although many of these programs reflected communities of practice, in order to be a true *scientific* community of practice, more intentional focus around scientific practices is needed. To develop master identities as scientists, participants need opportunities for engagement in and access to authentic scientific activity (Lave and Wenger, 1991). This was evident in some of the programs described, for example when students completed science fair projects (Rahm, 2008), but most programs either did not describe students engaging in any practices (i.e., Adams and Gupta, 2013) or focused on technological practices but not scientific ones (i.e., Eisenhart, 2008; Rahm 2012). Although technological practices are important, this would create a technology community of practice, and would be unlikely to impact students' science identity. Additionally, without an explicit focus on authentic scientific activities, there is the risk of creating an interstitial community of practice (Lave and Wenger, 1991), kept at a distance from an authentic science community of practice, that will only continue to limit participants' options for scientific identities.

Finally, although these studies focused on populations marginalized from science, they rarely considered the intersection of race, gender, and socioeconomic status, instead considering groups of heterogeneous students as having the same experiences. For example, OST science programs for girls did not differentiate among different races (i.e., Eisenhart, 2004; Rahm, 2012). Jayaratne, Thomas, and Trautmann (2003) found that, in mixed-race OST science programs, minority females were likely to report less positive experiences with the programs, and indicated that global features of the programs might be to blame. Taking an intersectional approach to developing programs that support the unique challenges of specific groups of marginalized students could help support the identity development of those groups.

### **Section 3: Science Identity Development of Students of Color And Females In Science Classrooms**

This section summarizes recent research on scientific identity development for students of color and females, specifically during the middle school years. The middle school years have been identified as an important period for many students when engagement and interest in science wane, particularly for girls and students of color (e.g., Catsambis, 1995; Hanson, 2008). Although the focus of this research is African American girls, few studies met this criteria. As such, the review below first presents research on scientific identity development in middle school students of color, then middle school girls, including middle school girls of color, and finally on African American, middle school girls. All of the studies examine, to varying extents, how social identities of gender and/or race interact with scientific identity development, in positive and negative ways, using the frameworks of identity described above.

#### **Middle School Students of Color**

This first section summarizes research that focuses on middle school students of color and their identity development in science classrooms. Both boys and girls are considered in these studies, which generally focus on ways teachers impact students' identity development.

Barton and Tan (2009) use the frameworks of both Lave and Wenger (1991) and Gee (2000) to identify the funds of knowledge students bring to school and how they are leveraged in a middle school science unit on food and nutrition. Although the study was initially planned with four girls as student co-planners, a fifth, male student was also included and the results included data from the entire class. The races of the co-planners or the students referenced in paper are not given, but the school is described as predominantly African American and Hispanic. This study focuses on the students' participatory learning as a way to engage in

scientific Discourse and identity building; in particular, the student co-planners, along with the researchers and teachers, plan class activities that are designed to leverage students funds of knowledge. Like Moje et al. (2004), they are interested in hybrid spaces where students' cultural experiences are valued along with scientific knowledge. Students were observed using family, community, peer, and popular culture funds of knowledge and Discourses during the activities. Using Lave and Wenger's community of practice framework, the researchers argue that this created new ways for students to engage in the community of practice in the classroom (and therefore new ways to learn and develop master identities) that would not have been possible without this hybrid space.

Using Holland et al.'s (1998) framework of identities-in-practice, Carlone et al. (2014) followed three students (one boy from El Salvador, one white girl, and one African American girl) as they transitioned from fourth to sixth grade science classes to explore the interaction between their social identities and scientific identities. Carlone et al. (2014) describe each classroom as different versions of school science figured worlds, with different norms and positionings. They found that so long as students' social identities were well-aligned with the "celebrated subjected positions" of the classroom, established and recognized by the teacher, they meshed well with scientific identities. In the fourth grade classroom, the teacher valued students who demonstrated scientific traits such as curiosity and approached science learning through inquiry oriented activities, which meshed well with all three students social identities, positioning all of the participants as strong scientists. The sixth grade teacher, however, valued more traditional, gendered, "good student" identities, where students were not expected to ask thoughtful questions and class assignments were predominantly worksheets. While the white, girl student was able to mesh her social identity to the new celebrated position (although in

problematic ways, such as feigning helplessness to gain the attention of the teacher), the Salvedoreño and African American girl could not fit into the white, masculine norms of this classroom. Because of the “good student” Discourse of the sixth grade figured world, all three students were less likely to identify with science, either seeing themselves or being seen by others as good science students, in sixth grade compared to fourth grade.

These studies demonstrate how students of color are constrained by “good student” Discourses, influenced by macro level discourses that define what a “good student” or “good scientist” looks or acts like. The importance of the figured world of the classroom is apparent; when that figured world includes multiple ways of practicing science, and authentic science practices are recognized and legitimated, more students are able to develop scientific identities. When the only celebrated position is that of a “good student,” defined in narrow and gendered and racialized ways, more students are marginalized from developing science identities. As suggested by Moje et al. (2004), the importance of spaces that allow for multiple types of Discourses to interact, creating new ways to be a “good science student” is evident.

### **Middle School Girls**

An abundance of research has focused on the scientific identity development and achievement of girls in general, particularly focusing on the positioning of girls into feminized “good student” identities. In these studies, girls are generally treated as a homogeneous group, with little attention given to differences of race and ethnicity. This section begins with recent research about middle school girls’ scientific identity development (with no distinction between different races or ethnicities) and then presents research that includes girls with varied backgrounds.

In one series of articles, Archer et al. (2010, 2012) and DeWitt, Archer, and Osborne (2012) looked at a cross section of students in and around London over a five-year time frame (from age 10 – 14). They found that as young as 10, students held gendered views of science, and although all students enjoyed “doing” science, girls were less likely to see science as a potential career, i.e., less likely to see themselves “being” a scientist (Archer et al., 2010). Archer et al. (2012) found that science identities more often aligned to typical masculine identities, such as being dangerous, and were in tension with typical feminine identities; both boys and girls stated that girls wouldn’t make good scientists. In addition to gendered educational discourses, macro level discourses of science as hard, only for naturally smart people, and uncool were prevalent and further constrained the science identities. When the researchers examined a subset of the sample that consisted of girls who did want to be scientists (Archer et al., 2012), they found that some girls carefully balanced a science identity with a heterofeminized identity of restraint, popularity, and well-roundedness (i.e., science was only one part of their identity), allowing them to be seen as both feminine and scientific. Most girls, however, were described (by themselves and their parents) as geeky, non-girly, and although not one sided, interested primarily in academic pursuits. The authors point out that both groups of girls represented middle class discourses of femininity, with no indication of overlap with working class or minority identities.

Tan (2008a, 2008b) also examined individual girls’ scientific identity development. Using Gee’s (2001) framework, Tan (2008a) trace one Dominican girls’ identity in science class over the course of her sixth grade year. They demonstrate that she goes from nonparticipation, i.e., passing or not answering teacher’s questions, at the beginning of the year to full participation in class activities by the end of the year. Although there is little evidence to support the claim that a *scientific* identity developed, the girl is shown as participating fully in the

community of practice and figured world of the science classroom. In the same classroom, Tan and Calabrese Barton (2008b) use a framework of identities-in-practice, communities of practice, and figured worlds to explore two Latina students improvise identities that allow them to combine social identities with scientific identities-in-practice, successfully merging different figured worlds. For example, one girl merged a pop culture identity with a science identity by re-writing lyrics to a popular song to reflect science content. In both papers, the authors recognize the importance of the teacher in positioning the girls as science experts, like Holland et al. (1998), and they also stress the importance of the girls' agency in creating new identities through engaging in tasks that weren't specifically assigned by the teacher, but macro level discourses are not addressed in this research.

In the same classroom as above, Barton, Tan, and Rivet (2008) further explore the ways in which the middle school girls merge science practices and different types of knowledges. They argue that through both sanctioned and unsanctioned use of scientific resources and identities, the girls are able to position themselves as legitimate participants in the science classroom community of practice. This occurs through the creation of signature science artifacts, such as the song described above, playing with identities during class presentations and other activities, for instance taking on the role of a scientist while presenting to the class, and negotiating classroom roles through strategic participation in certain activities. These merged practices, or newly negotiated scientific Discourses, can function to transform the community of practice, allowing the girls to circumvent the norms of the community of practice that might have been disengaging or silencing.

Drawing also on the combined framework of identities-in-practice, communities of practice, and figured worlds, Tan, Calabrese Barton, Kang, and O'Neill (2013) explore what they

call the “science identity gap,” the difference between girls’ overall interest in science, technology, engineering, and math (STEM) and interest in STEM related careers. They examine sixteen girls’ (white, Asian, and African American) identity work across school, after school, and home contexts to see how their identities-in-practice change in response to participation in different figured worlds. They found that girls’ narrated scientific identities, how they described themselves, and embodied identities, how they performed scientific identities, could fall into four categories: partial overlap, significant overlap, contrasting overlap, and transformative. The categories differed in how the girls saw themselves and were recognized by their teachers as well as how well the relationship between the narrated and performed identities could support future scientific identity development. The significant overlap category fit the description of the macro level “good student” discourse, but the authors suggest it is unlikely to sustain an interest in science as the girls were framed as consumers of science rather than producers. The partial overlap and transformative categories were likely to create sustained interest in science because the girls were more likely to pursue outside of school science opportunities that created a reinforcing cycle between the narrated and embodied identities. When the overlap between identities conflicted, the girls usually didn’t fit “good girl” discourses, and so were marginalized from school science, however, they did see the importance of science in problem solving and understanding the world outside of school.

These studies demonstrate that intersecting discourses of education, gender, and science prevent many girls from seeing themselves as scientists. They also demonstrate the tension between a gendered “good student” Discourse, i.e., the ways girls have to perform to be recognized as a good student, and authentic engagement in scientific practices. As with the studies in the previous section, it is important to have spaces, both in and out of school, where

social, cultural, and scientific Discourses are all valued and students can use resources for each to improvise new ways to be a “good science student.” However, these studies treat all girls as relatively homogeneous, ignoring differences in the experiences and histories of girls from different ethnicities and races.

### **Middle School, African American Girls**

Few studies focused specifically on identity development in middle school, African American girls. Out of the four studies considered here, all participants are African American girls, but the extent to which the girls’ specific identities as African American girls considered as unique and important varies.

Brickhouse et al. (2000) focused on four African American girls, highlighting the importance of the girls’ multiple social identities. Using Holland et al. (1998) conception of identity-in-practice, Brickhouse et al. (2000) examined both the students’ individual agency as well as the societal structures that position the girls within the figured worlds of school science. In examining how the girls’ social identities interacted with science identities, they found that school structures, related to macro level educational discourses that encourage policies such as tracking, support good student identities more than students’ personal experiences. For example, the two students who had significant interest in science and social identities of leaders and problem solvers were not positioned as good students by the teacher and tracked into lower level science classes. The two students who were obedient and engaged, even when the class wasn’t hands on or interactive, were positioned by the teacher as good science students and recommended for honors level science class. Because the curriculum didn’t allow multiple ways for the girls to engage in science, such as inquiry type activities, and deep understanding of the content was not valued by the teacher, the authors suggest that the girls encouraged through the

structures of the school to pursue science through, for example, honors classes may not actually develop a sustaining interest in science that is hinted at in the other girls.

In a separate study, Brickhouse and Potter (2001) examine two African American girls' identity development through science community of practices as they transition from middle school, where they were positioned as strong science students, to a computer science based high school. Although both girls are African American, one is from an urban neighborhood and the other a suburban neighborhood. The authors argue that the urban identity is marginalized in the science community of practice of the school, making it difficult for that student to develop a science identity. The student, and her parents, state that she is out of place and invisible in her all-white science classroom and her teacher positions her as a student who is not good in science. Additionally, as suggested by the previous article, although the student has a strong "good student" identity, quiet, passive, and asking few questions, this identity hindered the development of a computer science identity, as it limited her participation in a computer science community of practice. The suburban student, on the other hand, had previously developed a computer science identity through participation in computer science activities outside of school and was able to leverage this identity in the community of practice of the classroom.

Calabrese Barton et al. (2012) examine the identity work of two African American girls in middle school. They use a framework of communities of practice and figured worlds to develop identity trajectories for each girl, highlighting the "ongoing, cumulative, contentious nature of identity work" (p. 37). This study attempts to explore this identity work over both time and space: the time is the years of middle school and the spaces include school, after school, and home spaces. Through these trajectories, the authors show how identity work in science is not a linear or constant process, with the girls demonstrating increasing and decreasing interest in

science over time and also in different contexts. They also show that when the girls' identity work is recognized and supported, the girls are more likely to see themselves in science in the future. The importance of science experiences in out of school time places, particularly those experiences that allowed the girls to engage in scientific practices, is also highlighted, including the extent to which the girls could leverage those experiences in other spaces, such as the classroom. For one girl, the resources she accessed and developed in an after school space were sanctioned by her teacher in the classroom, who allowed her to present a science video she had created in the after school program to her science class, supporting her science identity work. However, the second girl did not have a chance to develop resources in the lunchtime science program she attended. Although the program was specifically for girls, it became almost exclusively white girls; the research participant quit attending the program so that she could see her African American friends, who were not in the same high-level classes she was, during lunch. This girl had to choose between a social identity, which is racialized due to the segregated nature of the school she attends, and a scientific identity.

In the last study, Olitsky et al. (2010) examine the relationship between agency and structure in science identity development for four African American girls. In particular, they highlight the ways in which classroom and school figured worlds create obstacles to science identity development, causing students who are interested and knowledgeable about science to discount it as a future career. The authors found that the school, which was a competitive magnet school, had a dominant "smart student" Discourse, with "smart students" being naturally gifted, completing all tasks quickly and easily. Because the school administrators and teachers continually referred to the school as only for "smart students", and only a narrow combination of ways of saying, doing and being was recognized as "smart," students who did not fit those norms

hesitated to participate fully in science and develop scientific identities. For example, in the classroom, only students with the “smart” label contributed to classroom discussions and students who weren’t positioned as “smart students” not only didn’t contribute in class, they did not take advantage of resources such as peer tutoring because it would signal they weren’t “naturally smart.” Additionally, students were more likely to trust the answers of a “smart student” than their own work, even when they were correct. The authors argue that this prevented a true community of practice from developing, as new comers to the community are less likely to participate and true negotiation of knowledge is not occurring. The authors also demonstrate that because the smart label is applied to students as early as their first tests in the middle school, students from highly-resourced schools who have a strong science background are more likely to be labeled “smart students.” Because these schools are also predominantly white, and the students from the predominantly African American schools did not receive the same background in science, white students dominated the “smart student” label, reinforcing macro level racial discourses of who can be viewed as “smart.”

In these studies focusing specifically on African American girls, the importance of having multiple ways to participate and be recognized in science is again apparent. In particular, the role of out of school science experiences is highlighted as these programs have the potential to create new spaces where multiple ways of doing science are legitimized, which is particularly important when legitimization this doesn’t happen in classroom. Unlike the previous sections, the papers in this section also point to the structural obstacles to science identity development created by schools and classrooms, and highlight the importance of examining the racial histories and impacts of these structures specifically on African American girls.

The studies reviewed here demonstrate the importance of figured worlds of science created in and outside of school for all middle school populations, and particularly African American girls. These figured worlds often contain racialized and gendered views of who can be a scientist, as well as conflating Discourses of “good student” with “good scientist;” i.e., the combination of characteristics recognized as a “good student” was often the same as the combination of characteristics recognized as a “good scientist.” This prevents many students, including “good students,” from engaging in true scientific communities of practice and developing science identities. However, although attention is paid to the structural influence on students’ agency, there is no explicit discussion of the macro level discourses that influence school structures and position African American girls in unique ways.

### **Future Directions of Research**

The research presented in this review indicates that many students, particularly female, minority students, are marginalized from science and how science identity development is constrained by traditional school structures. The first section detailed the culture and Discourses of science, and interactions between the Discourses of school science and students’ personal or cultural Discourses. The second section demonstrated how out of school experiences, not necessarily connected to formal classrooms, can create new spaces for students, especially female minorities, to engage in science in meaningful ways and position students in ways that support identity development, potentially disrupting macro level discourses and creating figured worlds that privilege different scientific Discourses and allow students to negotiate new ways of being a scientist. The third section explores middle school students’ identity development in science, focusing specifically on three groups: middle school girls, middle school students of

color, and African American middle school girls. This section demonstrated the intersecting nature of discourses of education, gender, science, and race.

Although many of the studies considered here explored the micro level experiences and interactions that influence students' agency and science identity development, few explored meso or structural level influences and none explicitly considered macro level discourses. Shanahan (2009) argued that often studies in science identity development over emphasize the agency of students and Carlone et al. (2015) argue for more attention to the interplay between agency and structure. This research argues that further consideration of macro level discourses is also important. The articles consider here clearly indicate that the teacher and school structures are important influences on micro level interactions, and both the teacher and school are influenced by macro level discourses. As Bazzul (2012) warned, we should "never assume that we can talk about science and science education outside of ideology" (p. 15).

Additionally, the studies here, while largely focused on micro level expressions and interactions, primarily relied on language as an indicator of identity. However, as Gee (2014b) argues, individuals have numerous ways of saying, doing, and being certain types of people and it is the combination of saying, doing, and being that should be examined, not just the saying.

Finally, relatively little research explores of middle school, African American girls are positioned in science by macro level discourses and how they experience and respond to this positioning. As a unique group, subject to distinct forms of oppression, the experiences of all girls or African American boys cannot be assumed to be the same as those of African American girls. It is important that future research focuses on African American girls as a distinct group and explores the multiple levels of discourse that influence their scientific identity development.

### **3. METHODOLOGY**

This research is a multi-level discourse analysis of middle school, African American girls' science experiences, specifically examining how different levels of discourse (macro, meso, and micro) position African American girls in science classrooms and other informal spaces. The goal of this research is to better understand how macro level educational, scientific, and gender/racial discourses are circulated through schools and classrooms, and how the intersection of educational, scientific, and gender/racial discourse impact science experiences for African American middle school girls. Additionally, it examined how African American girls accept or reject these discourses.

The perpetuation and circulation of discourses on multiple levels is a complex process that has not been studied in depth for African American middle school girls. In order to explore macro, meso, and micro levels of discourse, a critical ethnography of the science experiences in an all girls, primarily African American middle school was used.

#### **Framework of CRT**

Several tenets of CRT influenced all stages of this study. The research questions were conceptualized with an acknowledgement of the permanence of racism in U.S. society and the STEM Girls club was conceptualized as a way to disrupt discourses that marginalized the participants from science. Data collection also privileged the voice of the participants, and whenever possible direct quotes from students are used to present their experiences. Ahistoricism and dominant ideologies were challenged in the analysis of the data, which sought to understand how the unique history of African American women and ideologies of education and science intersect in the macro-level discourse circulation at the school.

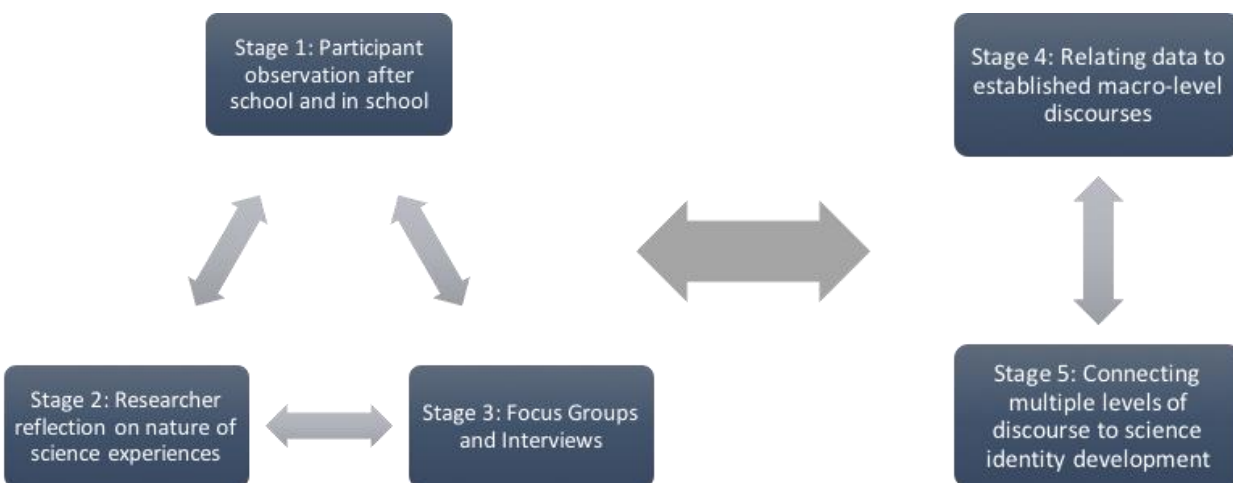
## Design of the Study

This study is rooted in interpretivist epistemological beliefs that reality is socially constructed and subjective, and there is no single reality or truth to uncover (Merriam, 2009). Instead, the aim is to examine how multiple levels of D/discourse impact specific participants in a specific context. Because of this, a qualitative research approach was used. Merriam (2009) describes qualitative research as, “Uncovering the meaning of a phenomenon for those involved” (p. 5), including a focus on how people interpret their experiences. This research seeks to uncover the meaning of participants’ experiences with science, include how the participants’ interpretation of these experiences impact their science identities. Other characteristics of qualitative research include a naturalistic or in-situ setting, reliance on descriptive data, concern for process, and an inductive approach to analysis (Bogdan & Biklen, 1997), all of which are present in this study.

The primary design of this study is based on Carspecken’s (1996) model of critical ethnography (also referred to as critical qualitative research, as Carspecken argues it is a useful model for any qualitative research and does not privilege ethnographic designs). Carspecken argues that qualitative research should do more than simply reconstruct or describe a phenomenon, it should seek to understand the relationship between culture and social structures. In this research, a critical ethnographic approach was taken to understand larger, macro-level discourses in both the school and after school setting, with data collection focused on one science classroom and four focus participants to address the meso- and micro-levels of D/discourse.

Carspecken (1996) provides a five stage model for critical qualitative research (Figure 2). In the first stage, the researcher builds a record of the culture or situation largely through observations and reflections. In the second stage, the researcher begins a preliminary

reconstruction of the culture or phenomenon, which is tested in the third stage, when the researcher works with participants to collect more collaborative data, such as interviews. The last two stages are a system analysis, where the researcher relates the system under study to a broader context, such as other sites or cultures (fourth stage) and then explains the relational system by connecting the system to macro-level theories (fifth stage). The five stages are meant to be cyclical and iterative, not linear. In this research, several cycles of the first three stages were necessary, with the first stage focusing on ethnographic data and the introduction of meso- and micro-level data in the third stage. The last two stages, which define the research as critical, was primarily used during the analysis of the data.



*Figure 2.* Five stage process of Critical Ethnography.

A critical ethnographic approach is “rooted in the belief that exposing, critiquing, and transforming inequalities associated with social structures and labeling devices (i.e., gender, race, and class) are consequential and fundamental dimensions of research and analysis” (Calabrese Barton, 2001, p. 906). The tenets of CRT are evident in critical ethnography, which places educational structures in political and cultural contexts and assumes an inherently unjust world. Critical ethnography values documenting the nature of oppression as well as the process of empowerment and maintains a focus on liberation and human rights. This approach supports an

analysis of the macro level questions guiding this research agenda, including an examination of both macro level little-d discourses as well as the big- D Discourses, or combinations of ways of saying, doing, and being that indicate specific identities, are recognized in science spaces as well as how these Discourses are sustained by institutions and groups of people. (The term “D/discourse” is used to indicate reference to the multiple levels of discourse and Discourse). Lee and Anderson (2009) argue that, “we need thicker descriptions of how students are sorted as certain kinds of people and where they learn to make choices about their identities. Thus, we need more in-depth study of everyday lives in schools that illustrate the nuanced contexts and consequences of identity negotiation for learning in their complex environments” (p. 204). This can be provided through critical ethnography.

Four focus participants were chosen to address the micro level questions of this research, allowing for an in-depth examination of individual students’ experiences in science spaces, including how multiple D/discourses and identities intersect with and influence scientific D/discourses and identities. Additionally, a focus on individual students provided more detailed information on the daily interactions in science classrooms, and other spaces, that position students in specific ways (i.e., as a “good student”), and how students responded to that positioning. The focus participants were chosen purposefully to represent a range of positions within the school, from privileged to marginalized, as described below.

### **Context of Study**

The site of this research was a public, all girls 6<sup>th</sup>-12<sup>th</sup> grade school in a large urban school district in the southeast United States. This is a small school (around 500 students), primarily comprised of African American students who qualify for free or reduced price lunch. The school, as well as a nearby brother school, was established under a federal pilot program

designed to examine single-sex education. The location of the school was strategic as it is located in the zip code that has the highest teen pregnancy, prostitution, and sex crime rates of the city. This is not a charter school, i.e., there is no lottery, and anyone who lives in the district for the school can choose to attend this school or the nearby co-ed school. However, recently the school became a choice school where anyone in the school district can apply to attend the school. Regardless, the overwhelming majority of students attending the school are from the neighborhoods surrounding the school.

This site was specifically chosen because of the study's focus on African American girls. Although the school is not officially a school solely for African Americans, it has been at least 98% African American since its opening. The staff is also primarily African American females, including all of the science teachers at the middle school.

Additionally, the school hosted an after-school program specifically for middle school students. The program is one of 10 in the metropolitan area; all 10 are part of a national network of after school programs. All middle school students are invited to participate in the program at no cost. To make it more convenient for families, transportation and meals (snack and dinner) are provided each day. In the program, students are given a choice of activities in which they can participate, including kickball, nutrition, arts and crafts, and technology. A nearby large, urban university also provides science and technology oriented curriculum and supplies developed specifically for the 10 after school programs in the area. Instructors for the after school program are mostly teachers at the school, with some specialists hired from outside the school. For example, the technology instructor at the after school program is also the technology teacher in the middle school; however, the nutrition teacher at the after school program is an outside hire.

For this research, data were collected in both school and after school contexts. The primary contexts for data collection are the seventh grade science classroom and the science club at the after school program, referred to throughout as STEM Girls (a pseudonym).

### **Participants**

Four focus participants were identified during the first year of the study. All four students were in the same science class at the school. A brief description of each focus participant, identified by a self-selected pseudonym, is provided in Table 1. Based on a purposive approach to sampling (Yin, 2013), the participants were asked to be focus participants because of their varied positions within the school. Two of the participants, Destiny and Bobbie, represented students who are positioned as “good students” in various ways within the school, based on conversations with both the students as well as teachers. For example, the technology teacher described one these students as “responsible” and “the right kind of student.” A third participant, Ashanti, was also a member of STEM Girls starting in sixth grade and expressed enthusiasm for science and technology, but was not as recognized as a good student throughout the school, possibly because she was also very quiet during the school day. The final student, Amaiya, was marginalized within the school, as evidenced through her own descriptions and participation in school. For example, she said, referring to STEM activities in her elementary school, that everyone did them, “well, not me, cause I’m bad.” This participant joined STEM Girls during the second year of the study, after being invited by a friend. All of the participants expressed interest and enthusiasm for being a focus participant.

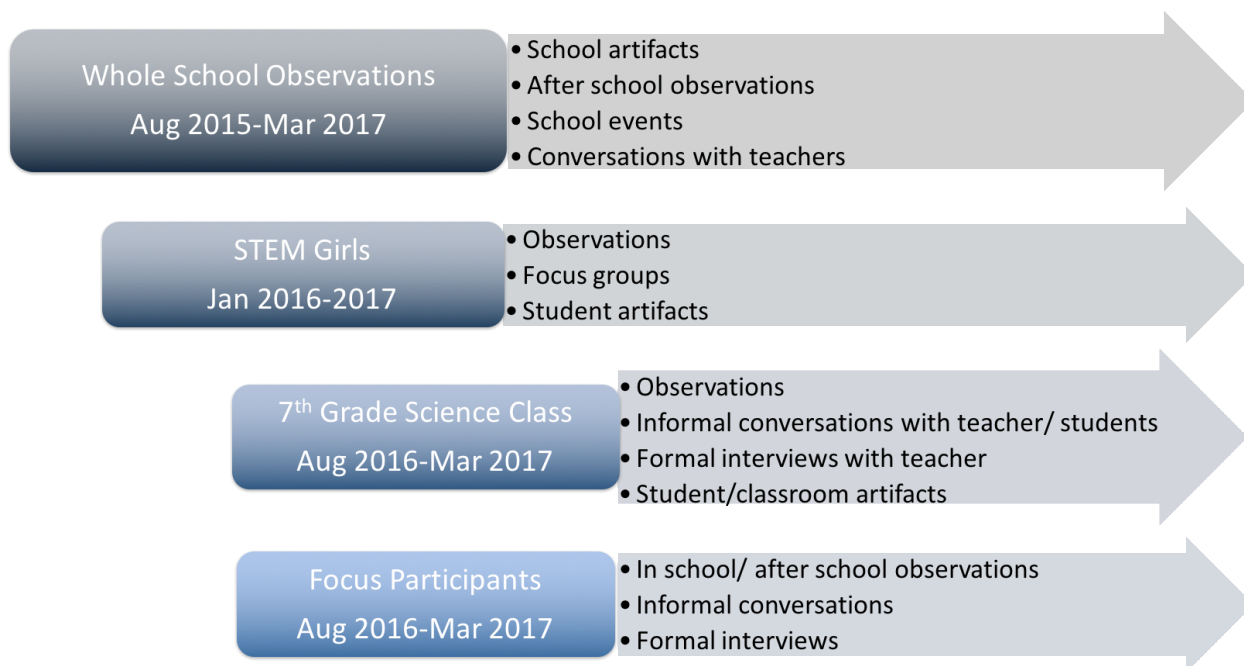
Table 1

*Descriptions of focus participants.*

<u>Participant (pseudonym)</u>	<u>Description</u>	<u>Reason for Selection as Focus Participant</u>
Ashanti	Original member of STEM Girls, joined because of an interest in a science career. Is very quiet during the school day, but much more talkative and engaged in the after school program. Loves technology, including cell phones, video recorders, and lap tops.	Sees herself as a good girl primarily, and sometimes as a good student.
Destiny	Joined STEM Girls summer before 7 <sup>th</sup> grade. Likes science and makes good grades in school. Often makes jokes during class and after school and has a wide variety of friends, including Ashanti.	Sees herself, and others see her, as a good student.
Amayia	Joined STEM Girls at the beginning of 7 <sup>th</sup> grade because she was invited by a friend and heard it was fun. During the school day, she associates mostly with her friend group. This group of girls often gets in trouble in school and struggles to maintain good grades.	Marginalized within the school. Does not see herself, or think others see her, as a good student
Bobbie	Joined STEM Girls during second semester of study. Describes herself as smart, advanced, science person. Has a small group of friends, all of whom make good grades and are seen as the “smart girls” in the school, but both other students and adults. Distances herself from other students that she feels don’t know how to behave.	Sees herself, and others see her, as a good student.

### Data Collection Time Frame

Data collection occurred from August 2015 through March 2017 (See Figure 3), beginning with a focus on data that would identify macro-level discourse circulation, i.e., school artifacts, continuing with data from the figured world of the science classroom, i.e., classroom observations, and individual participants, i.e., interviews and informal conversations.



*Figure 3.* Time frame of data collection.

**After School / Whole School.** In the first year of this study (August 2015 – June 2016), data were collected of the after school program during whole-group activities to explore the ways in which macro-level discourses were circulated through the after school program. This data included observations of the after school program two to three times per week as well as informal / conversational interviews with students and teachers. In the first semester, observations of a technology program were conducted to gain familiarity with the after school program as a whole, as well as the teachers and students, and the context in which the research was to be conducted. In the second semester, I led a science and technology based unit developed specifically for this after school program. This unit focused on increasing students' awareness of environmental concerns in their neighborhood, collecting data on water pollution throughout the city, and creating a website to communicate the students' findings. During this first year, there was a focus on building relationships and trusts with the focus participants and faculty and staff at the school. This data collection was ongoing throughout the study.

Additionally, pictures of school artifacts, such as bulletin boards and signs, and observations of school events such as pep rallies and dance recitals, were used to explore the ways in which macro-level discourses were circulated on a whole-school level. All school artifacts were photographed and field notes were taken during school events. Additionally, conversations with teachers at the school were recorded as field notes. Whole school data collection occurred throughout the study.

**STEM Girls.** Observations of the after school program continued on average two times a week during STEM Girls (one and a half hours) in order to examine how macro-level discourses impacted the way in which science and scientists were constructed in the Figured World of STEM Girls. Because the researcher leads the science club, activities were audio recorded and field notes compiled using the audio recording after each observation. Focus groups with the entire science club (approximately 12 members) were held six times during the study to examine how macro-level discourses were negotiated by students. The focus groups were generally informal, with members of the science club suggesting topics as well as the researcher. Topics included members' responses to incidents at the school, what members like or don't like in their classes, how members experience science in different contexts, and the impact of race in participants' lives.

**Science Classroom.** Observations of the science classroom occurred two to three times per week, depending on the school schedule, to examine how macro-level discourses impact the figured world of the science class. The school uses a block schedule, with classes meeting every other day for approximately 90 minutes; i.e., some weeks there were three science classes, other weeks there were two science classes.

**Participants.** Informal conversations with participants and teachers were recorded in field notes and audio recorded and transcribed when possible to determine the impact of macro-level discourses on individual's construction of science and science education. These conversations generally occurred during "down time" between activities as well as during informal times such as class changes or meals. Formal interviews with the case study participants occurred three times, throughout the school year, to more specifically examine how the participants negotiated D/discourses and how they viewed themselves in relation to science. Interviews were semi-structured, following general themes but allowing for participants to share topics as they wish. The first interview, at the beginning of the study, focused on how the participant views themselves in different contexts, how they think others view them, and what they like or don't like about the school. The next interview, at the end of the first semester, focused specifically on the science classroom and the experiences of the participant in the third semester. The final interview, during the second semester, revisited the ways in which the participant views themselves and believes others view them. In each interview, the participant was asked if they saw themselves as a science person and if they believed others saw them as a science person.

Table 2 below provides a description of the purpose of each data source and how it aligns to the research questions.

Table 2

*Connecting research questions and Data Sources.*

<b><u>Data Source</u></b>	<b><u>Purpose for Study</u></b>	<b><u>Research Question Informed</u></b>
School Artifacts	School circulation of macro-level discourses	1: Macro-level
After School Observations	School circulation of macro-level discourses	1: Macro-level
School Event Observations	School circulation of macro-level discourses	1: Macro-level
Informal Conversations with Teachers	School circulation of macro-level discourses	1: Macro-level
STEM Girls Observations	Influence of macro-level discourses on figured world of STEM Girls	2: Meso-level
Classroom Artifacts	Influence of macro-level discourses on figured world of science class	2: Meso-level
Informal Conversations with Science Teacher	Influence of macro-level discourses on figured world of science class	2: Meso-level
Informal Conversations with Participants	Influence of macro-level discourses on individual students' Discourse negotiation	3: Micro-level
Focus Groups	Influence of macro-level discourses on participants	3: Micro-level
Student Artifacts	Influence of macro-level discourses on participants	3: Micro-level
Formal Interviews with Students	Influence of macro-level discourses on individual students' Discourse negotiation and positioning in science	3: Micro-level

### **Analytical methods**

Data analysis was based on James Gee's (2014a; 2014b) method of D/discourse analysis. Gee argues that language and discourse highlight important connections between saying, doing, and being; identity is defined as different ways of being in the world at different times and places

for different purposes. Gee puts an explicit focus on non-language aspects of discourse, specifically in identity development, which he calls big-D Discourse. Little-d discourse includes language and language bits; big-D Discourse includes all the other ways of thinking, doing, and being as a certain kind of person. For example, clothing, gestures, or accents are all part of big-D Discourse. The use of both little-d discourse and big-D Discourse is governed by sets of rules that define who and how to use language and respond to others. Certain combinations of ways of saying, doing, and being are recognized by society as indicating specific identities.

Gee defines D/discourse analysis as examining language in use in culture and society (2014a). D/discourse analysis can be used to identify problems such as unequal distribution of social goods and who gets helped and harmed in various Discourses. Gee argues that D/discourse analysis should go beyond description to examine how and why language works in specific situations. Gee's D/discourse analysis is based on an examination of building tasks, which speakers engage in to create something, through the use of tools of inquiry. The building tasks speakers can engage in include significance, practices/activities, identities, relationships, politics (i.e., the distribution of social goods), connections, and sign systems / knowledge.

Each of these tasks can be examined using six tools (Gee, 2014a): social languages, Discourse, Conversations, situated meaning, figured worlds. Social languages are situationally specific languages, such as that of a specialist (i.e., scientific discourse), that can be informal or formal and can be used to show solidarity or deference to other individuals. Social languages are developed through immersion in social practices, which leads to the creation of socially situated identities. As discussed above, Discourses are the ways of saying, doing, and being a particular kind of person. Certain combinations of Discourses are recognized by others as indicating certain identities. Intertextuality is also a tool in D/discourse analysis, referring to cross-

referencing of other texts. Gee also defines big-C Conversations as the major themes within and among D/discourses, and another tool for D/discourse analysis. Situated meaning is the meaning a given utterance has in a specific context, taken from the larger range of all possible meanings for the utterance. Finally, figured worlds, also referred to as cultural models, are simplified versions of the world that define what is normal and taken for granted. Figured worlds identify different combinations of Discourses that are recognized as legitimate identities and others which are marginalized in specific contexts. The figured worlds and Discourse tools were used for this analysis and are explained in more detail below.

**Stage 1 analysis: Macro-level discourses.** In the first stage of analysis, observation data, school artifacts, and teacher conversations were coded to determine the presence of specific educational, scientific, racial, and gendered macro level discourses (see Table 3). This was partially iterative process, starting with discourses identified in the literature; if other macro level influences are identified, they were compared to existing literature and included in sequential rounds of coding. The codes developed in this stage informed the next stages of analysis.

Table 3

*Macro level discourses of education, science, and race/gender identified in the literature.*

<b><u>Category</u></b>	<b><u>Discourse</u></b>	<b><u>Literature</u></b>
Educational	Accountability	Bazzul, 2012
	Reform	Tobin, 2011
Scientific	Elitism	Aikenhead, 1996
	Scientists as gatekeepers of knowledge	Lemke, 1991
	Science is mysterious	Lemke, 1991
Race/Gender	Black girls need to be ladies	Collins, 1999; Morris, 2007
	Black girls are too loud	Fordham, 1993; Morris, 2007
	Black girls' bodies should be controlled	Collins, 1999; Renold, 2004

**Stage 2 analysis: Meso-level figured worlds.** The second stage of analysis used the figured worlds tool. Gee (2014b) describes figured worlds as typical pictures or stories of what is normal in a given context. Although these typical pictures are useful in order to interact in different contexts without having to consider all the nuances of those contexts at all times, they are also dangerous in that things or people who are not considered typical are marginalized. Because figured worlds are taken for granted, changing a figured world can be difficult. Gee also argues that figured worlds are not just in people's heads, they exist also in books, media, and interactions with others. Based on conceptualizations of figured worlds by Holland et al. (1998) and Gee (2014b), I consider four components of figured worlds in this research: meaningful acts, artifacts, people, and rules.

In this research, the figured worlds of the science classroom and after school science club were explored. In particular, the ways in which the macro level discourses identified are influence each figured world, and interacted in each figured world, were examined. Data collected in each figured world were coded twice, in parallel. In one round of coding, the macro-level codes developed in stage 1 were applied to the data collected in each figured world. In a separate coding process, the data were also coded for the components of the figured world: meaningful acts, artifacts, people, and rules. Next, Gee's (2014a) figured world tool was used to examine each building task gives the following set of questions to drive the second stage of analysis:

How does the figured world of the science classroom (after school science club) work to:

- build relevance or significance for certain things?
- enact specific practices?
- recognize (or not) specific identities?

- build or destroy social relationships?
- create, distribute, or withhold social goods?
- privilege and disprivilege different ways of knowing?

In particular, the third building task was a focus of analysis as the specific Discourses available to students in each figured world were identified.

**Stage 3 analysis: Micro-level Discourse negotiation.** In the third stage of analysis, data specific to the focus participants were examined using Gee's (2014b) Discourse tool. As described above, Discourses are all the ways of thinking, doing, and being as a specific person in a specific context. Gee argues that people use Discourses to enact situationally specific, recognizable identities; i.e., to position themselves in specific ways. The Discourses tool was used to examine how students position themselves in the figured worlds of the science classroom and the after school science club, as well as how others recognize this positioning. Gee (2014b) refers to the use of specific Discourses as making an identity "bid", which may or may not be successfully recognized by others.

As with the second stage of analysis, data from each focus participant was coded twice, in parallel. First, the macro-level codes derived in stage one were applied to the micro-level data. Separately, each of the Discourse categories developed in stage 2 were also used to code each focus participants' data to explore how participants are using language, actions, interactions, beliefs, values, clothing, tools, objects, and technologies to enact specific identities in specific contexts.

### Quality

Tracy (2010) lists eight criteria of high quality qualitative research. Some of these criteria, such as a worthy topic, resonance, and significant contribution to the field, should be

considered before research begins or while writing up the research. Rigor and credibility, however, should be a focus of the research design of the study. One means to achieve rigor in a study is to include a variety of data sources, contexts, and samples (Tracy, 2010). Within this study, rigor was achieved by using multiple data sources, including class observations, audio recordings of student group interactions, written work samples from students, informal conversations, and formal interviews. Additionally, data was collected from academic, after school, and social contexts.

Credibility refers to establishing a high level of consistency throughout the research study (Given, 2008). Tracy (2010) describes how including rich descriptions as well as using crystallization, multivocality, and member reflections can increase the credibility of a study. To this end, detailed illustrations/ transcriptions of after school and classroom Discourses was included to support the analysis, including collaboration with students and reflections on how and why they enact different Discourses. Crystallization, which is similar to Flick's (2008) description of triangulation of data, involves using multiple data sources, researchers, and lenses, was also used to increase the depth of understanding (Tracy, 2010).

Lincoln and Guba (1985) discuss how the credibility of qualitative research can be increased by engaging in long-term observations, debriefing findings with other researchers, and using member checking with participants. In this study, observations were made over two years, and were strengthened by collection of additional forms of data, including interviews and artifacts. Additionally, during the analysis stage of the study, I met weekly with a second researcher who was familiar with the study in order to discuss both the research process and the findings as they emerged. Finally, I shared specific pieces of writing about the science classroom and focus participants with them in order to check that they were accurate

representations. In particular, I focused on member checking specific observations with each participant to ensure that my interpretation of the event was consistent with the participants'. This generally involved describing an observation to the participant and asking her questions such as, "How did you feel during that?" or "Why did you chose to do this?" These steps, particularly use of member checking and discussions with a second research about the research process, also helped increase the confirmability of the study by providing confidence in the results and evidence that the findings presented in the study can be verified and are not the result of researcher bias.

Potential transferability of the results of this study was also considered as an important component of quality (Given, 2008). In particular, the selection of participants was conducted purposefully, with focus participants in particular chosen to represent a wide range of experiences of African American girls in this context. Additionally, detailed descriptions of the context, participants, and research design are included to increase the transferability of the study.

Dependability of a qualitative study refers to how logical and traceable the research methods are (Given, 2008). In this study, detailed descriptions of the methods for data collection and analysis are provided, along with the reasoning behind the selection of these methods, to increase the dependability of the study.

In addition to the steps suggested by Lincoln and Guba (1985), Merriam (2009) also suggests including reflection by the researcher on their positionality, including a detailed account of all of the methods and procedures in a study, and selecting participants who represent a diversity of experiences. Each of these items is also included in this study.

In additional to guidelines for quality in general qualitative research, Gee (2014b) presents four elements of quality specifically for Discourse analysis. These include convergence,

agreement, coverage, and linguistic details. Convergence involves the idea that answers to the multiple inquiry tool / building tasks questions presented above should have compatible answers. This was found to be true for both the figured world of school science and the figured world of STEM Girls. Agreement refers to agreement between researchers. In this study, results were compared to other, similar analyses to look for agreement and other researchers with similar frameworks were asked to review the findings. Coverage indicates that an analysis can be applied to related data sets. Finally, linguistic details indicates that the analysis is closely linked to the details of the given linguistic structure.

Gee (2014b) discusses how a complete Discourse analysis would include an investigation of each tool of inquiry paired with each building task. Realistically, this is not possible in a single study. This is one limitation of Discourse analysis: the researcher must decide which tools of inquiry and building tasks are most relevant, realizing that all are relevant to an extent and could add value to the study. Additionally, when transcribing and analyzing data, the researcher must also decide what level of detail and which samples to include. This is particularly relevant when focusing on capital-D Discourse, as there are many different types of Discourse (clothing, hair, expressions, gestures, etc.) which are not typically included in a transcription of language; trying to capture every Discourse of even one student would be overwhelming. The researcher must use their judgment when deciding which aspects of each Discourse to document. Additionally, with student-to-student interactions, when conversations are audio-recorded to minimize the influence of students' perceived pressure to perform for adults, many aspects of Discourse was not captured in the recordings.

As with most qualitative research, the results of this study are not meant to be statistically generalizable. However, reliability of the results is supported by providing a detailed description

of the data collected and analysis procedures, what Merriam (2009) refers to as an audit trail. This allows readers to determine whether they would draw the same conclusions as the researcher, what Yin refers to as internal validity (2013), as well as whether the research would apply to cases of interest to them, or has external validity (Yin, 2013).

As Tracy (2010) points out, every study will not meet every standard of quality. However, transparency and honesty about the limitations of the study are important and allow readers to make their own judgments about the quality of the research. To achieve this, the study, including any challenges or complications, is reported as accurately as possible.

### **Subjectivity Statement**

I am a middle class, white woman who has enjoyed, for a long time without realizing it, a life full of privilege. Although my parents did have to work, I was never hungry, I always had clothes, and I never worried about my place in the world. I come from a family of high school valedictorians and graduate school students, and I didn't question my trajectory from high school to college, college to graduate school, graduate school to a professional career. Maybe there were some subtle details that steered my trajectory, if not completely off track, then at least a little to the side. But it wasn't until my senior year in college that I heard the term "white privilege"; it was not until years after that that I really understood it. Many years ago, I began volunteering with a young girl and her family through a mentoring program. Visiting them, being welcomed into their home, was my first real experience with poverty, and it was culture shock for me. But although I did not see my new sister's poverty as isolated, it certainly did not seem systemic, and I didn't connect my own success to her poverty. I was there to make a difference! I would save her! I was one of the good guys! We are still together 18 years later, and I did not "save" her, I did not change her trajectory. She did not graduate high school, she

did not find a place in the world outside of her mother's house, where she lives with her boyfriend, and the park she goes to sleep in when she's fighting with her family. There is nothing that I, an obvious outsider, could do to change her path and if you asked her, she did not really want her path changed anyway. She is a very happy young woman, and I am proud and happy to have a place in her life. But the fact that she never had a real choice in the trajectory of her life (and, honestly, neither did I) did not escape me and often kept me up at night. Becoming a teacher, I thought I could maybe take on these systemic forces through education. Surely, education could fight oppression, racism, and the other social ills that were becoming so apparent to me. As Saul Alinsky says, "We will start with the system because the only other place to start from is political lunacy" (1989, p. xxi). It only took a few years to realize that public education today is just another cog in the system, a tool to maintain the exact same oppressive forces that I was hoping to combat. From the beginning of my teaching career, through an intern certification program, the prevailing attitude of those around me was one of the savior, often white, always middle class, coming in to rescue these poor children, to replace their cultural resources with more appropriate ones, to teach them how to be "good students" and train them for college. This seemed inauthentic, self-righteous, and sometimes downright ridiculous. The prevalent view was deficit based – we were here to correct, fix, remediate, essentially to change students into the type of students we had been. Many times I heard other new, untrained teachers say, "Well, we're better than the alternative." I had a hard time believing that; there had to be a better alternative out there. I constantly struggled as a teacher with the question of whether I was actually helping my students in any way, or just taking my place in the system, this time in a way designed to make me, still enjoying privilege by the bucketful, feel good about myself.

All of this is a drawn out way to say that I am just another white, middle class teacher who now wants to be a researcher. How do I dare make that decision? How do I dare think that I can speak for, or even with, cultures that have been marginalized for so long when not only have I not experienced that marginalization, I have in many ways benefitted from it? Obviously, I can never really be an insider working with inner-city, African American students. I have never experienced open discrimination, poverty, or violence as many of the participants I work with have. I never struggled in school; my educational experience was exactly the opposite of many of my students - I was the student that the system was made to support. Much like my mentee/sister had little choice in her path, my trajectory always led to "success." But in the last 10 years, I have gradually gained some insider access to the culture of the inner-city school. I have built meaningful relationships with students, families, and communities that give me moments of insider-ness. There are situations where my students invite me into their worlds (to teach me how to dance, for example), or where we have a common enemy (the oppression of the school system in the form of the dress code) to rally against. As Johnson-Bailey (2004) describes, positionality is not fixed, it is multifaceted and fluid. Although in many ways I will remain etic to the cultures I interact with, I can hope to be at least a welcomed outsider, an ally, a supporter and gain insider views in some small but important ways. However, Johnson-Bailey (2004) also describes how class differences can become more important than any other differences, including racial or gender, and this is what I worry about in my work. I cannot eliminate my privilege, I can only be acutely aware of it, so how can it not impact my research? There is no way to eliminate power relations; moving from a teacher to a researcher may only widen the differential. But I am hopeful that I can produce research that will benefit not just me but the students as well. I constantly reflect on the questions Johnson-Bailey (2004) provides:

What will we [as researchers] give back? What are the participants risking? The same question that followed me through my teaching career comes with me as a researcher: Am I doing the right thing? Asinsky's definition of ethics is doing what is best for the most (1989), and I think as a researcher I can only strive to do what is best for the participants as a whole. In the tradition of critical theory, I want to not only understand students' experiences in science education, and what makes them oppressive, but also to change the conditions that create oppressiveness in classrooms through emancipatory knowledge (Crotty, 1998).

One reason I decided to leave teaching to become a researcher is the pain and frustration of trying to work within the system. The reforms to address the so-called "achievement gap" do nothing to address the overarching, unjust flaws in the system. Science education privileges a certain way of knowing, alienating students who do not conform to the mold of "good student". My goal in science education research is to expose the privilege inherent in science education and examine new ways of doing and thinking about science. I want to share individual student's stories, and provide counter narratives to the deficit-based narrative, to move beyond generalizing and essentializing students and to legitimize their experiences and knowledge. I seek change along with understanding, in the way of the "radical" that Paulo Freire describes in the preface to *Pedagogy of the Oppressed*:

The more radical the person is, the more fully he or she enters into reality so that, knowing it better, he or she can transform it. This individual is not afraid to confront, to listen, to see the world unveiled. This person is not afraid to meet the people or to enter into a dialogue with them. This person does not consider himself or herself the proprietor of history or of all people, or the liberator of the oppressed; but he or she does commit himself or herself, within history, to fight at their side. (1996, p. 21).

I hope, as a researcher, to fight at the side of the students I am studying as a passionate, and compassionate, advocate. This means that as a researcher, I acknowledge that I am not able to be objective or neutral in this setting. However, I can use this motivation to build relationships that allow me to better capture the experiences of the participants. I have been a member of this school community for over four years; first as a teacher in the high school and now as a researcher in the middle school. Throughout that time, I have developed strong relationships particularly with students but also with parents and teachers at the school. In addition to teaching and research, I have attended school dances, sporting events, and field trips. All of this was done out of genuine care for the students and I am hopeful that the trust that has already been established will help ensure the truth of the data collected. Although I come from a different culture as the students, I consider myself an insider to the culture of the school. However, because I am a white researcher in a predominantly African-American setting, it is important to not dismiss the importance of the power dynamics between the researcher and participants. In particular, this research was conducted in the tradition of decolonizing or humanizing research (Paris, 2013). Humanizing research is described by Paris (2011) as a “methodological stance which requires that our inquiries involve dialogic consciousness-raising and the building of relationships of dignity and care for both researchers and participants” (p. 9). To achieve this, I worked closely with participants in all phases of research – data collection, analysis, and reporting the findings. The research was meant not just to benefit the researcher or the academy, but also the participants. The questions of how participants will benefit as well as what participants may be sacrificing were revisited regularly throughout the research. I strived to be open and honest about all stages of the research, seeking participant feedback and dialogue throughout the process. The CRT tenet of providing the perspectives of marginalized

populations, in this case the stories of the young African American students, also helped to humanize the research and maintain a focus on the participants' perspectives and experiences.

Additionally, it is important to acknowledge my role in developing STEM Girls along with the girls, and the relationships with the participants that developed as a result. STEM Girls was specifically developed to disrupt marginalizing D/discourses identified in the school and science class, and I purposefully introduced the discourse of science as engagement in scientific practices to this space. Although my close relationship to the club made analysis of the data more difficult, I relied heavily on discussions with other researchers about the data from STEM Girls in order to help identify ways in which I might be interpreting and presenting the data in inaccurate ways. Audio and video recordings of STEM Girls were also made in order to reevaluate the data at a later time. This was particularly helpful for hectic or emotional days in STEM Girls, i.e., days when an activity had gone really well and everyone was excited or days when students argued with each other and frustrated me. On these days my field notes were influenced by my feelings during the events. Revisiting video recordings after some time had elapsed, along with discussing the data with other researchers, allowed me to partially remove emotions and examine students' actions and responses in more detail. I also kept a researcher journal throughout the research study (Ortlipp, 2008), where I reflected on my role in the research, my relationships with participants, and the influence of my race and class privilege. This reflective journal was used to help me identify the beliefs, values, and emotions that I brought with me to the research, as well as ones that developed during the research, and how they influenced the research process. I particularly reflected on working with the participants in STEM Girls and having conversations with them, and how these interactions were colored by my

own beliefs about education, science, race, and gender, which ran counter to the macro-level discourses I observed at the school.

#### 4. RESULTS

Rosa Parks Middle School (RPMS, a pseudonym) is a public, all girls Middle School in a large city. It shares a campus with Rosa Parks High School and, during the second year of this study, the two merged into one school. The school buildings are about six years old and up to date, and are built around a large, open, well-landscaped green space. There is a small garden in the front of the school and a large public park with forested land adjacent to the school. RPMS has a large auditorium, cafeteria, two gyms, tennis courts, and a track, all well-maintained. The hallways are lined with lockers and are well lit, clean, and decorated with school posters. The school is three floors, with one grade on each floor and a large main office on the first floor. There is a steel gate surrounding the school and the outside doors, even those within the gates, are locked at all times and require a key card to open. During class changes, the hallways are crowded and noisy, but during class time the hallways are mostly empty except for the occasional student. The students all wear a school uniform, which consists of chocolate brown pants or skirt, a white or pink button down or polo shirt, and flats. Almost all of the students at RPMS are African American, with a handful of Latina students and no white, Asian, or other raced students were observed during the study. The staff was also almost entirely African American, with only one white teacher in the High School and none in the Middle School. RPMS is on a block bell schedule, meaning students take four classes a day, for about 90 minutes each, and alternate classes on A-days and B-days. Most students are encouraged to take an arts class, such as band, dance, or theater, in addition to their core requirements.

Although RPMS was a nicely designed and well-maintained school, it also reflected the low-income, urban neighborhood in which it was situated. There was a large piece of graffiti at the entrance to the school for the entire duration of the study, reading “Stay in School.” There

was occasionally crime on the campus, including at least one teacher's car getting stolen from the parking lot. Housing in the nearby neighborhood consisted of large apartment buildings and smaller, bungalow style houses. Although the city RPMS is located in was rapidly gentrifying just a mile or two away, the area immediately surrounding the school was economically depressed.

The science classrooms in RPMS were designed as hybrid classroom-lab spaces. They had large, moveable lab tables with sinks and cabinets lining the back wall of the room and large storage closets between rooms. Each room was well equipped with technology, including new smart board projectors. There were laptop and ipad carts available for teachers to use regularly.

RPMS hosted an extensive after school program, funded by a grant through a local university. All middle school students were encouraged to attend the program, which provided a snack, dinner, and transportation for no cost. At the beginning of this study, there were about 150 students attending the after school program on a regular basis. By the end of the study, there were only about 35 students. The program was organized by a local site coordinator and representatives from the university. Students who attended the program selected one or more activities, which they participated in two or three times each week. Activities that were offered during this study included videobroadcasting, nutrition, arts and crafts, karate, kickball, double dutch, dance, photography, STEM Girls. Students who participated in the program came to the cafeteria immediately after school, at 3:30 pm, for 30 minutes. During this time, they had a small snack (i.e., graham crackers and apple juice, yogurt, Cheez-Its) and the site coordinator made announcements. During the first year of the study, the girls generally used this time to chat with each other and play around on their phones. During the second year of the study, under a new site coordinator, students were instructed to quietly work on homework during this time.

After snack, students attended activities from 4:00 – 5:00 pm on Mondays, Tuesdays, and Thursdays. Wednesdays were reserved for tutorial days (teachers from the Middle School were available on these days and organized review and make up sessions) and Fridays were reserved for special events, such as field trips. Although field trips were common during the first year of the study, including ice skating, movies, science festivals, and amusement parks, they were less common during the second year. After their activity, the students reported back to the cafeteria for dinner from 5:00 – 5:30 pm. Dinner was generally well-balanced, such as spaghetti with a role and broccoli. After dinner, students reported to two school buses in the front of the school to ride home. The program also offered a one-month summer camp with many of the same activities, plus swimming and more field trips.

### **Macro-Level Discourses**

This section describes the macro level discourses of science, education, race, and gender (as well as intersections between discourses) that were identified at Rosa Parks Middle School (RPMS). These discourses are often circulated on national and international scales through institutions such as news outlets and social media and also through the mechanisms of popular culture, including television, movies, and magazines. The aim of this section is first to identify each discourse and how it functions in the construction of reality at RPMS (i.e., how the discourse informs what is known as science, education, race, and gender at RPMS), and then to describe the school structures through which the discourses are circulated and transmitted.

Acknowledging the dialogic nature of discourse, I seek to show how these discourses both construct, and are constructed by, the structures, procedures, and daily life of RPMS.

Additionally, the intersections of these discourses at RPMS, and subject positions made available

to students as result, are discussed. Future sections will consider in more detail the impact of each discourse on the seventh grade science classroom and individual students.

### **Discourses of Science: The Scientist Subject Position**

The discourses of science, and school science, identified at this school include many traditional stereotypes about science: that it is a special field, providing true facts, for smart people and is inaccessible to the average person. Discourses of scientists and science students as innately different were also identified. Notably, several common science discourses were absent in the school: the discourse of scientists as nerds and unpopular, as well as discourses of school science as engagement in inquiry and scientific practices.

**Science as elite, specialized, exclusive field.** As described by Aikenhead (1996); Gee (2014b) and Michael (1992), science is often viewed as an elite field, for highly specialized professionals that had to receive extensive education in order to become part of it. This discourse was present throughout RPMS in several school structures. The first structure was the way students were assigned to classes. Although science classes themselves were not tracked, extension classes were often seen as a way to separate the good students. In particular, engineering classes were regularly assigned only to the students with the best grades, sometimes over the protests of the students themselves. For example, in one focus group with after school students, I asked the students what they knew and thought about science. One student complained, “I told them I like to read and they put me in engineering!” In a similar vein, field trips, and particularly science or STEM (science, technology, engineering, and math) field trips were exclusive: students were only allowed to participate if they were invited by a teacher or administrator, a limited number of spots for each field trip was made available (sometimes as few as two students would attend a science related field trip), and selection for the field trips was

based on student grades and behavior, not student interest. The same student as quoted above stated, “If you have good grades, they’re going to force you to go on a STEM field trip.” This leads to a discourse of science as being only for the smart students, who were in some way chosen to be part of science experiences, echoing societal discourses of science being more difficult than other subjects and only for a select few, with science teachers serving as gatekeepers allowing only certain students to access science (Lemke, 1990).

**Science as a specialized way of thinking about the world.** Lemke (1990) describes a discourse of the “mystique” of science (p. xi), which relies not just on the discourse of elitism as described above, but also on the idea that science is somehow inaccessible to the average person, and even in conflict with common sense. Michael (1992) also describes discourses of science that portray it as “unfathomable” (p. 320) to the lay person and counter to local knowledge. This mystique of science was evident in the way science was presented throughout the school. For example, the science fair was an important structure for all students in the school during the fall semester, but very little information was provided about the project or expectations for students, other than that they were supposed to perform an experiment. Even the teachers rarely knew what was expected or when, for example, the school wide science fair would be held. No scaffolding was provided for students and in most (if not all) middle school science classes students had not performed any experiments or learned anything about how to design or carry out an experiment. This lack of information created a general air of confusion around the science fair itself. This air of confusion was also evident in the students’ finished projects, including those selected to be part of the school science fair. Many projects submitted by students were confusing and failed to make logical connections between the science experiment and common sense or local knowledge. For example a project around spoiled milk was entitled

“Germs in Your Body”; not only did this confusion go uncriticized by students and teachers, this project was selected as one of the best of the seventh grade by both groups and chosen to advance to the school science fair. Interestingly, instead of expressing frustration or critiquing this process, many students and staff members praised projects like “Germs in Your Body” and seemed to embrace the ambiguity as part of the scientific process, implying an expectation that science is difficult to comprehend and separate from common sense knowledge.

This discourse of science as specialized and inaccessible was also evident when the after school students chose pictures from activities we had done over the semester to represent science. Many students chose pictures that seemed “science-y” but where they didn’t actually know what was in the picture or participate in it themselves. For example, one student chose a picture of someone else’s science fair project about water pollution (a picture of pond water and a plant in a small fish bowl), explaining, “This is science because we did a science experiment about fish bowls and fishes.” This student did not participate in this project in any way, but chose this picture to represent science over many other pictures of experiments or science activities in which she had participated. Another student chose a picture of materials for someone else’s science fair project, stating, “And I chose this for science because it has sand and it looks science-y. I don't know what it is, but... it looks like sand or something. Science.” Again, this student did not chose pictures of items she was familiar with or activities in which she had participated, indicating that science is viewed as somehow inaccessible or beyond understanding, not as something that an average student would participate in or know about. Students in the after school club also struggled to connect science activities in the club to their homes and communities when explicitly asked. Activities such as baking cookies or making

bath bombs were identified as fun but not science, despite the fact that we explicitly discussed the science of each activity and created experiments around them.

**Scientists as different.** In addition to viewing science itself as a unique field, a discourse of scientists as somehow different from the average person was also identified. Although in some cases this discourse takes the form of the “mad scientist” (Nelkin, 1987; Weart, 1988), in RPMS it was seen more as a view that being a science person is something innate to certain individuals (Carlone, 2004; DeWitt et al., 2012) who are considered almost superhuman (Lemke, 1991). A bulletin board at the school entitled “STEM Girls Should BE:” transmitted this discourse, using words such as “inspired”, “different”, and “remarkable” to describe a “STEM Girl.” This was also conveyed through the elite nature of science field trips and other science experiences, as described above, which were reserved for “certain kids,” as one teacher explained.

**Science as the one true way to view the world.** Discourses of science often present it as the objective truth, indicating that there is only one correct way to understand the world (Michael, 1992; National Research Council, 1996). In science classrooms as RPMS, lessons revolved around the textbook as the primary source of information . In the science fair, students were expected to follow one set scientific method, which was rigorously enforced and obvious on each science fair board (i.e., Question, Hypothesis, Procedure, Analysis, Results). Students were provided with headers for each part of this scientific method in order to ensure that all were present, and in the right order, on their final project boards. Although students decorated their boards in creative ways, the underlying science or experiment presented did not deviate from the expected scientific method.

**School science as ordered and serious.** Discourses of school science being more serious and difficult than other subjects portray science classrooms as focused on “emotional control, orderliness, rationalism, achievement, punctuality, and social hierarchy” (Lemke, 1990). At RPMS, the “STEM Girls Should BE:” bulletin board perpetuated this discourse, describing STEM Girls as punctual and consistent. The discussion above regarding the science fair project boards also reflects this ideal that science is structured and organized: students were expected to conform to a given organization for their science fair projects and were critiqued when they failed to do so.

**Good science students are nerds.** Discourses of good science students being nerdy, i.e., less attractive, unpopular, not socially competent (DeWitt et al., 2012; Osborne, Simon, & Collins, 2003; Taconis & Kessels, 2009) are prevalent in societal stereotypes found in movies, television, and other types of popular culture. These discourses are often circulated simultaneously with discourses of science students as being more intelligent, motivated, and focused than the average student (DeWitt et al., 2012; Taconis & Kessels, 2009). At RPMS, although scientists were depicted as somehow different than average, as discussed above, this difference was generally limited to positive attributes such as intelligence and hard work, with the negative aspects associated with being a nerd. For example, students who did well on the science fair were revered and often considered the popular students. When students in the after school club were asked what a scientist might look like, they responded that anyone could be a scientist. Although students occasionally indicated that they knew about stereotypes of scientists, for example one student stating, “I have glasses, that’s science! Watch my glasses do science!”, they did not explicitly adopt these discourses when referring to the type of student who would be good at science.

**Participation in scientific practices.** In science education reform, the discourse of scientific practice and inquiry have become dominant within the topic of how best to teach science. The Next Generation Science Standards are designed around student participation in scientific and engineering practices, including: asking questions (for science) and defining problems (for engineering), developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations (for science) and designing solutions (for engineering), engaging in argument from evidence, obtaining, evaluating, and communicating information (NGSS Lead States, 2013). However, this discourse was almost completely lacking in RPMS, despite the obvious importance placed on the science fair. During the science fair, students were encouraged to find existing projects through websites such as sciencebuddies.com, and in many cases students admitted (to myself as a researcher, at least) that they didn't actually do the experiment, they simply found the necessary information about it and copied it as their own. Indeed, finished projects, even from students who did complete the experiments, often contained questions, procedures, and data tables that were copied verbatim from websites. This was left uncritiqued by teachers, who neither mentioned the copying nor factor it into the students' evaluations. Additionally, during the evaluation of the science fair projects by both peers and teachers, there was little reward or recognition for actually doing science, i.e., engaging in scientific practices, with most of the recognition going towards neatly organized and aesthetically pleasing display boards and well-spoken students. In the evaluation sheet used by students to rate their peer's projects, seven categories were included. Three of the categories focused on whether the information presented was "understandable" or "broken down" well, two were straight forward questions ("Is this a research project or an experiment?" and "Is there a log

book?”), and one asked whether the project was “neat and organized”. The final category asked in the project could be useful in the real world. None of these categories address engagement in scientific practices. Outside of the science fair, students reported (and I confirmed through observation and teacher discussions) that science classes generally revolved around taking notes from powerpoint presentations. When asked about activities they liked in science class, many students described a previous class (sixth grade) where they did lots of “experiments.” When pushed to describe the experiments, they revolved largely around what I am calling “edible science:” hands on activities that are created from edible items but do not involve scientific practices. For example, several students described making the phases of the moon out of Oreo cookies. Another popular activity was demonstrating plate tectonics using graham crackers and icing. In both of these activities, the focus was on following step-by-step directions to create a specific product, which was then eaten.

Despite the lack of a discourse of scientific practices in the school, students indicated that they had a fairly well-developed understanding of what it means to do science. In the first focus group, a student indicated an understanding of the connection between being engaged in scientific practices and learning when she contrasted her science class with the activities in the after school program, “some of our activities in science, really don't have anything to do with science, it's more like reading and... I like the experiments cause like, you learn like from experiments.” She went on to give examples from the after school activities. This focus group was held at the very beginning of the STEM Girls, and no explicit discussion about engaging in science had occurred yet. When asked during the same focus group what students thought science was, they gave a variety of active verbs including discovering, exploring, investigating, and experimenting, despite not being able to give examples of these actions in their science

classes. However, it seems students remained conflicted on the value of engaging in scientific practices to their educational goals, as, later on, when I encouraged them to choose more creative science fair projects related to their own interests and questions, all but two of the after school students chose projects from sciencebuddies.com, in some cases indicating that they thought this would be easier, but also suggesting some anxiety around not fulfilling the science teacher's expectations for the project.

Considering the discourses of science circulated at RPMS, science is constructed as something elite and special, yet separate from the average student. It is also constructed as a passive process, with expectations that students won't participate in science, instead taking a more passive approach to learning. This creates a subject position of a scientist as a special student who works hard and is able to access things other students cannot, including scientific knowledge. To be recognized in this subject position, one does not need to participate in science, but does need to be able to present science topics well, in orderly and visually appealing ways.

### **Discourses of Education: The Good Student**

Discourses of education that were identified at RPMS, and in the school district, included neoliberal discourses highlighting the economic goals of education (i.e., college and career), accountability (including testing and standards), responsibility, individuality, and competition.

**Economic goals of education.** Chesky and Goldstein (2016) describe the "economic purposes" (p. 132) of education as stemming from a focus on improving the workforce, and therefore economic prosperity, of the US. This discourse holds that the only important goal of education is to get a good (i.e., high paying) job in a competitive field. This discourse was prominent throughout the school as well as in district level texts. For example, the homepage of

the district website prominently displays the district's mission, which involves making sure every student is ready for college and career after graduation. This view is also reflected in the measurement index used by the state to grade schools, which explicitly mentions promotion of college and career for all students. Within the school, the focus on college and career was evident first in the signs and other decorations lining the hallways of RPMS. One prominent bulletin board in the school, which did not change over the course of this study, was titled "Think College," with pictures of graduation caps bearing logos from various colleges and nine squares with illustrated tips, presumably of actions that will help one get to college. The tips include suggestions such as "Study," "Participate in class," and "Communicate with others." Pennants from various universities also decorate the hallways and teachers and students are encouraged to wear college paraphernalia on some dress down days. There is also a district wide college and career week, where the entire school spends the week learning about potential colleges and careers. The girls also echo this focus in conversations around school; for example, when asked why they like a certain subject, the answers almost always involve a career path that the student is interested in. Students were also occasionally invited on field trips to visit college campuses, with the explicit aim of exposing them to a college culture. It is important to note what this discourse excludes, which is any focus on non-economic goals of education, including enjoying learning or creating students who are critical thinkers.

**Accountability.** Discourses of accountability have been commonplace in education for decades; Walberg (2003) argues that a focus on accountability was foreshadowed as early as the 1983 publication of *A Nation at Risk*, which called for higher educational standards and a focus on student achievement. Since then, throughout the U.S., increasing focus has been paid on holding schools, administrators, and teachers accountable for student learning (Tobin, 2011),

leading to a dramatic increase in educational standards and standardized testing. Nationally, this is evident in initiatives such as the Common Core Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) and the Next Generation Science Standards (NGSS) (NGSS Lead States, 2013). States, including the one in which RPMS is located, also have created and implemented detailed standards for all subjects. In the district in which RPMS is located, pacing guides and curriculum maps also accompany the standards, creating an extra layer of accountability. The district website includes a page devoted specifically to “Testing” as well as a separate page for the statewide assessment system, which is closely linked to the state measurement index described above. The assessment system includes test for specific grades and subjects; for example, middle school students take state-wide standardized tests in English Language Arts and Mathematics at the end of each year as well as Social Studies and Science at the end of their eighth grade year. The statewide assessment system website contains information on test administration, tips for test-takers, and results from previous administrations. In addition to the statewide tests, the district has developed tests for all other subjects and middle school classes are required to administer two benchmark examinations throughout the year, one in October and one in February. In RPMS, the results of these benchmarks was clearly displayed in each classroom in the form of tables and graphs. School-wide and department level meetings were held to prepare for the different testing administrations as well as to discuss the results. Practice tests were administered for the state-wide exams on multiple days, presumably in order to check the logistics of the online testing system and acclimate students to the tests, which resulted in at least a half day disruption each time. Additionally, other activities in the middle school were postponed during the “testing window,” the entire month of April, including after school enrichment programming. Students were not

just aware of the importance placed on the testing, they often expressed anxiety at their own performance as well as the performance of their peers. Students mentioned the “data wall,” where classes’ test results were displayed in each classroom and discuss content that will be covered on the tests. For example, in a conversation about water pollution during the after school club, a student uses the word “desertification.” Another student mentioned that this word will be on the statewide assessment, starting a conversation between several students about how they are simultaneously sick of hearing about the tests and nervous for them because of how teachers are always telling them that they won’t go on to the next grade level if they don’t pass. In one focus group, students spent around 30 minutes just expressing anxiety about the testing process. Another student, in an informal conversation with me, mentioned that she was worried about other students taking the tests seriously, saying that sometimes “they just circle anything and don’t get enough sleep and this year it’s on the computer.” Not only did the discourses of accountability circulated at RPMS cause anxiety among the students, they also created a system in which learning was only valuable in terms of acquiring enough knowledge to pass specific tests. Anderson (2016) also argues that a focus on standards denies the agency of teachers and students in the learning process.

**Responsibility.** Closely related to the discourse of accountability is the discourse of responsibility. Tobin (2011) argues that, “A tendency to blame public schooling, school districts, principals, and teachers is pervasive and consistent with neoliberal frameworks that embrace the needs to hold individuals responsible for educational productivity” (p. 3). At RPMS, responsibility was passed from the state, to the district, to the schools, to the teachers, to the students. Generally, this responsibility focused on why students weren’t learning what they were supposed to or as much as indicated in the standards, as demonstrated by low scores on

standardized tests, or on student behavior, and resulted in tremendous pressure on teachers. Many times, teachers indicated that there was only so much they can do if the students “don’t want to learn” and expressed frustration, directly to students, that they wouldn’t take more responsibility for their education. Students were often told that they were responsible for their learning, from completing assignments to keeping up with their materials. Teachers expressed frustration that they were held responsible for students’ achievement without consideration of any other factors. One teacher, when discussing how students are passed on to the next grade even if they aren’t ready, expressed, “we’re pushing them on and pushing them on, then you’re holding me responsible for it.”

Students were often directly told they were responsible for the school’s challenges. For example, during snack time at the after school program, a period of about 20 minutes directly after the end of the school day and before students move to their chosen after school activity, the site coordinator reprimanded the entire group of students for not working on homework while they ate snack. The following notes were recorded as field notes (not verbatim quotes):

She tells them that they’re trying to keep THEIR school open so they need to “improve your scores.” The admin is pulling grades and they see all these zeroes for homework. At the end of the semester your data goes to the people who run this program and they need to see you gained something. [Partner university] pays a lot for this program and budgets are being cut because of attendance, people not coming to get snacks and dinner. They need to start coming every day and tell their friends who are on the roster that they need to be here too. Next week they’re going to start taking attendance again and rewarding attendance. Some of you know, like this crew (refers to group of 7<sup>th</sup> graders)

that you don't need to be together, so split up, sit somewhere else. And if someone's bothering you, move, don't tell me about it because I don't care.

In this exchange, the site coordinator, who herself is likely under tremendous pressure to show student gains in achievement and attendance, transfers responsibility for several aspects of the program to the students. They are responsible for keeping their school open, despite the range of external factors in a decision like this that are well beyond the control of any student, they are responsible for their own attendance as well as that of their peers who aren't coming to the program, and they are responsible for handling anyone who might be "bothering" them or distracting them from their work. Essentially, these students are being told that they are the ones solely responsible for their education as well as after school program.

Some students, especially those who were labeled "gifted" or viewed by teachers as academically advanced, indicated that they felt additional pressure around standardized tests because teachers told them that they needed to perform well on the test to compensate for other students' lower scores. One high achieving student expressed frustration during a focus group, saying, "you don't need to tell me that our school is in jeopardy of being taken over by the state because of our horrible test scores...that's a lot of pressure and they wonder why we don't have extra time or leisure time or hobbies, you know?"

**Individuality and Competition.** Other neoliberal discourses permeating education include focuses on individuality and competition (Bazzul, 2012; Tobin, 2011). Bazzul (2012) notes that in education, a focus on economic gains "means emphasizing individual achievement over the common good" (p. 4) and Bencze and Carter (2011) discuss how current educational practices "promote values such as individual responsibility, competition, excellence, efficiency,

and standardization.” At RPMS a focus on competition was felt district wide, as large-scale competitions like Race to the Top affected policies such as the teacher evaluation system as the district competed with other districts for federal money. RPMS was also in competition with other schools in the district, particularly as school closures became commonplace. This competition was based on test scores and enrollment and, at the end of this study, RPMS was on the list of proposed school closings.

Within the school, students were encouraged to work individually and in competition with each other. This was seen in the science fair, where students were encouraged to work alone, even though groups of students were allowed in the official rules of the science fair, and working collaboratively is considered an important aspect of the nature of science. The teachers told the students that they might not be able to count on their group members and that they should think carefully about working with anyone they couldn't trust. As a result, most students completed the science fair as an individual project. The science fair itself was structured as a competition, with various levels of awards given within the classroom, school, and district. Several students expressed that their goal for the science fair was to win an award. The school also held other academic fairs, such as a social studies fair, that was structured in the same way. Other special events often focused on field trips as well, such as a market day that was held by the business and entrepreneurship department. In this event, students competed to run a market-based business, i.e., selling snacks or small trinkets, and the group who made the most profit off their business was considered the winner.

The impact of these discourses of education, which focus on test scores and preparing for college and career, is to create an homogenized student, one who's only value is the ability to perform for the school and, later, for the economy (Chesky & Goldstein, 2016). The subject

position constructed is that of a good student who does well on standardized tests, works independently without help from others, and is planning to attend college. Students who do not do well on tests or plan to go to college, as well as students who need support or offer support to others, are excluded from this subject position.

### **Discourses of Race (Urban Education): The At-Risk Student**

Because this research focuses on the experiences of African American, middle school girls in school environments, discourses of race specific to educational environments are considered here. I do not mean to imply that other racial discourses are not important in US society and the participants' lives, however it is not within the scope of this analysis. These include common discourses of urban education: increased discipline and punishment for students of color, discourses of violence in urban schools, and deficit based discourses describing the students and community. Discourses specific to African American girls (i.e., intersecting discourses of race and gender) will be discussed in the next section

**Increasing discipline and punishment.** Research in urban education has identified the increasing criminalization of schools, including the presence of police, or school resource officers, in schools (Theriot, 2009) and high levels of suspensions and expulsions of students of color, leading to the “school to prison pipeline” (Wald & Losen, 2003). This leads to a discourse of urban education that positions students as in need of increased discipline and punishment, compared to their suburban or white counterparts. This was a dominant discourses at RPMS as well, where students faced formal punishments for larger offenses, such as fighting, which were punished with long-term suspensions of up to 10 days or more, as well as subjective offensives like disobedience. Students were regularly sent to in school suspension for being disrespectful or talking back. Although not consistent, students were also sent to ISS semi-regularly for being

out of uniform, including minor infractions like wearing the wrong color socks. However, this seemed to be used more as a way to control certain students than as a way to enforce the dress code; to my knowledge, only students who had reputations for being disruptive were sent to ISS for dress code infractions although I saw dozens of girls daily wearing sneakers, bright socks, or other non-dress code approved items. There was also a commonly acknowledged connection between the school's discipline policies and the police system. Several school officers, dressed in full police uniforms, were present in the halls, monitored the cafeteria during lunch, and even were asked to come to the after school program to remove girls. The threat of ending up in "juvie" (juvenile detention center) was also used against the girls, and the girls themselves referred to the alternative school, where students were often sent after larger infractions such as fighting, as CP – the children's prison.

Wun (2016) has also shown that black students are more likely to be punished for nonviolent and subjective offenses, such as talking back or being insubordinate, and are subject to excessive policing in school. African American girls in particular are also subject to informal means of punishment, such as getting sent out of class or being the subject of neglect and humiliation (Wun, 2016). These informal means of discipline were also widespread at RPMS. For example, one student explained to me that the reason she wasn't allowed to go on a field trip was because she got up to throw away trash without permission from her teacher. The same student was forced to walk home from the after school program, a distance of three miles, after being "disrespectful" to the program coordinator. Kicking students out of class was widespread, accepted practice – in at least half of the days in which I observed a class, at least one student was asked to leave, usually for the entire class period. Students were also regularly kicked out of the after school program, for being disruptive or even, ironically, having too many absences.

Many of the students internalized this informal punishment, often agreeing that the “bad students” should be sent out of class. In my first semester leading the after school science club, students repeatedly asked me to kick out students who they felt “didn’t know how to act.”

The dominance of discourses of discipline and punishment, both formal and informal, at RPMS continuously impacts the experiences of the students and the atmosphere of the school. As Wun (2016) points out, even for students who are not being disciplined, the fear of punishment for infractions such as “disrespect” leads to a fear of asserting any kind of agency in their educational experiences.

**Prevalence of violence.** Discourses of urban education often construct urban schools as violent, out of control places. This was seen at RPMS most noticeably in the presence of police officers throughout the school. Officers were regularly seen in the cafeteria and hallways, closely watching students. Although in general the officers were friendly, and many made efforts to establish relationships with the girls, their presence alone indicated an assumption that something could happen at any second that would necessitate their involvement. The most common need for the officers, and the only time I witnessed them in action, was in breaking up fights and removing students from classrooms or other school areas for behavior related reasons. The officers, as well as the administration at the school, often positioned students as potentially violent individuals, regardless of what the student was actually doing. For example, after an activity in the after school science club where we were visiting a nearby creek and clearing trails along the way, a group of about five students and myself were walking through the school hallways. One of the students was carrying the hedge trimmers we had used on the trail, resting lightly on her shoulder. We were approached from the opposite direction by a school police officer who immediately took the hedge trimmers from the girl and told her, not prefacing the

statement at all, “These are a weapon.” I explained that they were hedge trimmers that we used for trail maintenance and was informed that we could not have them in the school. During this exchange, the police officer spoke loudly and, in my interpretation, aggressively at the girls, who all remained quiet and stared at the floor or at me. In another instance from the after school club, a girl went to the bathroom alone to get water and was escorted back to the classroom, about 20 feet away from the bathroom, by the police officer who then questioned me on what we were doing and why she would need to get water. Again, the students did not respond to the officer in any way, remaining passive. Interestingly, these interactions made me feel as if I had done something wrong, despite knowing logically that I had not, and led me to monitor the actions of the students more in order to avoid further interactions with the officer.

The students also often discussed their school as a violent place and, in particular, a place where fighting was common. They often told stories of fights that happened during school, with one student telling me there was a fight about every week. In reality, it seems as if the number of actual fights is lower than students perceive it to be, but they do still occur and students treat fighting as a way of life or even a rite-of-passage in the school. For example, after one fight involving a member of the after school science club, another member told me, “I thought I would get into a fight before her!” Indicating that at some point during their time at RPMS, it was expected that most students would get into a fight. Another student involved in a fight explained it as a natural result of a conflict with another student. Before this fight, I witnessed the increased emotions of this girl as well as her peers, who were excited at the prospect of a fight and encouraged to continue. Once the fight started, several other girls joined in. Afterwards, despite being suspended for ten days, the girls involved explained to me that they had to fight to

protect their reputations and support their friends, so that they wouldn't be "messed with" anymore.

Students also discuss violence in their communities, such as a pool getting "shot up" over the summer, and occasionally express anxiety and fear that they will be a victim of violence, including kidnapping, rape, or murder. Several students explained to me the precautions that take to stay safe, including having guns in their homes.

Although the threat of violence in the school as well as the community does exist and should be treated seriously, the discourses of urban education often position students as inevitable perpetrators of violence within the school, even when engaged in activities such as a science club. The students themselves have difficulty navigating or resisting this discourse, and at times seem to engage in fights because it is what's expected of them by peers and adults at the school.

**Deficit Discourses: Being Ghetto.** Research has shown that deficit discourses of urban education and urban schools are common place in US society, including among teachers (Jacobs, 2015; Milner, 2012). Indeed, the word "urban" is often used as a euphemism or code to describe under resourced public schools that serve Brown and Black students (Barton, 2001; Milner, 2012; Mutege, 2013). Milner (2012) notes that at one school, "They seemed to classify the school as urban because of their perceived shortcomings of students and parents in the school" (p. 558). At RPMS, the teachers often perpetuated deficit discourses of students and the community, at times referring to students as "ghetto" or "ratchet." One teacher, when I asked her what made a student ghetto, explained that it was based in the family, that you knew a student was ghetto if her whole family showed up at the school to fight someone (although she referred to a specific student, it was unclear to me if this had actually happened). Another

teacher maintained that ghetto-ness came from the neighborhood one grew up in, a more traditional view. It's important to note also that in the same conversation, these teachers also expressed a great deal of concern for the students, saying, "I don't care how much I fuss here, I love these little girls" and explaining that they "play ghetto" and it's not who they are at "the core." These teachers are all middle class African American women, and, as Morris (2007) suggests, perhaps struggling with what they view as the importance in helping the girls learn social skills or overcome stereotypes to better compete in a middle-class, white world.

Students also took up this same deficit discourse when referring to peers, perhaps as a way to differentiate themselves. They often referred to students who they didn't like, or who had angered them in some way, as ghetto or ratchet. When I asked students what it meant to be ghetto, they explained that it depended on a variety of factors, including your neighborhood, how you dress, how you talk, if you're too loud, and if you get in fights. One student explained being ghetto as someone who "talks ghetto, talks loud, gets in fights, starts stuff." The topic of neighborhoods being ghetto or ratchet also came up several times during the study. The following exchange was taken from a focus group conversation, which had previously been focused on violence. One girl mentioned that if you live in a "ratchet neighborhood," you were more likely to be a victim of violence.

T: This school is around a ratchet neighborhood, right at the river - at that creek

Me: What do you mean ratchet neighborhood?

T: Ghetto

Me: What makes it Ghetto?

A: the people

T: There's always police

B: They don't deliver the pizza there no more. Y'all know what I'm talking about

Me: Why not?

B: They don't deliver pizza to at [nearby neighborhood] no more

S: They really don't

Me: Why not?

B: Cause they dangerous

L: And they police, they always like, going down our streets and stuff

In this exchange, the students are indicating that a ghetto neighborhood is defined by the people who live there, and is also unsafe, so much so that outsiders won't enter the neighborhood (i.e., pizza delivery). The prevalence of police is also not uncommon.

These discourses of race and urban education construct the subject position for students of the "at-risk student": a student who is out of control, needs to be punished to learn how to behave, is often violent, and acts and talks in ways that are detrimental to their education. This subject is "at-risk" of not succeeding in school, and is in need of training to become a "better" student. This subject position seems to be the foil to the good student described above.

### **Discourses of Gender: The Good Girls**

Discourses constructing what it means to be a girl or woman have long been documented in society (Butler, 1994) and educational settings (Archer et al., 2012; Renold, 2006). For example, Renold (2006) examined high achieving girls and identified tension between the roles of "being bright" and "doing girl." In her work, teachers were more likely to recognize a "nice girl" as a good student, particularly when the student was working class and non-white. Even for girls who are trying to position themselves as feminine and clever, both teachers and peers often

undermined their efforts, describing the girls as bossy, selfish, or arrogant. This section describes how general discourses of femininity are present and circulated at RPMS. The following section examines the intersection of these discourses with discourses of race to consider specifically how African American girls are positioned.

**Discourses of presentation.** There are reminders throughout the school of how the girls are expected to present themselves. Most noticeable is a large banner (approximately three feet by six feet) that hangs in three places, over each turn in the stairwell that students use daily between classes. The banner reads, “I am poised, polished, professional, and full of school pride.” This saying is echoed in other places in the school, and I often heard the girls repeating it (sometimes in mocking tones). Another sign that bore the same logo, with the addition of a fifth word: prepared, actually broke it down to instruct students on appropriate presentation; this sign, referred to by students as BP5, which measured approximately three foot by three foot and was present in several classrooms and common spaces such as the media center, provided bullet points of how girls could demonstrate that they were “poised, polished, professional, and full of school pride” in different locations of the school building, including hallways, classrooms, the cafeteria, buses, and the media center. Instructions regarding presentation included “dress in full uniform” and “use appropriate etiquette.” The uniform itself presented a feminized image of a student. Colors were limited to pink, brown, and white, with girls expected to wear skirts or dress pants, tights or knee highs, and flats, not sneakers or boots. Additionally, according to the school’s website, “Extremes in haircuts, hairstyles, or hair color are not permitted. Excessive make-up is inappropriate. Bandannas and scarves are never permitted while in uniform - on or off campus,” further defining an appropriate way to look for the girls. Of all of the signs and bulletin boards in the hallways of the school, only one contained images of students. This

picture also presented an overly feminized image of a student: the picture is of four girls wearing long dresses, each holding the dress out with one hand, the other hand on their hip as if in the middle of a curtsy. Each girl has a crown of flowers on her head and bracelet of flowers on one arm. These images and descriptions of students construct for students a highly feminized, and homogeneous, view of how to be a girl. In the after school science club, when students were asked to chose pictures to represent themselves (taken over the course of the semester during the after school club), the majority of students chose pictures where they “looked good” or “pretty” or “cute.” Most of these pictures were passive, showing the students smiling at the camera but not engaged in any activity. Even in the school creed, which is recited by students each morning, the word “beautiful” is used, in the first person, to describe the RPMS student.

**Acting nice and helpful.** In addition to how to look like a girl, discourses also circulated around how to act like a girl. For example, one bulletin board in the school had the word “BE” in the center, surrounded by 29 different adjectives. Although some of these adjectives were gender-neutral, including confident, accepting, and unique, many conformed to discourses of girls needing to be nice and helpful, including words like friendly, polite, kind, happy, and calm. On another hallway, a counselor’s door was decorated in a similar fashion and also included the words calm, friendly, helpful, and kind. To elaborate on these adjectives, the BP5 sign contained many explicit directives on how to act like a girl. For example, some bullet points read, “Use appropriate language at all times” and “Be courteous.” The girls themselves identified these as standards that they were held to specifically because they were girls. In a focus group in which we were discussing the BP5 poster, one student stated, “They expect more from us because we’re girls” and another student followed up, “For girls, they want you to be very decent, calm,

and all this stuff.” Additionally, when girls were asked to describe themselves on the first day of the science club during the summer camp, the most common words used were nice and beautiful.

These discourses of gender create the subject position of a “good girl” as someone who presents themselves in highly feminized ways, including “looking pretty” and “acting nice.” This subject position is highly regarded by teachers, but rewards passivity instead of active engagement in learning.

### **Intersecting Discourses of Gender and Race**

For African American girls, there are distinct discourses indicating a belief that they are incapable of living up to the expectations of femininity. For example, African American girls are often viewed as being in need of control and being too loud.

**African American girls are in need of control.** African American women and girls are often viewed as being in need of control. Youdell (2003) examined how teachers and staff in one school saw African American bodies as needing additional surveillance and bodily control. At RPMS, this discourse was evident in the BP5 poster (Figure 3), where, in addition to the bullet points referring to being feminine discussed above, a large number of bullet points refer to some kind of body regulation. There are 17 instances of a bullet point telling a student how to control or display their body, including where students are allowed to be (“Sit in assigned area”), how students should position their bodies (“Feet on floor under desk”) and what students can look like (“Dress in full uniform”). The word “appropriate” is used eight times on the board, generally in terms of “appropriate interactions.” In practice, this focus on control was seen in the amount of time spent trying to maintain order and giving the students directions. In the after school program, the majority of interactions between adults and students during the 30 minute snack and 30 minute dinner periods involved the adults giving some kind of direction to control

students, telling them when they were allowed to stand, get a snack, throw away trash, and leave the room, or reprimanding students for not behaving, using phrases like, “y’all are out of control.” Some teachers in the after school program even used a whistle to get students’ attention and maintain order. Students are also told to line up and travel in straight lines when leaving classrooms for lunch or when going to their after school activity.

BP <sup>5</sup> Matrix					
Area of Building	Poised	Polished	Professional	Prepared	Pride
Classrooms	<ul style="list-style-type: none"> <li>• Feet on floor under desk</li> <li>• Sit up straight</li> <li>• Prepared to work</li> </ul>	<ul style="list-style-type: none"> <li>• Dress in full uniform</li> <li>• Use appropriate language at all times</li> <li>• Be courteous</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain a positive attitude</li> <li>• Work collaboratively with peers</li> <li>• Engage in the lesson</li> </ul>	<ul style="list-style-type: none"> <li>• Be ready in advance</li> <li>• Have all materials necessary to work effectively</li> </ul>	<ul style="list-style-type: none"> <li>• Be eager to learn</li> <li>• Ask/Answer questions</li> <li>• Participate</li> </ul>
Hallway	<ul style="list-style-type: none"> <li>• Respect yourself and others</li> <li>• Inside voices</li> </ul>	<ul style="list-style-type: none"> <li>• Go directly to your destination</li> <li>• Enter lockers at appropriate times quickly and quietly</li> </ul>	<ul style="list-style-type: none"> <li>• Move with purpose to destination</li> <li>• Interact appropriately with others in the hall</li> </ul>	<ul style="list-style-type: none"> <li>• Have your hall pass in hand</li> </ul>	<ul style="list-style-type: none"> <li>• Dress in full uniform</li> <li>• Walk on the right</li> <li>• Hold your head up high</li> </ul>
Cafeteria	<ul style="list-style-type: none"> <li>• Enter orderly and move to designated seat</li> <li>• Line up when directed</li> <li>• Follow directions</li> </ul>	<ul style="list-style-type: none"> <li>• Enter the lunch line in an orderly fashion</li> <li>• Respect cafeteria workers and peers at all times</li> </ul>	<ul style="list-style-type: none"> <li>• Sit in assigned area</li> <li>• Interact appropriately with peers</li> </ul>	<ul style="list-style-type: none"> <li>• Get all condiments and utensils when you go through the line</li> <li>• Know your lunch number</li> </ul>	<ul style="list-style-type: none"> <li>• Display proper etiquette</li> <li>• Keep your area clean</li> <li>• Discard trash appropriately</li> </ul>
Media Center	<ul style="list-style-type: none"> <li>• Use inside voices</li> <li>• Focus on the task</li> <li>• Be attentive and respectful</li> </ul>	<ul style="list-style-type: none"> <li>• Interact with students and teachers in an appropriate manner</li> </ul>	<ul style="list-style-type: none"> <li>• Enter and leave quietly</li> <li>• Return all materials/books to appropriate area</li> <li>• Be responsible for your belongings</li> </ul>	<ul style="list-style-type: none"> <li>• Be prepared to do research</li> <li>• Have all materials necessary to work in the media center</li> </ul>	<ul style="list-style-type: none"> <li>• Read/check out books</li> <li>• Take care of books</li> <li>• Participate in school-wide competitions</li> </ul>
School Bus	<ul style="list-style-type: none"> <li>• Enter the bus loading zone in an orderly fashion</li> <li>• Follow all bus rules</li> </ul>	<ul style="list-style-type: none"> <li>• Respect the driver and students on the bus</li> <li>• Remain seated until time to get off the bus</li> </ul>	<ul style="list-style-type: none"> <li>• Interact appropriately on the bus, at the bus stop, and in the bus loading zone</li> </ul>	<ul style="list-style-type: none"> <li>• Be prepared to exit the bus at your stop</li> <li>• Keep up with your belongings</li> </ul>	<ul style="list-style-type: none"> <li>• Keep your area clean</li> <li>• Sit in your designated seat</li> <li>• Keep arms and head inside the bus</li> </ul>

Figure 3. BP5 Poster.

**African American girls are too loud.** Morris (2007) shows how African American female students in particular are encouraged to be more feminine, or lady-like, at the expense of academic achievement, which teachers describing the students as being too loud and wearing inappropriate clothing. Seeking to control the bodies of these students, they encouraged them to be more quiet and passive. On the BP5 poster, ten bullet points refer to how students should

sound, controlling both volume (“inside voices”) and language and interactions with others, which should be “appropriate.” This was observed at RPMS as an insistence not just on quiet, but on silence, particularly in spaces with large groups of students. For example, in the after school program, during announcements to the entire group the adults would express frustration at any amount of noise, usually responding by yelling or reprimanding the girls. On several occasions, a teacher or other adult at the school would reprimand students for talking or being too loud at times when the room seemed quiet to me, as an observer. Students were often praised by adults for their ability to be quiet, such as when a teacher called a particular student “awesome” because, “She's been listening the whole time, not talking, you guys didn't even know she was over there.” Adults also controlled access to food based on noise level, with tables chosen for lunch or snack based on which ones were quietest.

These discourses of race and gender lead to a construction of the good African American girl that is more extreme than that of the good girl. The good African American girl is someone who is silent, passive, and under control. This student doesn't make a lot, or any noise, and always behaves in appropriate ways. This subject position is under constant surveillance and subject to continuous reprimands and reminders of how to look, act, and sound.

### **Intersecting Discourses of Education, Science, Gender, and Race.**

Additional intersections between multiple macro level discourses were also observed at RPMS. These intersections segregated students into subject positions of special and not-special, with access to science experiences reserved exclusively for special students.

**Special Students.** Discourses of gender and race intersect with discourses of education to create connections between educational access and achievement and student behavior, creating a discourse that some students are just special. As discussed above, students were expected to

meet feminized standards of appearance and behavior in order to be considered good students. The implications of this extend beyond just recognition as a good student, students who met this expectation were rewarded with additional educational opportunities and even better grades. For example, educational field trips were commonly used as rewards for good behavior, both during the school day and in the after school program. One student explained that she didn't go on a field trip "Because I'm a bad kid." Some field trips were exclusive, for only two or three students who were hand selected by teachers. Generally the same students were selected multiple times for these field trips. In the after school program, students had to "buy" permission slips to field trips using "after school bucks" which they were given by their teachers. There was no formal list of ways to earn the bucks, but they were generally given as positive reinforcements for desired behavior, such as being on time and being helpful. Interestingly, when I asked several girls how to get the bucks, they told me they didn't know. One student told me the after school field trips were also connected to behavior in school, explaining, "They invite you if you're good in school." Field trips were also revoked for students as punishments for bad behavior.

In addition to field trips, other school structures served to link discourses of gender, race, and education by creating connections between learning, or at least grades, and behavior. For example, students were often penalized for behavior by exclusion from class, which directly resulted in lower grade when students missed assignments and instruction. Students were also given a conduct grade in each class, and there were formal recognitions for students chosen by their teachers as "good students." This recognition was in the form of an assembly where pictures of all of the chosen girls were shown in a presentation for the entire school. The award, though completely subjective on the part of the teachers, was called "BP5," a reference to the

sign described above, indicating that the selected students somehow met the expectations spelled out on the sign.

These structures led to students conflating grades and behavior. In the following conversation between three students and myself, one student (C) spent about 15 minutes explaining to me that she did not like school because it's boring and her teachers don't like her. In the following exchange, she is describing an exception to this pattern.

C: But like I was saying, the art teacher likes me. A lot. I am a nice student. I got nominated for BP5

L: yes we are!

Me: What's BP5?

J: Poised, polished, professional, prepared, and FULL of school Pride!

L: Make it a great day!

C: And I got nominated two times

Me: Your art teacher nominated you?

C: Yes, I made a 100 on my vocabulary test

In this exchange, the girls show that they are familiar with BP5 by quoting verbatim the motto printed on the poster and reproduced throughout the school. We also see that C is equating getting recognized for BP5 with being a "nice student", which is related to being liked by her teacher. Finally, C makes the logical connection from the teacher liking her, to being nominated for BP5 to doing well academically ("I made a 100 on my vocabulary test"). In this short excerpt, we see evidence that within this educational discourse, "good girls" are more likely to be positioned as good students, as Youdell (2003) noted.

The intersection of discourses of education, gender, and race led to a construction of two specific types of students at RPMS: the special student and the not-special student. The special student meets the feminized expectations of appearance and behavior and is afforded more educational opportunities and better grades because they are seen as a good student. The not-special student does not meet appearance and behavior expectations and is often excluded from educational experiences and generally has lower grades, marking them as a bad student. There is very little space here for a student who does not meet feminine expectations for appearance and behavior to also be considered a good student. Teachers often expressed views that certain students were just better than others, and students who were benefitting from this dichotomy, i.e., the special students, often internalized it, referring to other students as not belonging or knowing how to act. Interestingly, the not-special students would acknowledge that there was a dichotomy at the school, and could quickly identify who the special students were, but were more likely to critique this discourse, often pointing out a teacher's favoritism. One example of this is the discrepancy in uniform policy enforcement described above; it was generally students who were already positioned as not-special students who were disciplined for minor uniform infractions and sent to ISS as a result.

**Science is for special students.** Extending the special student and not special student dichotomy, there was also an explicit connection between student behavior and science education. Discourses of science being only for special people and discourses of African American girls being too loud and in need of control intersect at RPMS to create a construction of science being only for "good girls." This intersection is seen most clearly in the "STEM Girls Should BE" bulletin board. The board contains 28 adjectives on pink cards in a variety of different fonts (Figure 5). Some of the words have already been discussed, but considering the

board in its entirety helps us understand the impact of intersecting discourses of science, education, race, and gender at RPMS. First, consider the title of this board. The use of the word “STEM” instead of science, technology, engineering, or math adds a level of abstraction, particularly for middle school students who may not be familiar with the acronym. This highlights the discourses of science as mysterious. It is also important to acknowledge the privileging of STEM subjects here, indicating the discourse of science as elite, as there was no board mentioning “Literature Girls” or “History Girls.” Returning to the title, one might expect it to read “STEM Girls ARE”, as a way to show off attributes of the girls in this self-proclaimed STEM school. However, by changing the verb to “Should BE”, we get a different message. Now our audience has shifted from a school already full of STEM Girls to a school that is hoping to create STEM Girls, by explaining to them how they SHOULD be (in contrast to how they already are being). This is subtle form of control, part of the discourses of race and gender, and the girls are being told how to be if they want to be recognized in the privileged subject position of a “STEM Girl.” The majority of words on this poster are similar to, or even synonyms of, nice: helpful, kind, calm, humble, happy, patient. This further develops the intersection of discourses of science, gender, and race: African American girls must act in overly accommodating and traditionally feminine ways, which are not typically part of the discourses of science but have been included with them in this board. Other words on the board seem irrelevant to both school and science: open, grateful, available, everywhere. What is interesting to note is that none of the words on the board have anything to do specifically with STEM. These words are in line with discourses of gender and race circulated at the school, but they also might indicate a lack of understanding or confusion about what a STEM Girl actually would be, indicating again the discourse of science as confusing or mysterious. Additionally, any

discourses of scientific practices or science as a process or way of thinking is absent. If one truly wants to capture what makes a person “scientific” (a dubious task), words such as creative, critical, curious, open-minded, persistent, courageous, motivated, skeptical, or imaginative might be included. Even the traditional, neoliberal STEM discourse found in many textbooks and schools (Bazzul, 2012), which might include words such as independent, competitive, or intelligent, is missing. As Tobin (2011) found, there is little evidence here to indicate a view of science where student are curious, asking questions and seeking answers, possibly because of an emphasis on accountability, which includes memorization and test-taking, not exploring and learning. This board has presented a subject position of a “STEM Girl” as being essentially the same as that of a “Good Girl.”

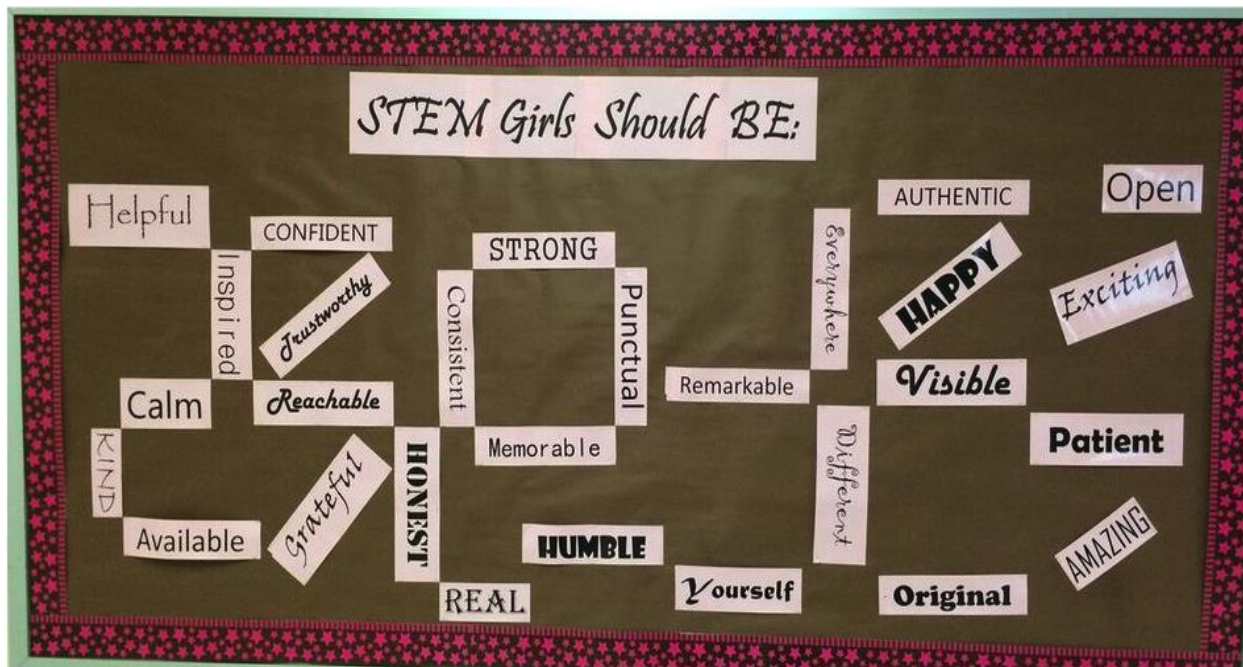


Figure 5. STEM Girls bulletin board.

As an illustration of this intersection, several students, as well as teachers, expressed that their classes did not do labs or experiments in science because of student behavior. Students in different grades expressed that their teacher had told the class that while they wanted to do labs

with them, the class would have to “earn” them through good behavior, something that never happened during the time frame of the study. Additionally, science (or STEM) field trips in particular were reserved for certain, specially chosen, students. One student expressed in a focus group, “If you have good grades, they’re going to force you to go on a STEM fieldtrip!” As with the special student discourse discussed above, students who were benefitting from this dichotomy often wanted to maintain it, for example insisting that the after school science club be exclusive and that certain girls not be allowed to join or be kicked out if they didn’t meet the behavior expectations of the other girls. Tension was regularly felt in the club between “special” and “not special” students.

### **Meso-Level Discourses**

This section describes the meso-level of discourse analysis, examining how the seventh grade science classroom functions as a figured world of science. As Gee (2014b) explains, “Figured worlds are an important tool of inquiry because they mediate between the “micro” (small) level of social interaction and the “macro” (large) level of institutions” (p. 95). The seventh grade science classroom is conceptualized as a figured world where the societal and school-wide macro level discourses identified in the previous section intersect in unique ways and are passed on to and negotiated by students. This section first describes the seventh grade science classroom that was the focus of this study. This description includes the physical description of the classroom as well as the components of the figured world of school science, including meaningful acts, artifacts, people, and rules. Next, the influence of macro-level discourses of education, science, race, and gender are discussed. Finally, the figured world of the science classroom is analyzed by examining how it functions to construct science and position students in unique ways.

### **Seventh Grade Science Class**

**Description.** The seventh grade science class that was the focus of this research met every other day for 84 minutes immediately after lunch. The classroom itself has many features of a traditional classroom: there is a large white board and projector at the front of the room, a bulletin board on one wall, and a row of five computers and a printer against a wall. On the whiteboard, the teacher posts the agenda and standards for the day. There are also features of a traditional science classroom: instead of desks, there are black tables (seating two students each), along the back wall, there is a row of storage cabinets over a counter that has two sinks. On one side of the room is a bookshelf full of text books. On the same side is a table with three bins full of notebooks belonging to eighth graders. A similar table is on the other side of the room, next to the computers, with bins for seventh graders' notebooks. The tables in the room are arranged in two large U-shapes, with chairs on the outside of the U facing towards the front of the room. Each U seats 12-15 students. Decorating the walls are several mass-produced science posters, including smaller posters with physical science vocabulary words, including atom, element, sound, light, and more generic science words such as observation, investigation, and theory. Along the back cabinets, there are posters made by the eighth graders. There is no work created by the seventh grade students displayed in the room. The bulletin board, created by the teacher, says "She blinded me with SCIENCE," with the word science made out of various science tools or images, such as a magnifying glass.

**Meaningful acts.** A meaningful act is a taken for granted sequence of events in a figured world (Holland et al., 1998). These acts are also referred to prototypical events (Gee, 2014b) and represent the regular, day-to-day activities of the figured world. In this classroom, several recurring events comprised a typical class session.

The seventh grade science class begins each day with a “Sponge,” or warm-up activity. Generally, this activity is a short set of about 3 questions for students to answer in their science notebooks. Often the questions ask students to define given vocabulary words using textbooks, and sometimes they involve preparing for the day’s lesson in some way (i.e., copying a template for notes or beginning a reading). Generally the textbooks are already on the students’ tables; when they are not, students retrieve them without prompting from the bookshelf. During the warm-up activity, the students worked quietly and independently in their seats and the teacher completed logistical tasks, such as attendance.

After the warm up activity, most learning activities in the classroom revolve around taking notes, generally in a science notebook. The notes are usually from a PowerPoint led by the teacher, a reading, or a technology based assignment, like a web quest or simulation. Most days, the students also use the textbook in some fashion, either to take notes or, more common, to look up definitions of words. As with the warm-up, students generally completed the note-taking activities quietly and individually, with the teacher explaining or reviewing what the students should be writing down. The teacher also often put on music while students worked on assignments.

During the course of the fall semester, the science fair emerged as another meaningful act in this figured world. All students were expected to complete a science fair project, which consisted of designing and performing an experiment to answer a unique question. A small amount of time was available in class for students to work on planning for project, including time to research topics and materials needed and design their display boards, but the majority of the project was to be completed individually at home. Near the end of the semester, students brought in their completed boards and presented their projects for the rest of the class. The

teacher gave the class evaluation rubrics to fill out as they watched the presentations and a list of appropriate questions to ask the presenter at the end. The teacher also chose several projects to progress on to the school wide science fair.

Another meaningful act in this classroom revolved around punishment. On over half of the days that I observed the class, at least one student was put out of the class for behavior reasons. These events followed a typical sequence. The student would engage in some kind of behavior that the teacher found disruptive or unacceptable, such as talking too much or not working on the assignment. The student might receive a warning, but often the teacher simply asked them to “get out” or “step outside.” The student, usually with some grumbling, would slowly make their way to the hallway. The teacher then continued what she was doing until a natural break in the lesson and then stepped into the hallway to talk to the student. Occasionally, the student was allowed back into the room but, more often, they were sent to another teacher’s classroom for the remainder of the class period. During this event, other students waited quietly.

**Artifacts.** The most important artifacts in this classroom were the textbooks and notebooks that students used almost daily. Textbooks were generally already on the desks for student use at the beginning of class, and students often referred to them with no prompting from the teacher, i.e., if a warm up question asked for a definition, all students immediately used the glossary in the textbook to look up the word. A class set of textbooks was stored on a bookshelf at one side of the room; students were not given textbooks to take home or use outside of the classroom.

A second important artifact in the classroom was the science notebook. Each student was expected to bring in a notebook to be used just for their science class. Most students used spiral notebooks for this purpose. Three bins on each side of the room were used to store the

notebooks for each class (seventh grade bins on one side, eighth grade bins on the other). Like the textbooks, students were expected to leave the notebooks in the bins after class – not to bring them home. However, there was little oversight of the notebooks and students sometimes did bring them home or store them in their book bags or lockers instead of the classroom.

**People.** In this figured world, there were two main roles, teacher and student, who participated in the meaningful acts of the figured world. Rarely did other people enter this figured world.

*Teacher.* At the time of this research, Ms. Smith was in her third year as a teacher. She is a young, African American woman who grew up in a nearby neighborhood and attended college at a nearby university. She began her teaching career at RPMS, teaching eighth grade physical science. The 2016-2017 school year was the first year Ms. Smith taught seventh grade life science. Ms. Smith had a background in life science – she majored in biology and worked in a research lab. However, it was not until several weeks into the school year that Ms. Smith was told that she would have to teach all of the eighth grade and seventh grade science tasks. This was the result of a district wide process that occurs after the school year has started where teachers are transferred among schools based on the actual enrollment of each school. When this happened at RPMS, the school needed an additional English teacher and, because she held the certification, the seventh grade science teacher became the English teacher. Ms. Smith then took over responsibility for the seventh grade science classes. Although she had a background in life science and often shared interesting and innovative ideas for class activities, labs, and projects, she rarely implemented these ideas in class. She expressed frustration that she did not have time to adequately plan for the seventh grade class, she did not get to know the students at the beginning of the year (she was still struggling to learn names at the end of the first semester,

something she noted was a challenge), planning for two different subjects was time-consuming, and because the eighth grade class had a state-mandated assessment, she felt she had to focus her energies on that class.

In the classroom, the teacher, Ms. Smith, maintained complete authority. She expected students to work quietly and follow directions. Although very personable and friendly outside of the classroom, Ms. Smith generally came across as stern, and sometimes angry. She often made sarcastic comments to students, telling them in a dry tone, “No one cares. Go sit down.” However, despite her tough demeanor in class, she occasionally showed a soft spot for students. Ms. Smith once told me about a student who was well known in the seventh grade as a trouble maker and out of control. One day, Ms. Smith found a caterpillar and brought it in for the class to see. That day, the student was put out of another class and came to see Ms. Smith. The student immediately became engaged with the caterpillar, and began doing research to find out what type of caterpillar it was, what type of butterfly it would be, and what it ate. Ms. Smith was surprised and proud of this student, and went out of her way to visit all of the seventh grade teachers to tell them what happened in order to show them that the student was capable of more than they might think about her. Ms. Smith often showed this more supportive side in one-on-one conversations with students.

*Students.* The seventh grade science classroom had about twenty-five students, all African American girls between the ages of 11 and 12. The students generally came in and sat down quietly, found their notebooks, and began working on the sponge. During written assignments, the class as a whole worked quietly, sometimes talking to a neighbor. At the beginning of the school year, the students were clearly divided into cliques. On one side of the room, the louder girls who got in trouble more often and generally had lower grades sat in the

corner. On the other side of the room, the quieter girls, who rarely got in trouble and made good grades, sat near the front of the room. This separation was noted several times by the students and teacher. However, over the course of the first semester, Ms. Smith changed several students' seats to limit talking. By the end of the first semester, the separation in groups wasn't as noticeable, except on days when there was a substitute teacher.

**Rules.** At the front of the classroom, above the white board, was a poster of class rules. The poster contained a clip art picture of an Erlenmeyer flask with a pink liquid inside of it. It was titled "Ms. Smith's Class Rules." The following ten rules were printed over the clip art:

1. Enter quietly and quickly, get started on what is displayed on the board.
2. Homework is to be placed on the demo counter upon entry.
3. When I am talking, you are not (this includes making noise of any kind). Raise your hand to speak.
4. Do not get up for any reason. You will not throw away trash, sharpen pencils or any of the sort unless permitted to do so.
5. No grooming, come to school presentable. No hair combing, lip-gloss application or makeup in class at any time.
6. Respect the space of others at all times.
7. No gum or food is allowed. You may have only water from a sealed container. All other items will be thrown away without question.
8. Sit upright in your chair with both feet on the ground. At no time is your head to be on your desk.
9. You are expected to come to class prepared with pencils sharpened and paper for class, no excuses.

10. When in doubt, ask for assistance after thinking through your question.

These rules were enforced rigorously in the classroom. Students, for the most part, entered class, turned in homework to the appropriate location, and immediately began working on the warm up activity. Students asked for permission any time they needed to leave their seat, including sharpening pencils, throwing away trash, or blowing their nose. The few times girls were combing hair, their own or others, they were stopped and reprimanded by the teacher. There was almost no evidence of food in the classroom and students generally raised their hands to speak. Although students did not have assigned seats at the beginning of the year, Ms. Smith did occasionally move students to specific locations and, by the end of the first semester, about half of the students had been assigned a seat.

In addition to these rules, several other school-wide policies functioned as rules in this classroom. The door was kept locked at all times, meaning students who were late or left the classroom for some reason had to wait to be allowed back in by the teacher. Students were not allowed to wear book bags in the classrooms and, particularly at the beginning of the year, students who brought a book bag into the science classroom were told that they needed to store it in their locker and threatened with punishments such as phone calls home or lunch detention. Additionally, cell phones were not permitted at all in the school and several times were confiscated from students during science class.

### **Influence of Macro-Level Discourses**

**Discourses of Education.** Many of the macro-level discourses identified in the previous section influenced the figured world of the science classroom. In particular, discourses of accountability, responsibility, and individuality were prevalent in this classroom.

*Accountability and Responsibility.* Educational discourses of accountability had a large influence on this figured world. The statewide, standardized test was mentioned in class by the teacher at least once a week, on over half of the observed class sessions. Often this was in the form of the teacher pointing out information that was likely to be on the test. For example, during one class on evolution, the teacher showed a slide of Charles Darwin and his ship, the Beagle. The teacher mentioned that this topic often comes up in reading passages on standardized tests and that, “You’ll see this again.” Other times, the teacher gave questions from standardized tests as practice problems in class, as a way to prepare the students for the test taking process and improve test taking skills. For example, during one class the teacher gave an example of a test question that involved diagrams and told the class, “I want us to be able to get these state tests and not get blown out of the water because we’re smart about what we read and what we can and can’t process.” This type of incorporation of test information into class was a school-wide phenomena; at one staff meeting I observed, the entire time consisted of an administrator telling the teachers about the logistics of the state-wide test and urging them to make sure their students were familiar with the exam before they took it.

The teacher also brought up testing and standards in informal conversations we had after class, expressing her frustration at the level of accountability she was held to. On the very first day that I observed her class, Ms. Smith explained how the test scores of the students were included in her scores when she was evaluated as a teacher, which she felt was unfair. She also expressed frustration that she knew she could be a better teacher and have better relationships with the students, but that she was under too much pressure and the students, “Don’t understand how much stuff I’m dealing with.” Additionally, her schedule was sometimes changed because of school-wide testing. For example, Ms. Smith had no control over when to administer the

district's benchmark exams, and on days when the school was running trials of the state tests, regular classes did not meet. Individual students were also pulled out of class to complete standardized tests in other subjects. This uncertainty and lack of control made the already difficult task of planning for two different grades even more challenging.

Perhaps as a result of the pressure Ms. Smith was under to improve her students' test scores, she passed the responsibility for student performance on to the students' themselves. She often told students that if they weren't learning in class, that was because they chose not to. About halfway through the fall semester, when several students were missing assignments and grades were falling, she told students, "If you're falling behind, that's not my problem, that's your problem," and "there are zero reasons you should be failing other than your choice." At the beginning of the spring semester, Ms. Smith told the class that they were going to have to take more responsibility for learning because she was, "Not interested in continuing to stand up here and posturing when you're not going to do your part. We'll see how you do when it's left up to you." She then gave the students a lecture on responsibility, incorporating their grades and test scores. The following excerpt is from field notes collected while observing this class.

And maybe some additional numbers of averages will assist you in understanding what I mean when I say you are responsible. So when I say you are responsible, 39% of you can't even read on grade level. 45% of you are barely on grade level as far as reading and only 15% of you can read at or above grade level. But I'll break it down further. Uh, let's see. 45% of you are failing more than one core class. 31% of you have barely passed more than two core classes. And I mean barely, like 70. And that's probably on somebody's good graces. I have, if the line has, mm, we'll go with almost 98% of you failed the benchmark and that wasn't even from me, that was from the state. Close your

mouths. (I don't hear any talking) If you have 45% of y'all who can not read on grade level, you shouldn't have anything to say. Period. But maybe, maybe you're having trouble reading so lets go ahead and go through this together. (Moves from behind desk to sit on stool near door) Let's go ahead and break it down like you're in fourth grade, because you can't be trusted to do anything on your own. Which is why you will continue - TURN AROUND (bangs hand on desk while saying turn around) - which is why you will continue being below grade level. (Pauses, looks at class) If that's what you want, by all means, don't come to my class. I'm not basic. Nothing about me is basic and I do not have basic expectations of my students. You either rise to the challenge or you don't show up at all. Cause you're wasting my time. I told you last class period, several of you need to improve in maybe your homework, maybe your classwork, maybe your behavior. If I need to lower my expectations, by all means, let me know, but don't show up. You're a waste of space. And if I have to redirect you every thirty seconds, you need to be in a special classroom. A different classroom.

In this lecture, Ms. Smith is explicitly referring to test scores and levels, reflecting a discourse of accountability, and connecting this to discourses of responsibility by telling students they “can’t be trusted to do anything on their own.” She then connects this to the worth of the students, telling them they are a waste of space and shouldn’t come to class.

*Individuality.* In this figured world, students spent most of their time working individually. Even during activities that might traditionally be thought of as partner or group work, such as the science fair, students were prompted to work individually. For example, when one student asked if they had to work in groups for the science fair, Ms. Smith answered, “No,

and I strongly suggest you don't, to be honest, it's such a huge portion [of students' final grade], better to work alone or at most one person. It's a huge chunk, like 30%." Smaller classwork assignments were also almost always completed individually and even for activities like preparing for a quiz, students were told not to work together. In one class, students were given ten minutes to prepare for a quiz at the beginning of class. Two students traded notebooks and began asking each other questions from the notebooks. Ms. Smith told the girls that it was individual study time and to, "Stop talking. Review. It's not a joint quiz."

**Discourses of Science.** In the figured world of the science classroom, several discourses of science influence the way the students were taught, included discourses of science as the truth, science as special way of thinking, and science class as ordered and serious. As seen on the macro-level analysis of the school, the discourse of science as engagement in scientific practices, although acknowledged by the teacher, was absent in this figured world.

*Science as truth.* In this figured world, the reliance on the textbook perpetuated the discourse that science is the truth, that it can be viewed as a set of discrete and proven facts to be learned. Textbooks were used explicitly in about two-thirds of classes (e.g., the teacher assigned work directly from the textbook), and were also referenced by students on other days when completing assignments. Additionally, there was a strong emphasis on vocabulary in class, with students rewarded for providing definitions verbatim from the textbook. For example, the teacher would respond, "Good job," or "Perfect," when a student provided a definition directly from the glossary of the textbook; students were never probed for genuine understanding of the definitions, such as being asked to rephrase their answers, put answers in their own words, or provide any additional information.

*Science as a special way of thinking.* By limiting access to resources outside of class and failing to make connections to students' lives outside of class, science was configured as something that was only accessible within the classroom. Although the class activities relied heavily on the textbook, students were not given their own copies of the book to take home and there weren't enough copies of the book for each student to use their own in class. Students shared books during class and struggled to complete assignments that relied on the book outside of class. Similarly, students were expected to store their science notebooks in class, although not all did. Students who had internet access at home relied on using internet searches to answer questions. (I also witnessed this happening in class – several students would use Google to find answers to questions on in-class assignments on their phones (out of view of the teacher). However, instead of looking for information for research purposes, students generally typed entire questions into a search engine and copied, verbatim, the first answer or website that came up.) Rarely did students use outside information or experiences to understand what they were learning in class. In one exception to this, the teacher performed a demonstration of diffusion by lighting a match at one end of the classroom and asking students to raise their hands when they could smell the smoke. During this time, there was also a large forest fire in the northern part of the state, which had created smoky conditions, and a distinct smoky smell, a hundred miles south where the school was located. One student said, "That's how it be smelling outside!" The teacher acknowledged there was a fire going on, but did not connect it in anyway to the content of the class; demonstrating how even when the students themselves tried to make connections to their own lives, they were not encouraged or supported by the teacher. There are many reasons why the teacher might not encourage this, such as time constraints or not being comfortable with new topics. However, the result of this limited access to information, and lack of connection to

students' lives, created a situation where science was seen as something distinct from everyday life, that could be read about in books or on the internet but not experienced by regular people in their homes or communities.

*Science class is ordered and serious.* The figured world of the science classroom relied heavily on rules and the teacher as an enforcer of order. Students were expected to stay in their seats, asking permission if they needed to get up for any reason, including throwing away trash or sharpening a pencil. Students were also given explicit instructions for completing class activities, with little room for flexibility. For example, when taking notes, students were instructed on exactly what to write. Very few activities involved any type of creativity or fun, in most classes students were very quiet and did not move around much. This perpetuates a view of science as a serious space, where excitement, creativity, and even fun do not belong and are actively discouraged.

**Discourses of Gender and Race.** The macro-level discourses of gender and race identified in the school were also prevalent in the science classroom. In particular, there was an emphasis on discipline and punishment as well as on controlling the students' bodies, actions, and sound.

*Being Helpful.* One way for students to get positive recognition from Ms. Smith was to volunteer to help with a classroom activity, such as passing out papers or supplies. Ms. Smith occasionally asked students for this type of help and, more often, students volunteered, asking her if they could help. On a few occasions, Ms. Smith asked students to record the names and behaviors of other students, i.e., asking one on-task student to create a list of other students who were on-task.

*Discipline and punishment.* In almost every single classroom observation, instances of discipline and punishment were noted. The most common was for a student to be put out of class, as described above. Another common threat of punishment was to call parents. At the end of the first semester, before the winter break began, the teacher threatened to call parents on Christmas Day if the students did not behave. This was not a one-time threat, made out of frustration or anger, but a regularly repeated statement in the week before winter break began. It was also not uncommon for the teacher to threaten students with the punishment of more notes or bookwork, particularly when they were talking during individual work, or to write students up for misbehavior. These threats seemed to be rarely followed through on.

*Black girls need control.* During each class, Ms. Smith issued almost constant reminders to students of how to behave and act. These reminders reflected the class rules, which primarily referred to controlling students' movements and bodies, explicitly telling students to enter the room quickly, raise their hands, stay seated, and sit upright with both feet on the ground. The control of students' actions was reflected during observations in the expectation that girls ask for permission to leave their seats or to leave the room. In addition to asking permission, another way of controlling the student's movement occurred when girls needed to use the restroom and Ms. Smith would make them wait a set amount of time for seemingly no reason. In one instance, a girl asked to use the restroom and was told she had to wait seven minutes. When she protested, she was told, "It has to do with your attitude," and made to wait the full seven minutes plus some. On some days, Ms. Smith set rules that students were not allowed to leave the room for any reason. An emphasis on controlling students' actions through timing was seen in all classes, with the teacher setting time constraints on all activities and regularly reminding students of them, i.e., "two minutes left for this task", "you will have exactly eight minutes". Rarely did the

teacher ask the girls if they needed more time, and on the occasions when they were given extra time or did not complete a task in the time given, she told them they had “poor time management” or did not “manage their time appropriately.” Ms. Smith expressed on several occasions that when the students were in the classroom, it was her time and they needed to follow her directions. She also expressed to students that if they followed her directions, which were very detailed and left little room for flexibility, they would be successful, and would express frustration with students who did not completely follow directions. For example, when reviewing the science fair The implication of this level of control is that students could not be trusted to be successful in class on their own; they needed the teacher to control their every move in order to be good students.

*Black girls are too loud.* In addition to reminders of how to act and what to do, Ms. Smith also constantly regulated the noise level of the room by limiting student talking. This again correlated with the class rules, which directed students to enter quietly and not make any noise when the teacher is talking. Ms. Smith expected silence, or near silence, when students were working and often reminded students of this by saying curtly, “Stop talking,” “be quiet,” or “close your mouths.” Often, I would note in my field notes that these reprimands happened at times when it seemed the class was already quiet and I was not able to identify who had been talking. Rewards were also attached to the noise level of the entire class. For example, when working on a study guide for the final exam, students were told that if they weren’t too loud they would be able to use the study guide for the test. Another time, the entire class’s technology privileges were revoked because they were too loud. Even when Ms. Smith played music in class, which she did regularly while students completed individual work, she did not allow girls

to sing or hum along to it. Several times she threatened to turn off the music if girls sang to it, and if girls even mentioned they knew a song, she would change the song to prevent singing.

**Intersections of Discourses.** The discourses of education, science, gender, and race intersected in unique ways in the figured world of the science classroom. These intersections impacted how science learning was constructed, including what constituted science learning and who could participate in it.

*Special and non-special students.* Intersections of discourses of education, race, and gender were seen in this classroom in the explicit relationships between grades and behavior. In some cases, the teacher allowed students to use resources on quizzes or tests if they behaved well. For example, for a quiz given at the end of class, students were allowed to use their notes only if they were well-behaved throughout the class. For the final exam of the fall semester, students were allowed to use the textbook and their notebooks if they behaved well during the class before the final exam. Ms. Smith told the class, “It’s 100% contingent on your behavior, if you’ll get to use the study guide during the test.” The reverse relationship was also true- the teacher often used grades in threats of punishment for bad behavior. Several times, Ms. Smith threatened students that if they were off task or misbehaving, she would give them a zero for the assignment. For example, in one class she told two students who were talking that she had the gradebook open and was more than happy to put zeroes in” for the assignment.

This conflation of grades and behavior led to the conflation of “good girls” and “good students.” In this classroom, although it was difficult for students to maintain the privileged position of the “special student,” some students were clearly marked as “not-special students,” by both the teacher and the other students. For example, it was established that only “certain students have assigned seats,” according to one student, and, especially early in the school year,

the class was clearly segregated with the special students sitting on one side and the not-special students sitting on the other. One student, who was not considered a good student, explained that “we sit on one side and most of the nerds sit on the other side.” The same student went on to explain that what made the students on the other side of the room good students is that, “They just do their work. They just sit right there and do their work.” She contrasted this to her side of the room, which was for students who liked to talk a lot. Another student, who sits on the special student side of the room, explained her behavior in class as, “I’m quiet. And I try not to play and talk to much, like the other side.”

*Science is for special students.* The discourse of science for special students influenced the structures of this science class as well as how the teacher positioned and interacted with the students. For example, only certain students were selected to participate in the school wide science fair, and those students were generally quiet, well-spoken, and presented aesthetically pleasing science fair boards. Ms. Smith also regularly excluded students from class that she viewed as trouble makers, who did not fit into the discourse of the good girl or good student. However, in most observations it appeared that while the teacher clearly viewed science as being for special students, there were no students in this class who would fit the criteria for participating in science. The teacher often mentioned how much better behaved and more advanced her eighth grade classes were, and often brought up the gifted high school students she mentored. She also actively prevented students from engaging in scientific practices based on behavior, telling the students that they weren’t “ready” to do experiments or labs and that it was their responsibility to demonstrate to her that they were good students. In this way, science was constructed as being beyond the reach of any member of this figured world, and reserved only for ideal students.

### **Analysis of Figured World of School Science**

This section explores how the macro-level discourses identified above intersect in this classroom to influence the figured world of science education. In particular, it examines the following questions from Gee (2014b): How does the figured world of the science classroom (after school science club) work to:

- build relevance or significance for certain things?
- enact specific practices?
- recognize (or not) specific identities?
- build or destroy social relationships?
- create, distribute, or withhold social goods?
- Connect or disconnect things; make one thing relevant or irrelevant to another thing?
- privilege and disprivilege different ways of knowing?

**Significance.** In the figured world of the science classroom, significance was primarily assigned to two items: standardized tests and the textbook. In most class meetings, as well as the majority of informal conversations with the teacher, references were made to the standardized test students would be taking. For example, the teacher often gave practice questions that mimicked those found on the test or noted that certain information was more likely to be on the test. The textbook was also used in almost every class meeting, and students were aware that it should be the first source of information for them. Textbooks were almost always set out on the tables for students, and most classes began with “warm-up” questions, which prompted to students to use the text to find an answer. Often, students read verbatim from the book, with little indication of understanding, and were praised by the teacher for finding the correct answer. This shows the influence of educational discourses of accountability, in reference to standardized

tests, intersecting with scientific discourses of science (in this case represented by textbooks) as objective truth.

Additionally, significance was assigned to student behavior. This was seen in explicit connections between behavior and grades as well as between behavior and engagement in scientific practices, as described below. When students were asked to describe a good science student, they overwhelmingly highlighted what the teacher viewed as good behavior, i.e., being quiet and getting the work done quickly.

**Practices.** Throughout the school year, there was no indication of engagement in scientific practices (see NGSS, 2014), i.e., students never performed experiments or engaged in inquiry type activities. Instead, practices of looking up information and passively learning from the teacher's presentations dominated class time, demonstrating again the discourse of science as the truth intersecting with the racial and gendered discourses of students needing to be passive, quiet, and well-behaved to learn. Additionally, students were told that they couldn't do labs because of their behavior, indicating discourses of race and gender suggesting that the students needed to be better controlled and that only special students could participate in science.

**Identities.** Few identities were available to students in this figured world. As noted above, scientific practices were not observed in the classroom and, therefore, there was no authentic way for students to enact or gain recognition for a scientific identity. Even when completing science fair projects, students relied almost exclusively on replicating projects found on the internet, often not even completing the actual experiment, and expressed confusion about the process as well as what they gained from it. This lack of understanding was not questioned or critiqued by the teacher or the students, indicating the influence of the discourse of science as mysterious, and only for the elite (i.e., the process of science was not meant to be understood by

the students). The only recognized identity in the class was that of the good student, one who does well on tests and is well behaved, demonstrating the intersection of discourses of accountability and race/gender.

**Relationships.** Social relationships between students were not encouraged in this figured world. In addition to encouraging the students to work individually and suggestions that they could not trust each other as partners, for example on the science fair project, the teacher also seemed to encourage girls to be unsupportive of each other. Many times, a sarcastic remark made by the teacher and directed at one student was met by laughter from other students, perhaps hoping to gain recognition from the teacher. Students were also quick to turn each other in to avoid getting in trouble themselves. For example, when one student was reprimanded for being off task, her immediate response was, “Look at (other girl)!” who was on her phone. However, even though it was discouraged, many students were observed asking each other for help on assignments and providing information for each other.

**Social Goods (science knowledge).** In this figured world of school science, science knowledge as learning through engagement in scientific practices was withheld from students. Instead, science knowledge was viewed as knowing discrete facts about science. The distribution of this type of science knowledge was often directly tied to students’ behavior, both on individual and collective levels. For example, individual students were chosen to participate in science clubs and field trips based primarily on behavior, as opposed to interest. Collectively, the class was told they could not engage in experiments because they were not well-behaved and assignments were often linked in some way to behavior (i.e., if you don’t talk or act up, you can use your textbook to complete a quiz). This demonstrates the intersection of discourses of

elitism in science (although in this case, the intellectual elitism is conflated with behavioral elitism) with race and gender discourses of needing to be quiet and in control of one's body.

**Connections.** Few connections were made in class between the content the students learned and their home experiences or even other experiences in the school. Everyday examples of science topics were rarely mentioned and when reference was made to other places, they were often science institutions that students were not familiar with, such as the Centers for Disease Control. Because no information was provided to students about the institutions they remained elusive to students. For example, the Ms. Smith mentioned several times that her mother worked at the Centers for Disease Control, referring to it by the acronym CDC, but did not explain what she did there or even what the purpose of organization is. Even though students naturally attempted to make their own connections, such as the student comparing the smell of the burning match to the wildfire occurring in the state, these connections were barely acknowledged and were not encouraged or elaborated on.

**Ways of Knowing.** This figured world privileged only one way of knowing: receiving information from an expert source, i.e., the textbook, internet, or teacher. Students were discouraged from creativity and making connections to their lives. The language and vocabulary of science was also privileged in the figured world of the science classroom, with a strong focus on memorizing vocabulary words. Students often commented on the abundance of vocabulary that they had to learn, and sometimes noted that they struggled to understand what the teacher was talking about because of her vocabulary. In some case, the students “translated” the teacher's words into more understandable forms. For example, when discussing the digestive system, the teacher used the word esophagus. When the students were discussing the digestive system, they used the word throat instead, even if it was immediately after the teacher had said

esophagus. One student described seventh grade science as just, “a bunch of words that I can’t pronounce.”

In this figured world of school science, science is constructed as a static collection of facts to be absorbed by students. Students are regarded as passive recipients of information. Because of the view of students as needing control and discipline, which leads to the lack of engagement in scientific practices, students are positioned as outside of science altogether and are shown a world of science that is not to be understood or engaged in by people like them.

### **After School Science Club**

**Description.** The after school science club was part of a larger after school program in the school. The after school program met everyday from 3:30pm – 5:30pm, and provided a snack, dinner, and transportation home for students. From 4:00pm – 5:00pm, students chose an activity to participate in, such as arts and crafts, nutrition, fitness, or the science club. The science club did not form until the second semester of this study (Spring 2016); in the first semester, I observed and helped out the technology based after school activity. The science club formed as a result of observations made during that first semester and student feedback.

The science club met 2-3 days per week (three days per week during Spring 2016, two days per week during the 2016-2017 school year, and 5 times total during the summer between). There were no requirements for joining, e.g., grades or test scores. All students who were interested were encouraged to join, and to invite friends to join. The science club met in a science classroom on the high school side of the school building, which was set up in a typical high school lab science fashion: tall, immovable lab tables with sinks, stools to sit on, and storage cabinets and sinks at the back of the room. During the course of the science club, the students and I created posters of our activities to hang up, and students created collages of

pictures that represented themselves, science, and the science club to hang up as well. Equipment that was used during the science club, such as microscopes, test tubes, and pipettes, were stored in the cabinets in the room or in a storage closet attached to the room.

**Meaningful Acts.** Several meaningful acts helped define the figured world of the after school science club. The first was a second snack, in addition to the after school program's snack. As a group, we created a list of snacks that the girls would like and I brought one to each meeting. The girls then organized and passed out the snacks at the beginning of the meeting. A similar meaningful act, that did not occur every day, was having monthly parties. These parties were designed to celebrate birthdays, discuss topics that came up in the science club, and plan future activities in the science club. Although at first I brought pizza, snacks, and drinks for these parties, the participants began planning them during the second semester.

Other meaningful acts included engagement in scientific practices. In particular, participants were encouraged to ask questions about the world around them and try to find ways to answer their questions. During the first semester, these questions revolved around a topic I chose: water pollution. Students asked questions like, "How can you get pollutants out of water?" and I designed activities to help answer the questions (e.g., making water filters). During the summer and following fall, students came up with their own questions and activities, such as, "What makes pop rocks pop?" and "How can we make better cookies?" Additionally, several participants described previous experiences with engineering challenges, such as building paper bridges or towers out of toothpicks, and expressed an interest in doing others. While the engineering challenges were based on problems defined by me, the students developed and tested solutions to the challenges. When asked what they liked about the science club, or why they joined, students almost always mentioned that they liked doing experiments. One student said

she joined the science club because, “It’s all about experiments and labs.” Another student, when explaining what the science club did to new members, said, “We ask questions we don’t know the answer to and try to figure them out.”

**Artifacts.** Although provided with lab notebooks, most participants chose not to use them, or to only use them sporadically. Instead, group created posters became important artifacts in the after school science club. A variety of posters were created and hung in the classroom, including posters with questions that the girls brainstormed about different topics, a schedule of events, observations made by the girls for different experiments, a list of participants’ birthdays, and posters identifying the science, technology, engineering, and math in various activities and then connecting them to their home and communities.

Other important artifacts included the scientific equipment that girls learned how to use. In particular, girls regularly used microscopes, hot plates, thermometers, pipettes, and various glassware and would often use the equipment to their own ends, not in a directed activity. For example, students used hot plates to melt wax for a lip balm activity and later asked to use the hot plates again when they were dissolving borax in water to make slime. Similarly, students used petri dishes and pipettes when observing water samples one semester and the following semester asked to use them during a pop rocks experiment. The participants mentioned that this was an important part of the science club, referring to the storage closet as a “magical closet” and differentiating between their science class, where they didn’t have access to equipment and extra materials.

**People.** The participants in the science club were students who attended the after school program and chose the science club as one of their activities. Originally, the participants already had some interest in science and/or had been in the technology and science related activities

previously. During the first year of the study, I made an effort to get to know all of the students in the after school program in an attempt to invite students who didn't already identify with science, as well as those who weren't identified as "special students" by the teachers, to join the science club. This seemed to be successful, as halfway through the spring semester of the first year, several new students chose to join the science club. Many students also invited friends to join the program. Over the two years of the study, the number of participants ranged from 8 to 20 on any given day; however, a core group of about 12 girls participated continuously throughout the study. In the second year of the study, most of the participants were seventh graders, many of whom were friends with students who had been in the science club in the previous year. Only three eighth graders and three sixth graders were members of the science club.

After the first semester of the study, I took on the role of facilitator for the science club. This was not originally planned, but came about as I noticed challenges with the existing after school program and a lack of access to scientific activities. Having been a classroom teacher previously, I struggled with my role as facilitator of the science club. Knowing that I did not want the science club to feel like a traditional science class, I consciously made choices to allow the girls freedom in selecting activities. I saw my role more about supporting their curiosity, by providing materials for example, then about telling them what to do. I also viewed my role as creating a space that felt comfortable and welcoming for them, so that more girls would join and have access to science experiences. I did this through explicitly disrupting some of the macro level discourses identified at the school, for example I told the girls they didn't have to ask permission to get up or go to the bathroom. I also expressed to them that I cared about their

experiences both in and outside of the club. We often had long conversations about what was happening in the school or the community during science club time.

Participants indicated that they appreciated my enthusiasm and commitment to the science club, and that they felt like I genuinely cared about them. One participant sent me an email during the first semester of the club telling me that I felt like a big sister to her. Another participant told me that she felt like I “cared truly about the students at RPMS.” Several participants indicated that having a fun teacher was why they kept coming to the science club, with one girl saying (about me) that she tried to, “Be really good for her ‘cause she’s really nice to us.”

**Rules.** At the beginning of each semester, group norms were established and agreed upon by the participants. In the first semester, these norms were similar to school rules and focused largely on logistical issues, like “everybody has to clean up”, “raise your hand to talk”, and “be responsible.” The norms evolved in subsequent semesters to include expectations like, “express yourself,” and “have fun.” The process of establishing the norms was a negotiation between all members of the club. For example, the following type of exchange was common when creating the norms:

Me: T said be respectful, what does that look like?

T: Being respectful is not having your head down while other people are talking.

Me: What if you have a headache?

B: Yes, exactly, when somebody has a headache, they don’t want to keep their head up.

They want to lay it down.

D: Then they should say that they have a headache so it don’t seem disrespectful.

This type of negotiation and clarification happened for most of the norms, with most participants contributing their own ideas about what would make the club successful.

### **Influence and Disruption of Macro-Level Discourses**

As mentioned above, the primary motivator for establishing the science club was the lack of scientific experiences for girls in this school. Specifically, one of my aims for the after school science club was to disrupt macro-level discourses that appeared to be limiting students' abilities to form scientific identities, with a goal of developing a space in which the students positioned as not-special and outside of science could gain access to authentic scientific experiences which might potentially lead to scientific identities. Most girls described the after school science club as fun, and indicated specific differences between the after school club and their science classrooms. In many cases, these differences did seem to support the goal that the limiting macro-level discourses were at least partially or temporarily disrupted.

**Discourses of Education.** Because the science club took place after school, and was not a part of the formal school curriculum, many of the discourses of education were naturally disrupted, such as a focus on accountability. Other discourses, specifically the focus on individuality, were purposefully disrupted through the science club's structure and activities.

*Accountability.* Many of the discourses of education noted within the school had less influence in the after school setting. Obviously, the after school club had no standards, standardized testing, or even set curriculum to follow. Many students also noted that in the after school club, you don't have to worry about grades. One participant, when asked what she liked about the science club, said "We are more free... we get to decide what we want to learn and what we want to do." She explained that this was different from classrooms, where teachers have lesson plans and standards to follow. Another participant indicated that the difference with

the science club was, “It’s after school. And in after school, school is over and it’s after school. I become more open because it’s not like I’m constantly being monitored on my behavior and stuff and getting a grade on it and being super critiqued with it.”

*Individuality.* In the science club, there was a focus on working together as a community, as opposed to the individual work that was prominent in the science classroom. Several students noted that this was a benefit of being in the science club, saying, “We all get to contribute,” and “We all have something to say.” When selecting pictures to represent the science club, many students chose pictures of the entire group. One student explained her choice of a picture of a group of participants together as, “It represents [science club] because it’s team work.” Another described her picture as, “We’re all grouped up together and being normal.” Students valued not just being with their friends, but also the opportunity to engage in activities with other participants, indicating they see the value of collaboration instead of independent work.

**Discourses of Science.** A discourse of science as participation in scientific practices, which was absent in the figured world of school science, was explicitly introduced in the science club. By maintaining a focus on engagement in science, other discourses of science, such as science as a specialized way of thinking, were disrupted in the after school club.

*Scientific Practices.* One of the central aims of the science club was to introduce a discourse of science as engagement in scientific practices. Every single meeting involved engagement in at least one scientific practice. This was in stark contrast to the discourses of science in the classroom, which presented science as a passive process of receiving static information. Students indicated that not only did they find the activities fun and engaging, they often saw them as legitimate ways to participate in and learn about science. One student explained, “Our experiments and stuff, they’re actually science based cause like some of our

activities in science, really don't have anything to do with science, it's more like reading and... I like the experiments cause you learn from experiments. Cause I didn't know all this stuff, when I first got here, I didn't know all these things in a river, all the different things you put in a river pollute 'em. I didn't know that."

*Science as a specialized way of thinking.* Another discourse of science that the science club aimed to disrupt is the discourse of science as special and different from everyday knowledge. Many of the activities were designed to directly connect to students' home lives and interests, such as exploring pop rocks and baking cookies. For some activities, participants brought home supplies to try out at home or performed their own experiments at home. For example, students were interested in how bath bombs worked and so they created bath bombs using different materials and brought them home to test them. In another example, when we tested the tap water in the school for metals, several student brought testing supplies home to test the water at their houses. Participants enjoyed these types of activities, saying, "I like the experiments, the ones that you're able to take home and actually see for yourself what the reaction is," and "Science Club is really fun and we could do stuff that's really fun that relates to real world."

However, despite disrupting the discourses that construct science as an active process, and something that connects to everyday knowledge within the science club, there were indications that students still saw real science as separate from what happened in the science club. For example, one student, referring the baking activities in the science club, described the science club as a place where we do, "All sorts of things instead of just science." While it's possible this student was indicating a connection between "all sorts of things" and "just science," it seemed like she was indicating that she didn't see the more everyday activities in the science

club as having to do with science. Additionally, when asked to choose pictures that represent science from among all the pictures taken during the science club, several participants chose pictures of things that they had not themselves participated in or did not understand or know about. However, these were generally students who had only participated in the science club for one semester at the time; students who had participated for multiple semesters were more likely to choose pictures to represent science that involved them participating in a scientific practice. For example, one student selected a picture of herself taking water samples for her science fair project, and described why that picture represented science by saying, “I chose this one for science cause I'm doing science stuff right here.”

**Discourses of Race and Gender.** Initially, I envisioned the science club as a space where students could relax and be free from many of the pressures they felt in school. By maintaining a focus on participants’ comfort and trying to create a space that met their needs, many of the oppressive discourses of race and gender were at least temporarily disrupted.

*African American girls need to be controlled.* The discourse that students, particularly African American girls, need to be surveilled and controlled was still present in the after school program, but was challenged in the science club, where participants were given more freedom over their actions. As is typical in after school settings, participants were there voluntarily, and there were no assigned seats. Students were also allowed to leave the room to get water or go to the bathroom, and we often left the room while doing experiments. For example, during a project on tap water, groups of students went to different floors and halls to collect water samples from the sinks and water fountains around the school. Participants indicated that having great control over their own actions impacted how they felt in the science club. As quoted above, one student felt she could be more open in after school, “because it’s not like I’m

constantly being monitored on my behavior and stuff and getting a grade on it and being super critiqued with it...I don't have to worry about the teacher be like, sit down, stop talking so much, you get points taken off!" Other students also indicated that they didn't feel rushed in the science club, explaining that they felt like they learned more in the science club because, "In school it's fast paced."

**Intersections of discourses.** The ultimate goal of disrupting discourses of education, science, race, and gender in the science club was to create a space where African American girls could potentially develop science identities, i.e., to disrupt the discourse that only good girls could do science.

*Science is for Special Students.* Some girls did see different ways of gaining recognition in the science club, describing a good science club member as someone who doesn't give up, has integrity and diligence. The same student also acknowledged that I would likely not have favorite students, that "It don't seem like you would pick a favorite, it seems like you're like, 'Well I think you're all good [participants], I can't chose between one,' because like everybody's good." When I asked her if she agreed with the idea that everyone could be a good participant in the science club, she said yes.

However, for other participants it was harder to disrupt the discourses of the "good girl" and "good student." For example, when asked what makes someone a good science club participant, one participant explained that she picked someone because, "She don't talk she just sit there... she just a good person in general." Another student said that the most important characteristics of a good science club participants were to listen and clean up

Additionally, many participants wanted to limit participation in the science club, specifically by either kicking out or not allowing in girls who were positioned as not-special

students. This was particularly prevalent in the first few semesters of the science club, but was noticeable any time there was conflict or tension in the club – students would often blame any challenges in the science club on the participation of the not-special students. One student explained why didn't want new members of the science club, who were not positioned as special students, as, "They come and they just...loud." She also explained that the science club was special, implying that it was for special students, because, "It's not like a regular science class so you should feel very privileged." Another participant, arguing that some students should be kicked out of the science club, said, "they really don't do anything that can contribute to the class except being a distraction and horseplaying."

The figured world of school still privileged in many ways – students missing science club to go to tutorial, can't come to club if grades are low, not viewing the science in the club as the same as the classroom

### **Analysis of Figured World of After School Science**

This section explores how the macro-level discourses identified above intersect in this classroom to influence the figured world of after school science. It addresses the same areas detailed by Gee (2014) as the above section analyzing the figured world of school science: significance, practices, identities, relationships, politics and social goods, connections and relevance, and ways of knowing.

**Significance.** In the figured world of after school science, there were no textbooks or other reference materials that were prominent in the figured world of school science. This decreased the significance of reference materials as sources of knowledge. There was also less focus on rules and maintaining order and control of the girls, and more of an emphasis on participation. The goal of this was to increase significance of active participation in science.

Additionally, many girls mentioned that one of the goals of the science club was to have fun, something that was not seen as a goal in school science. One participant explained, “It’s after school so we supposed to have fun!” The same participant also made a connection between doing science and having fun, saying, “I would describe [science club] as... fun. A fun way to do science. Cause it’s like we’re doing science, but you make it really fun. Like maybe more fun than anybody else cause they would probably just make it like another one of our science classes.” This indicates that to this participant, the active nature of the club (“a fun way to do science”) is significant, and is also what makes it distinct from science class.

**Practices.** As described above, an explicit focus was placed on learning and using scientific practices. Each activity involved participation in at least one scientific practice and, as they became more experienced in the skills and equipment used in the science club, girls began organically engaging in scientific practices. For example, in the first semester of the science club, many of the participants learned how to use microscopes to examine samples of pond water. Two semesters later, when the students were curious as to what was growing in our Wynogradsky columns, they suggested examining samples under the microscope, and compared samples across columns to begin to develop explanations about what was happening in the columns.

**Identities.** While one of the goals of the science club was to provide a space where African American girls could develop science identities, this was at least partly accomplished by allowing for multiple forms of participation in the science club. In this way, girls were able to develop a strong science club identity, which could potentially serve as a gateway to a science identity. The multiple forms of participation included allowing the girls to chose their own jobs in the club. Some girls chose more technical jobs, such as videographer, while others chose

social jobs, such as party planner. Some girls didn't want to commit to one specific job and it was decided that they could act as substitutes and perform different duties each day. This allowed girls a way to see themselves as, and be seen as, a legitimate member of the science club. Participants also chose different ways to participate in the club's activities. For example, one participant preferred working alone and reading and volunteered to do background research for the activities. In another instance, when girls were examining samples using microscopes, one student found a dead ladybug and examined it using her microscope and shared it with the other students. As the facilitator of the club, I also strived to recognize all of these activities as legitimate participation, which was acknowledged by the participant above, who acknowledged that I would not have a favorite participant because everyone was a good participant.

Even though additional identities were available in the science club, the identities of "good student" developed during school still had influence, as noted by the girls who wanted to keep certain students from joining the science club based on their behavior in school. It was also difficult for students to acknowledge that a participant who was "loud" or playful could also be a good member of the science club.

**Relationships.** In contrast to the figured world of school science, social relationships were encouraged and actively supported in the figured world of after school science. In the first semester of the club, this was a challenge. Many of the girls did not know each other well and those that did often bickered in a manner similar to that seen in the science classroom. Several activities were instituted as a way to improve the social relationships of the group. The first, described above as a meaningful act, were the monthly parties. These became regular times for everyone to sit together, socialize, celebrate events like birthdays, and share ideas in a safe space. When selecting pictures to represent the science club, many girls chose pictures from one of

these parties. One student explained that she chose a picture of a party because, “We’re all sitting together eating good food. And even though that’s not all that we do, it’s a part of it.” Another student, when explaining what she liked about the science club, said, “I appreciate... the little celebrations for the students.”

Another activity to promote social relationships in the first semester of the science club was named (by the participants and myself) “One Nice Thing.” Each participant wrote her name on a card, which I shuffled and handed out randomly. Each participant then had to say one nice thing about the person on the card. Although at first the girls were hesitant to participate, we did this at the beginning of each meeting during this semester and soon the girls were asking for it. The girls also developed more substantial “nice things” as the semester went on. Initially, many of the comments were superficial, often about a person’s looks or hair, but as the girls got to know each other the comments became more detailed, appreciating other girls for being helpful or sharing their ideas, for example.

There was also a continuous focus on group work, in contrast to the science classroom’s focus on individual work, that supported (and was supported by) the development of positive social relationships. Girls generally chose to work with their friends, but crossovers between groups were common. For example, when examining samples using the microscopes, girls visited other groups to see what they had found and compare with their own findings and when doing activities involving consumables, girls fluidly shared materials between groups and tables.

**Politics/Social Goods.** In the figured world of school science, access to science and scientific practices was withheld from students, often based on the teacher’s view of students’ behavior. In the figured world of after school science, participation in science was presented as a right that each girl had. This was reflected in the lack of exclusionary practices in the science

club; i.e., I refused to kick girls out of the club, even when other participants or adults suggested I do so. In several cases, I negotiated with other adults in the after school program to allow girls who had gotten in trouble for their behavior to stay in the science club. In one instance, I arranged transportation for a student who was expelled from the after school bus so that she could continue to attend the science club.

In addition to access to science, all participants also had access to the same resources and materials in the club. Several girls mentioned that this was different than their science class where, for example, “We don’t have all this equipment” and the teacher “Doesn’t bring in extra materials for us, or high price equipment.” Interestingly, many of the pieces of equipment we used, such as the microscopes, belonged to the school and were available in the science classroom. Even many of the consumable supplies were available in the school, however, there was no central organizing system to know what was available and where it was stored. Because I had worked in the school for several years and was familiar with the support staff, and had more time to spend planning and organizing than the classroom teacher, I was often able to find the materials I needed.

**Connections and relevance.** An important aspect of increasing engagement in and interest in science is to make it relevant to the participants (National Research Council, 2015). This was done in the after school science program primarily by having participants suggest their own ideas for activities based on their interests, and having explicit discussions around how what we did in the science club related to their lives outside of the club. Starting with the second semester of the science club, all of the activities we did were based on suggestions and questions raised by participants, who also helped create the semester schedule for the activities. Sometimes these were based on things the girls had seen online, such as making bath bombs, or

just wanted to learn about, such as baking cookies. Other times the participants heard about a topic in the news or from their parents or other community members and wanted to explore it. This is what prompted a long-term investigation into lead in tap water during the fourth semester of the science club: girls had heard about the water crisis in Flint Michigan, and were curious about what caused it, and there had also been a local news report on lead testing in water at all of the schools in their district. Based on this, students wanted to test the water in the school themselves. Some participants also connected this back to their homes by taking home sampling materials and testing their tap water at home. As noted above, students liked the real-world nature of the activities in the science club, and enjoyed opportunities to take home experiments.

**Ways of Knowing.** The ways of knowing privileged in the figured world of school science, and in particular passive learning from the textbook or teacher as the authority, were not available in the figured world of after school science. Although participants did occasionally look up information online, the primary way of learning was through active participation. Participants indicated that this was the main point of the science club. One participant was explaining that she had a hard time choosing a picture to represent the science club, as she was trying to decide between a picture of a party and a picture of a group of girls building a tower out of spaghetti. She ultimately chose the picture of the girls building the tower because, “I feel like eating pizza and stuff isn't the definition of [STEM Girls], I think it's when we're building projects and stuff like that.” Another student explained that she liked the science club because, “We work as a group, everyday we go out and get water,” referring to the water quality sampling at a nearby creek that was the focus of the first semester of the science club.

In the figured world of after school science, several of the discourses influencing the figured world of school science were disrupted, and discourses of science as engagement in scientific practices were introduced. This led to a figured world that supported girls' having fun, being themselves, and developing identities as members of the science club. Students were also able to connect science to their lives and communities, and began to see the value in knowing and learning through experience. However, the figured world of school science was still privileged by the students in many ways; although they enjoyed the after school science club, they still prioritized grades and achievement in school.

### **Micro-Level Discourses**

This section explores the impact of macro-level discourses, through the figured worlds of both school science and STEM Girls, on girls' individual experiences. In particular, it looks at the capital-D Discourses, or ways of saying, doing, and being, that indicate certain types of people (Gee, 2014b). First, the commonly recognized Discourses available to students at RPMS are described, based on school, after school, and classroom observations and conversations with students over the entire study. Next, four participants who were selected as focus students are described. For each participant, the influence of macro-level discourses on their views of school, science, and the students at RPMS is described, followed by their micro-level use of and negotiation of multiple Discourses in both their seventh grade science class and STEM Girls. Additionally, for each girl, a consideration of how their view of themselves, and in particular their science identity, changes over the course of their seventh grade year is presented.

### **Common Discourses Available to Students at RPMS**

Over two years observing students at RPMS, I identified several common Discourses. These Discourses were recognized by teachers and students, and I observed students engaging in

these Discourses in different spaces. Each of these Discourses is described below, including ways of saying, doing, and being that indicate each Discourse. Based on Gee's (2014b) method for Discourse analysis, a consideration of who the students are trying to be and what they are trying to accomplish by engaging in each Discourse is considered, as well as the macro level discourses that influence them.

**Good Girl.** Students engaging in the Discourse of being a Good Girl are generally quiet, not speaking loudly or out of turn. They usually have a neat appearance, including well-groomed hair and a tidy uniform. Students engaging in this Discourse are trying to be recognized, particularly by teachers, as special students. The goal of engaging in this Discourse is to receive the benefits of being a special student: praise from teachers, access to field trips, and other special privileges. This Discourse is the result of intersections of race in gender at the school, which specify that African American girls should be quiet and passive. This Discourse was prevalent throughout the school, in all spaces, and recognized by all adults and most students at the school.

**Good Student.** The Good Student Discourse is similar to the Good Girl Discourse in that students engaging in this Discourse are also quiet and polite. However, there are other school-specific actions that differentiate the Good Student Discourse. In particular, students who engage in this Discourse are prepared for class, which includes have a textbook, notebook, and pen or pencil for class. They ask appropriate questions in class, complete all assignments, and do well on tests. Like the Good Girl Discourse, students who engage in this Discourse are trying to be recognized by their teachers as special students; however, the primary goal of this recognition is to get good grades on report cards, which is the primary form of recognition. For example, almost every time I asked a student how a class was, they responded with their grade.

Additionally, teachers closely related behavior to grades, often telling students if they are off task or unprepared they will be given F's. This Discourse is the result of intersections of race, gender, and education that define good students as those who are in control of themselves, i.e., focused in class, and make good grades and do well on tests. Like the Good Girl Discourse, this Discourse was recognized throughout the school by teachers and students. Participants described Good Students as those who, "don't talk, don't do nothing, just do the work." Another participant said that a good student should, "Listen, be respectful, and get the work done."

**Good Science Student.** In the science classroom, the Good Student Discourse acquired more situationally-specific actions. Like the Good Student, the Good Science Student needs to be quiet, polite, and prepared for class and make good scores on tests. The Good Science Student also needs to work quickly, finishing all assignments with a high level of accuracy, and does not talk or interact with peers during class, particularly during note taking and independent work time. Participants describe Good Science Students as those who are "able to move quickly and also getting everything, or most of everything right." The Good Science Student also answers questions "correctly," which usually indicates reading an answer from a textbook and knowing relevant vocabulary, and does not display any emotion, either positive or negative. Finally, the Good Science Student completes a science fair project by closely following a procedure, displaying it neatly on a display board with the proper headings, and presenting it to the class clearly, with a pleasant speaking voice. For example, during class presentations of science fair projects, students overwhelmingly praised a project that had confusing and inaccurate science because the presenter spoke well and her board was neat and organized. Like the Good Student Discourse, the aim of this Discourse is to be recognized by the teacher as a special student in order to make good grades in science class. Another goal of this Discourse, at

least for some students, is to have the teacher like you and treat you better than other students. This Discourse is recognized in the science classroom by the teacher and students, who all identify the same few students as Good Science Students. Several participants explained that the teacher liked students who work fast and ask intelligent questions, with one student explaining that Ms. Smith likes, “A student that is intelligent and can like, bright, and can like get their work done fast and not be afraid to ask anything. Or they ask intelligent questions, not questions like when she’s doing a presentation like, ‘Can I go to the bathroom?’”

Students often did not differentiate between a Good Student and a Good Science Student. For example, one participant, when asked who was a Good Science Student, said, “I’m just naming all the smart people...” and when asked what made a particular student a Good Scientist, she replied, “She is a good student.”

**Helper.** Students engaging in the Helper Discourse volunteer to do tasks for the teacher or other authority figure. This usually involved passing out and collecting papers or other supplies. Some students also engaged in this Discourse by cleaning up after activities, such as pushing around trash cans after lunch or snack and cleaning off their tables at the end of the STEM Girls. The Helper Discourse is similar to the Good Girl Discourse in that it is a bid for recognition by the teacher as a special student, and was seen throughout the school, however it did not gain as much recognition from teachers and other authority figures as the Good Girl Discourse. This Discourse is the result of discourses of gender that indicate that the most important thing for girls is to be nice and helpful.

**Ghetto Girl / Hood Rat.** The Ghetto Girl Discourse is a result of macro level discourses of urban schools, and African American students who attend them, being ghetto. Students who engage in this Discourse are loud, calling out in class and talking back to the teacher, and often

exhibit physical signs of being from a lower socioeconomic status than other students in the school. They often wear hoodies or jackets over their uniforms, which often aren't in good condition or barely meet uniform requirements. For example, girls engaging in this Discourse might wear tan skinny jeans instead of brown trousers, and tennis shoes instead of flats. They often do not have elaborate hair styles. They are more likely to play around in physical ways, chasing each other or play-fighting, more likely to get in fights or other type of trouble at school, and less likely to finish their work and make good grades. One participant described this type of student as, "Loud, ratchet. And... ready to fight whoever said one thing about them." Another participant describes this type of student as, "The people that always be getting in trouble and always somewhere on their phone... come to school nappy headed... talk back to the teachers." One student referred to this type of student as a "Hood Rat," which urban dictionary defines as, "A girl who sleeps with various men in the neighborhood. Usually noticeable via her slacking standards of personal care," or "A person who partakes in scandalous activity in order to achieve a goal or bad image. Some of the activities may be classified as illegal." Although these definitions refer to adults, they are still useful for understanding the Ghetto Girl Discourse. Often, girls engaging in this Discourse have hair that hasn't been done and well-worn uniforms. These girls also use slang phrases to refer to sex, although its not clear if they always understand what they mean, damage school property by writing on desks, for example, and sometimes steal from other students or the school. Often, these things seem to be done in an attempt to appear scandalous and gain recognition, even if it is negative recognition, from adults and peers.

**Authentic Science Lover.** The Discourse of Science Lover was characterized by curiosity, a willingness and enthusiasm to try to new things, and wanting to explore and make things. A student engaging in this Discourse has internal goals, wanting to learn and answering

their own questions, as opposed to external goals focused exclusively on recognition.

Noticeably, this Discourse was not recognized by teachers, other authority figures, or students in the school and the science classroom, and there were few ways for them to enact this Discourse during the school day. It was present during the STEM Girls, however, this was primarily supported through my own recognition and not that of the girls. The girls did notice that STEM Girls involved doing experiments, and many participants indicated this is why they joined STEM Girls. This Discourse is the result of the intentional introduction of discourses of science as engagement in scientific practices.

**Imitation Science Lover.** The Discourse of Imitation Science Lover was based on a stereotypical and shallow view of science. Students engaging in this Discourse often pointed to scientific symbols like beakers or safety goggles, but rarely engaged on a meaningful level with science, such as performing experiments or trying to figure things out on their own. For example, when talking to three students about what STEM Girls was, they asked if we would wear lab coats and safety goggles and mimicked pouring chemicals into beakers. Despite the lack of substance, student engaging in this Discourse saw themselves as science people and were viewed that way by peers as well. Indeed, the main goal of engaging in this Discourse seemed to be recognition as a science person, by the teacher, other students, and myself. This Discourse was prevalent in the science classroom and, to a lesser extent, STEM Girls. It is possibly the result of discourses presenting science as mysterious and confusing, which could limit students' understanding of and engagement in authentic science, discourses of science as elite and special within the school, and lack of discourses of science as engagement in scientific practices; i.e., students *want* to participate in science and gain recognition for it, but are not sure how.

**Good Friend.** Students engaging in the Good Friend Discourse displayed loyalty to their peers both in and out of classrooms. In classrooms, this loyalty looked like defending their peers to the teacher, or offering verbal support to peers, when they thought something was unfair. For example, during one classroom observation, a student asked to go to the bathroom but was not allowed to. Another student felt this was unfair, and started asking to go to the bathroom herself. When she was allowed to go, she said she did not really have to go, but she thought the first student should be allowed to. Students engaging in this Discourse also helped peers with school work, sharing answers in class even to the point of allowing other students to copy their work. Outside of class, this Discourse was influenced by discourses of urban education that construct urban schools as violent places as the ultimate way of displaying loyalty to one's friends was by supporting them during a fight, either by participating yourself ("jumping in") or by continuing the fight with the other students either physically or verbally. One student explained to me why she joined a fight by saying, "Of course I'm gonna jump in, that's my favorite friend." The goal of engaging in this Discourse is to establish a support system and sense of inclusion in a group. Although recognized by some students at the school, this Discourse was not recognized positively by teachers or authority figures at the school and, in fact, was usually punished.

**Mean Girl/Tough Girl.** Students engaged in the Tough Girl Discourse are likely to get in fights, physical or verbal, with their peers. They are also blunt with their peers, to the point of meanness that is sometimes recognized as bullying by authority figures at the school. One student said, describing herself, "What if your personality is mean? Like if somebody said something stupid and you tell them that they said something stupid." These students are more likely to stand up for themselves in unfair situations and engage in verbal disputes with adults at the school. Students engaging in this Discourse are seeking to be recognized as strong and

independent, with an aim of protecting themselves and/or righting an injustice. Although not privileged by teachers or administrators at the school, this Discourse was recognized by them (as indicated by a large-scale anti-bullying campaign) and was also recognized by students at the school.

### **Micro-Level Discourse Analysis**

**Ashanti.** I met Ashanti during my first semester observing the after school program. Although she was not in the activity I was observing, I sat with her and her friends talked to her during snack and dinner. During the second semester, when STEM Girls started, Ashanti joined. We have developed a close relationship during the two years that I have known her. I've given her rides to and from school, we've gone out to eat together, we exchange text messages.

The entire time I've known her, Ashanti has been interested in technology. She often talks about phones, tablets, computers, and cameras and asks to use my electronic devices. She told me once that she wanted to carry my phone so that, "Everyone will think I have an iPhone." Other students have also noted that she loves technology and she and a group of friends started making and editing videos, using equipment from STEM Girls, to start their own YouTube channel. Ashanti also regularly researched topics online, mostly watching YouTube videos, covering a variety of topics such as how to make slime, why white people voted for Trump, what college dorms look like, and how ice cream makers work.

Ashanti describes herself as emotional and has expressed frustration to me that she's "too sensitive." She often gets very quiet or cries when she is frustrated about something. She explained it once to me that when she cannot keep up in a class or feels lost and confused, she gets headaches that make her cry. Other students often commented on this, telling me,

“Ashanti’s crying again,” but, at least in front of me, did not seem mean spirited about it.

Ashanti also told me that she didn’t feel picked on, just embarrassed.

*Influence of macro-level discourses.* Ashanti’s views of school, her science class, and other students were influenced by macro-level discourses of science, education, race, and gender. In particular, she balanced discourses of science as engagement in scientific practices with discourses of science as elite and special, economic goals of education, and African American girls as loud and in need of control.

*Discourses of Science.* Throughout the year, Ashanti expressed the idea that science involved participation in scientific practices, such as asking questions and performing experiments. Especially at the beginning of seventh grade, she was frustrated that her science class did not do any labs and said science is, “Figuring out problems and observing and illustrating new information.” She described a scientist as someone who is not afraid to take chances and try new things. However, she also engaged in discourses of science as exclusive and specialized. She consistently expressed the idea that a scientist had to be smart or intelligent, and often conveyed the ideal that it should be easy and come naturally. She consistently described a good science student as someone who works fast, doesn’t need help, and gets everything right.

*Discourses of Education.* In conversations with Ashanti, the influence of macro-level discourses of education was clear. Ashanti had a strong focus on careers, defining the type of person she was by what her career choice was. This choice changed from meteorologist, to baker, to YouTuber over the course of the year. Particularly in the case of YouTuber, she focused on the economic benefits of this choice, often talking about how much money she could make. Additionally, Ashanti focused on grades, and to a lesser extent test scores, as the primary

marker of success in her classes. She explained she was frustrated with her math class because, “I don’t want to be in an advanced class and make low grades and make it seem like I’m not smart.” Ashanti also expressed that students were responsible for learning, stating that if students don’t understand something in class, “They could just go home and get on , like, youtube and stuff about it, and websites.” However, she balanced this with her views that teachers have some responsibility, particularly if all of their students are struggling, explaining, “I don't think it's just like all on the students, it should be half on the students and half on the teacher, because like if you go into a meeting and all your students have bad grades, then that means you're not doing your part as a teacher.” Ashanti also shared views of individuality, not wanting to work with other students and stating that a good student was someone who doesn’t need help because, “If you ask for help a lot, it makes it seem like you don’t get it.”

*Discourses of Race and Gender.* Ashanti used gendered discourses to describe herself, saying that she is a good person because she knows how to act and helps others. Although she indicated during the first semester of her seventh grade year that girls were smart, by the end of the year she said that girls had to be both smart and obedient to do well in school. She explains, “People say that girls are smart... it all depends on your home training basically. If you’ve been taught to be obedient, or at least when you’re in school, then you will have a good working environment [in school].” Ashanti consistently separated herself from girls who were loud and got in trouble, indicating the influence of discourses of race and gender that describe African American girls as too loud and in need of control. Ashanti also makes a direct connection between behavior and grades at the end of the year. When I asked about an incident in class where she was reprimanded by the teacher and told to stop moving and be quiet, she says, “I’m

standing still and paying attention so I can know what's going on so I won't be clueless and I could get a good grade.”

*Negotiation of Discourses in Figured World of Science Class.* Ashanti primarily engaged in Good Girl and Good Science Student Discourses in the science class. She was always prepared for class, worked almost silently, consistently referenced her notebook and textbook during class, and devoted a significant amount of time and energy to her science fair project. However, Ashanti's bid for recognition as a Good Girl and a Good Science Student were repeatedly rejected by her teacher.

*Good Girl.* Across the spaces that I observed Ashanti in, as well as the interviews and focus groups conducted with her, she consistently presented a Discourse of being a Good Girl, often explicitly stating that she was a Good Girl. For example, when some students were getting in trouble for talking during announcements in the after school program, Ashanti whispered to me, “We're good girls,” referring to the fact that she wasn't talking to her friends. She once told a substitute teacher that she could be trusted to get water, because, “I'm a good girl.” She also explicitly distanced herself from what she considered the bad girls, saying things like it was funny that the principal called all of the students ladies because, “Most of the girls, they be getting in trouble.” Ashanti was also careful to follow the school dress code, although when she thought she could get away with it she wore silver sparkled hightop sneakers, and her hair was usually neatly styled. She rarely called out in class, except occasionally when she was excited about giving an answer. She generally sat quietly, almost completely silent many days, in class. At first, she sat next to her friend Destiny and the two of them would sometimes talk about assignments, but she was moved to the other side of the room and rarely talked to other students.

Ashanti was also careful to closely follow all of the rules of the class. For example, because the class was right after lunch, students were expected to report to class to check in and then line up and walk to lunch together. Ms. Smith often had students start on the warm up activity during this time, and Ashanti was one of the few students who always reported to the classroom first (other students went directly to the cafeteria). Ashanti also always asked for permission to leave her seat, for example to sharpen her pencil.

*Good Science Student.* Ashanti tried very hard to gain recognition as a Good Science Student. In sixth grade, she made all A's and was recognized as one of the top students during the annual awards assembly. However, in seventh grade she felt like her classes were much more challenging and science in particular moved very fast. While she struggled to keep her grades up, earning a C in science during the first semester of seventh grade, which she felt was not very good, she engaged in other aspects of the good student discourse. She was always prepared for class, with her science notebook, pens and pencils, and paper. She also made sure to have a textbook to use during class and always began work on whatever the assignment was immediately. In order to study for a test, Ashanti asked for permission to take her notebook home. As she struggled to keep her grades up, she began focusing more on working fast and finishing assignments, sometimes sacrificing engaging in the material. She explained this to me saying, "I don't want to do something so complicated because I might be putting all of my time into it and I might not finish."

*Recognition by others.* Ashanti's bids for recognition as a good student were repeatedly rejected by Ms. Smith, who described Ashanti as pouty and spoiled. Although she recommended Ashanti to go to the school wide science fair, which could be seen as positive recognition of a Good Science Student, she told her ahead of time that she better not start crying during it, a

statement that visibly affected Ashanti. After talking to Ms. Smith, Ashanti returned to her seat and put her head down for several minutes, an unusual occurrence for her. Several times, Ms. Smith rejected Ashanti's non-verbal bids for recognition as a good student in almost cruel ways. During one class, the band members (including Ashanti) were absent as they were participating in a band competition. They arrived back to school during the period in which Ashanti had science and she obviously came straight to the science classroom (other students arrived 10 to 20 minutes later). As she entered the room, the teacher was giving directions for that day's activity; Ashanti silently walked to the other side of the room where her seat was. As she neared her seat, the teacher stopped class and told her, in a very harsh tone, to "Stop walking and pay attention 100% right now." Ashanti stopped and listened. After a few seconds, she took off her backpack and got out her science notebook and pencil, at which point Ms. Smith told her, again in harsh tones, "Are you paying attention like I asked you? I just told you literally to do nothing and listen." Ms. Smith then told Ashanti she wouldn't explain any directions to her, she would have to ask another student. Ashanti remained silent and only slightly nodded during this exchange. Despite Ashanti's clear bid to be recognized as a Good Science Student by coming straight to class, entering silently, and having her materials ready, Ms. Smith not only rejects this bid but chastises Ashanti in front of the class. In another observation, Ashanti had a book out from another class. She didn't have the book open and was looking quietly at Ms. Smith giving directions. From across the room, Ms. Smith stopped the class and said to Ashanti, "You have lost your entire mind – and when I chunk you off, and you start crying, I need you to think about this moment right now. And then I want you to think about that 58 or whatever your grade is, cause it's definitely not an 80." Ashanti silently nods and puts the book in her lap. She looks down a little and mouths, "It's a 74." In this exchange, not only does Ms. Smith reject Ashanti's

bids at being a Good Science Student, she makes a clear connection between Ashanti's emotionalism and grades, indicating that someone who expresses emotion (i.e., crying) cannot be a good student.

Once, after class, Ashanti asked Ms. Smith about an assignment she had received a bad grade on. She asked Ms. Smith if she could re-do the assignment. Ms. Smith told her, "This is unacceptable, this is like two sentences. You're wasting my time. I'm gonna let you turn it in, yes, but at least do it right, otherwise it's a waste of both of our times." Ashanti nodded her head, gathered her papers close to her chest, and hurried out of the classroom; in this instance, she appeared to leave before she could start crying. Again, Ashanti makes a bid as a Good Science Student by trying to figure out how to bring her grades up and, again, Ms. Smith cruelly rejects this bid, mocking Ashanti on the way out by calling out after her, "Have a great weekend!"

*Negotiation of Discourses in Figured World of STEM Girls.* During STEM Girls, Ashanti often seemed like a completely different student compared to in class. During her seventh grade year, several of her friends joined STEM Girls and Ashanti was much more outgoing and enthusiastic than she was in science class, volunteering information, laughing and joking. She often stated that she felt more "free" in STEM Girls. However, she still made attempts to engage in the Good Girl Discourse, but negotiated this by engaging in the Authentic Science Lover Discourse.

*Good Girl.* In STEM Girls, Ashanti's engagement in the Good Girl Discourse involved distancing herself from students who she thought shouldn't be allowed to join STEM Girls. She often told me things like, "They come and they just loud!" Although at first she pointed to

students' behavior as a reason to exclude them, by the end of the year she said that if they weren't participating in the experiments they shouldn't be allowed to join the club.

*Science lover.* Ashanti engaged in the Authentic Science Lover Discourse consistently in STEM Girls, participating in experiments, asking questions, and providing suggestions for activities in STEM Girls, both in group brainstorming sessions and in conversations with me. Often, Ashanti referenced stuff she looks up online specifically for STEM Girls, such as how to make slime. She says that in STEM Girls, "I'm a good scientist because I can get my work done and have reasonable explanations and logical explanations." This is in contrast to her view of herself in science class, where she struggles to keep up with the fast pace of the class and describes herself as a passive recipient of information. The feeling of being "free" described above also enabled Ashanti to engage more deeply in the Discourse of Authentic Science Lover. For example, when collecting water samples for a STEM Girls project, Ashanti said, "When we did the water samples, we didn't have to go straight down there and come straight back... we walked at our own pace... and had a fun time."

*Recognition from others.* In STEM Girls, I purposefully privileged the Authentic Science Lover Discourse over the Good Girl. When Ashanti would suggest that some girls not be allowed to join, or be kicked out of, STEM Girls, I consistently explained that everyone could participate in their own ways. It was difficult for Ashanti to negotiate this with the in-school response for the Good Girl Discourse. Once she told me, "It don't seem like you would pick a favorite, it seems like you're like, 'Well, I think you're all good STEM Girls, I can't chose between one,' because everybody's good, or maybe you don't want to hurt nobody's feelings." Here, she does not quite believe that I would think everyone is a good STEM Girl, suggesting maybe I am just being polite. To privilege the Authentic Science Lover Discourse I also asked

Ashanti to report to the STEM Girls on her online research, and she designed and led several activities for the entire group. I also provided her with extra materials, in particular a video camera and computer with editing software, to support her interest in technology.

***Science Identity Development.*** Over the course of seventh grade, Ashanti's view of herself and consideration of science changed. At the beginning of seventh grade, Ashanti's favorite subject was science. Ashanti described science as figuring out problems, and observing and illustrating new information and explained that she joined STEM Girls because she wanted to do experiments. She described what makes someone a good scientist as, "Being not afraid to say what you want to say. Not being passive, which is basically the same thing. But step it up, showing leadership, and being courageous and being able to try new things. Also, intelligence." Ashanti explained this was what her sixth grade teacher had taught her about science. She said she saw herself as a science person because she liked science and wanted to be a meteorologist and that her mother and siblings also saw her as a science person because she practiced being a meteorologist or weather person at home. However, she did not think Ms. Smith or other students would see her as a science person because she does not yell out answers in class, but she did think that in STEM Girls she was viewed as a science person, because she's more open and not worried about being critiqued or graded. She described her science class as hard and fast paced and hoped that they will do more experiments in class. When asked to describe herself, Ashanti said she the word that best described her was "emotional." She explained that she often got frustrated in class and would sometimes cry.

At this point, Ashanti is not limiting who can be a science person, the only qualification she gave for seeing herself as a science person being that she likes science. She has a view of science as active engagement in scientific practices and sees it as something she can do and

wants to do, which is why she joined STEM Girls. She also sees a potential career in science. Although she sees herself as emotional, she doesn't indicate that this impacts her interest or ability to engage in science.

By the end of first semester, Ashanti says she no longer sees herself as a science person, because she wants to be a baker, reflecting her focus on careers. Even though Ashanti was chosen by the teacher to represent the class in the school science fair, she still doesn't think others see her as a science person because, "I don't stand out in science class." She also says that Ms. Smith probably doesn't see her as science person because, "I just do what she say. I just write down the stuff. I participate but I don't be acting like I know everything about science. That's probably why, cause I don't yell out answers and stuff. I raise my hand." At first this seems contradictory, the teacher choosing Ashanti to attend the school science fair should provide positive recognition as a science person. However, the selection process was not accompanied by any positive recognition. The selected girls' last names were put on a PowerPoint slide that was briefly shown at the beginning of class. There were no encouraging words from the teacher or other students and the selected girls did not give any indication of happiness at being chosen, i.e., Ashanti looked at the slide on the board with no expression on her face and, when I congratulated her later, barely acknowledged me. The lack of recognition for this, accompanied by significant amounts of negative feedback on a regular basis from her teacher, led Ashanti to feel her teacher did not see her as a science person. Ashanti's response indicates that she is having trouble negotiating what she thought a good scientist is, not being afraid to say what you want to say, and the Discourse of a Good Student, which requires that she be quiet and ask permission to speak.

Ashanti also continued to not see herself as a good student, describing other students who work quickly and get everything right as good students. At the beginning of one interview she described her science class as fun and challenging, explaining that it moves fast and has a lot of vocabulary. However, by the end of the interview she says that, actually, her science class is not that fun because they have not done any experiments yet. When describing a scientist at this time, Ashanti still had an active view of science, listing words such as courageous, diligent, and brave. However, she also included words like happy and said that scientists, “Can’t be gloomy,” explaining that if you are a scientist mixing up chemicals, “You’re gonna put your tears in there. And that’s not one of the things.” Because Ashanti sees herself as an emotional person, particularly one prone to crying, this statement positions her outside of the realm of science. It’s likely that this belief comes from the view of science as unemotional portrayed in the figured world of the science classroom and conveyed directly to the Ashanti by comments from the teacher (i.e., telling Ashanti not to start crying in class and warning her that she can’t be pouty during the science fair).

At the middle of the second semester, Ashanti still doesn’t see herself as a science person and now wants to be a YouTuber. During an interview, she takes out her phone and teaches me how to create an animated video on it, and describes the different types of equipment and tools you need to be a good videographer. However, when I ask her if she sees herself as a “technology person” (instead of a science person), she says no because she doesn’t know how to do the advanced stuff. Despite not seeing herself as a science person, she does now think that Ms. Smith and other students see her as a science person. She says Ms. Smith probably sees her as a science person because she answered questions from the warm-up correctly in class, and she thinks others see her as a science person because they want to copy her paper. Both of these

examples indicate the view that a Good Science Student must answer all or most questions correctly. Influenced by the figured world of the science classroom, Ashanti is redefining her view of a science person to reflect Discourse of a Good Science Student.

Additionally, Ashanti now describes her science class as fun and not challenging. Although she admits they still haven't done any experiments in class, she now connects that directly to students' behavior, saying that some students can't act right to do a lab. Ashanti still describes her science class as fun, because they, "Use textbooks and it's like, theories and colorful... and testing effects." This shows not only a view of science as truth (the textbook) but also hints at the Discourse of Imitation Science Lover for the first time, using words like "theories" and "testing effects" that don't have meaning in this context.

***Ashanti Summary.*** Over the course of her seventh grade year, the influence of macro level discourses of science, education, race, and gender impact Ashanti's ability to see herself as a science person. Although initially she views herself as a science person because she likes science, and enthusiastically engages in scientific practices in STEM Girls, she gradually becomes less confident in her ability to be a science person as she receives negative feedback from her science teacher and her grades go down. Even seemingly positive science experiences, like being chosen for the school science fair, are overshadowed by negative feedback from her teacher. By the end of the year, Ashanti has moved away from an Authentic Science Lover Discourse, possibly in an attempt to gain recognition as a Good Science Student.

***Destiny.*** Destiny attended the after school program from the beginning of sixth grade and joined STEM Girls over the summer between her sixth and seventh grade years. She is close friends with Ashanti, and they often work and hang out together. Destiny is well-spoken and confident when speaking to adults or her peers and is generally seen as a smart, funny person at

the school. Destiny always wears the traditional school uniform, rarely deviating even in her accessories or shoes. Her hair is usually neat, but she rarely has elaborate hair styles.

*Influence of Macro-Level Discourses.* Of the participants considered in this section, Destiny is the most critical of traditional discourses of education, science, race, and gender circulated at RPMS. She ascribes to discourses of science as engagement in scientific practices and is critical of discourses of science as specialized and elite. She is also critical of discourses of the economic goals of education, as well as the view that students need to be well-behaved in order to be smart.

*Discourses of Science.* Like Ashanti, Destiny expressed a view of science as engagement in scientific practices, saying that she likes science because she likes, “How we do experiments, and finding out how things work.” Destiny was one of the few students who openly critiqued many of the macro discourses of science evident in the school. When asked about scientists, she said, “A scientist doesn’t mean that you’re some kind of genius that knows everything.” She explained that to be a scientist, you have to be creative, but that doesn’t mean you’re good in everything. She says, “Just because you’re considered a STEM girl doesn’t always mean that you necessarily have to be good in all things.” This disrupts discourses of science being only for special people, and scientists as special and different. Unlike most of the other students, Destiny also critiques the type of science activities they had done in sixth grade, which were largely edible, saying they were fun, but “I wouldn’t call them experiments.”

*Discourses of Education.* Destiny consistently describes herself as smart because she makes good grades and does well on the benchmark tests they take in science, echoing a discourse of accountability in education. Destiny attributes this to her hard work. Unlike Ashanti, Destiny rarely mentions careers, and when asked she says her view on careers is, “If

you know you like science, then get a job in science,” because “you’re not just supposed to get a job for the money.” Destiny also is not competitive with her peers and works at her own pace without getting frustrated by the fast pace of the class. I often observed her working on assignments well after others had finished, staying after the bell rang to finish. In STEM Girls, during the one competition we had to build a spaghetti tower, Destiny did not seem to care that her group didn’t win and continued to work on her tower well after the competition was over.

*Discourses of Race and Gender.* Destiny often brought up fighting and drama at the school, often implying that fights happened far more often than they actually did. When asked to describe a typical day at RPMS, she says, “There’s always some type of fight.” However, most days that I observed there were no fights. Usually, when she brought up fighting she explicitly distanced herself from the types of girls who got in fights. When describing herself during her first interview, Destiny says, “I would describe myself as a smart person, that doesn’t really get into much drama, or you know... anything like bad. I don’t see myself as somebody that just likes getting in to fights or anything.” Destiny is engaging in discourses of urban education that construct urban schools as violent places, even when that doesn’t agree with her actual experience at RPMS. She further engages in these discourses by referring to other students as ghetto, which she connects directly to the BP5 poster and expectations. Destiny explains, “It’s just they want girls to be poised, polished, and professional, meaning always wearing the right clothes, you’re not wearing holy pants when we have dress out days. And we’re not being ghetto and stuff, we’re not cursing and we’re not fighting when we go on a field trip.” Destiny also acknowledges the role of surveillance, saying, “If you’re not gonna be poised, polished, and professional, like, just on a normal day, at least make it seem like you are if we have visitors coming in... at least make it seem like you’re smart.” Here, Destiny is conveying the belief that

a good student, i.e., someone who's smart, needs to look and act according to specific rules, expressing the discourse that African American girls need to be controlled and surveilled. However, later in the year Destiny also said that you can be smart but still get in trouble, "because the people in my class, they're really smart. They might have a couple of behavior issues, but they're really smart," indicating she is negotiating the discourses of race and gender that position well behaved girls as smart girls with her own experiences at RPMS.

*Negotiation of Discourses in Figured World of Science Class.* In science class, Destiny most often engaged in the Good Science Student Discourse and seemed to eschew the Good Girl Discourse. Over the course of the year, she gradually gained recognition for this from the teacher.

*Good Science Student.* In her science class, Destiny avoids the Good Girl Discourses but engages in a Good Science Student discourse, which she negotiates using humor. Destiny does not engage in many of the ways of saying, doing, and being that mark a good girl – she often calls out answers or makes comments or jokes in class without raising her hand and she doesn't ask for permission to leave her seat. These actions are not remarked on by the teacher, however, possibly because of the way Destiny communicates with the teacher. She is one of the few students to laugh at Ms. Smith's jokes, and she generally prefaces any requests in class with sorry or excuse me. She also explained to me that she would occasionally text Ms. Smith through an educational app, "Just to say hi," and felt that Ms. Smith was approachable if any students were struggling in the class. This relationship helped Destiny establish herself as a Good Science Student. Although Destiny regularly completes homework and gets good grades on most assignments, she often doesn't have her science notebook, telling me that she loses it regularly, and works slower than most of the students.

*Recognition from others.* Because Destiny makes good grades and interacts pleasantly with the teacher, she is recognized by her teacher and peers as a Good Science Student. Ms. Smith regularly asked Destiny to help in class, for example passing out papers, and often referred to her by name, unlike other students in the class, whose names she often confuses. When Destiny would call out an answer in class, or make a joke, Ms. Smith would often acknowledge her answer or reprimand her lightly, with humor. For example, if Destiny was talking during class, Ms. Smith would say, “Cool it, [Last name]” instead of using the harsh language she used with other students.

*Negotiation of Discourses in Figured World of STEM Girls.* In STEM Girls, Destiny acted very similarly to how she did in science class, but was more active and engaged. She still used humor often, but her primary Discourse in STEM Girls was Authentic Science Lover.

*Authentic Science Lover.* In STEM Girls, Destiny often engaged in scientific practices in an organic way; for example, when investigating how pop rocks work, Destiny developed her own experiment where she timed how long the pop rocks popped in hot water and cold water and compared the two. She often continues working on activities when the rest of the group is done, such as the tower described above, and expresses that she enjoys not just doing experiments, but learning from them and sharing that with her family. When describing STEM Girls, Destiny said, “We actually do experiments in here and even though we still talk about science, it’s fun and we, I don’t know about everybody, but I learn things from it sometimes and I get to go home, tell my mom about it and you know, not everyone goes home and tell their mom about school... I can go home and tell my mom, ‘well we found out that there was lead in one of these waters, but mine, it didn’t have lead, it was somebody else’s.’ I get to go home and do that, so it’s kind of fun.” Destiny was also one of the few girls who chose her own science fair project,

based on a pond water experiment from STEM Girls, even after being encouraged by Ms. Smith to select a topic online. She completed the project after school, during STEM Girls, and said, “I actually learned something from experimenting!”

*Recognition from others.* As discussed above, the Authentic Science Lover Discourse was privileged in the Figured World of STEM Girls and Destiny was recognized by others as a Science Lover. When working with groups, she was recognized as a leader and the other girls trusted her ideas during STEM Girls activities. For example, when designing a spaghetti tower with her group, she found a small whiteboard and began sketching out her ideas for her group members, who implemented her ideas closely. She also contributed to STEM Girls discussions and I often had one-on-one conversations with her about the activities.

*Science Identity Development.* At the beginning of seventh grade, Destiny described herself as a science person because ever since first grade she “liked experiments and like seeing how things work.” She thought other students maybe saw her as a science person because she’s smart and makes good grades. While she didn’t know yet if her seventh grade teacher saw her as a science person, she thought her sixth grade teacher did because she asked questions and liked figuring things out. Destiny described science as doing experiments and learning how things work, and several times referred to RPMS as a STEM School, which she explained means, “We do more experiments and... other STEM activities,” something she seemed proud of. Interestingly, this is not true, RPMS is not a STEM School; possibly Destiny is indicating a view of science as special and elite, and attempting to extend that privileged view to the school.

At the end of first semester, Destiny still sees herself as a science person because, “I like science and I like learning how new things work and how new things happen and stuff.” She says she doesn’t know what other people, including her teacher, think about her now. When

asked to describe science, Destiny says it's exciting, challenging, different, favorite, and everywhere. By everywhere, she explains things they learn in other subjects connect to science, like learning about the cardiovascular system in PE, and how your heart pumps faster or slower. Her ability to naturally make connections between her science class (learning about the cardiovascular system) and everyday experiences (working out in PE) demonstrates an organic engagement in the Discourse of Authentic Science Lover. When talking about her class, she says she thinks the teacher is fun and mentions how she jokes around with her in class, but she does say that she wishes they would do more experiments. She guesses that they don't do experiments in class because, "She thinks we're not ready, or there aren't experiments that deal with the stuff we're learning." Destiny seems to be negotiating what she thinks science should be (Authentic Science) with her experiences in science class, and attempting to make sense of the difference. Destiny also described a good science student as a "listener," but then added that her sixth grade teacher told them that good scientists ask a lot of questions, indicating she is negotiating the Discourses of Good Science Student and Authentic Science Lover. At this point, Destiny also explains that relies more on humor to help her negotiate the Good Science Student Discourse. She says about her science fair project presentation, "I already knew I was gonna get points taken off for neatness... when she said you can get bonus points for how you talk and stuff, I was like, okay, let me try to make this the 'fun' presentation."

By the middle of second semester, Destiny no longer sees herself as a science person. She says, "I like science, but I wouldn't really consider myself a science person," because, "If you ask me something like, what is homotosis [sic] and mitosis... nope couldn't answer that." She also says, "I like science, finding out where things come from, but I don't always KNOW where things come from or KNOW how things work and stuff." This indicates that Destiny has

adopted a discourse of science as the truth, and as a set of static facts to know. She does not mention experiments or any other engagement in scientific practices, and her use of made up science-sounding words (homotosis) might suggest a Discourse of Imitation Science Lover. Destiny also says that Ms. Smith might see her as a good student, but she doesn't know if she sees her as a science person and that other students probably don't see her as a science person anymore, just as a funny student. When describing her class now, Destiny says she doesn't like taking notes all the time and complains that the teacher gets mad at the whole class when only a few students act up. She also says that the teacher moves too fast and only checks in with the good students. Destiny wishes they would do experiments in class, and thinks they don't because, "She thinks we're not worthy enough. She sometimes thinks we're not even responsible enough to watch a video!" It's interesting to note that Destiny is pointing not to students' actual behavior, but to the teacher's view of the students.

***Destiny summary.*** Over the course of seventh grade, Destiny's actions in both science class and STEM Girls do not change much. However, her view of herself and, in particular her positioning as a science person, do change. At the beginning of the year, Destiny sees herself as a science person because she engages in discourses of science as engagement in scientific practices. However, over the course of the year, her view of a science person changes to more closely resemble the privileged discourse of Good Student, including a focus on defining vocabulary words. This can likely be attributed to the discourse of science as truth, i.e., as a set of discrete facts and vocabulary words to memorize, that is prevalent in the figured world of the science classroom. However, despite distancing herself from the non-special students throughout the year, Destiny continues to resist the idea that only special students can do science,

instead suggesting that behavior and smartness are not connected and that the teacher's view of students, not actual student behavior, is what prevents them from doing experiments in class.

**Amaiya.** Amaiya first joined STEM girls in the fall of her seventh grade year. She was invited to join by a friend who told her it was fun, but was hesitant to come with us the first day. Her friend went back to get her, and since that day she has been a big part of STEM Girls.

Of all of the girls in STEM Girls, Amaiya is the one most marginalized from school. She is regularly put into ISS or suspended outright, and often clashes with teachers and other school staff. She is openly critical of many of the school's policies and procedures. Although she technically abides by the school uniform, she usually wears tan skinny jeans, tennis shoes, and either a leather jacket or combat jacket over her uniform. She wears her hair in a ponytail or bun at the top of her head everyday, and rarely had braids or any other type of hair style.

***Influence of Macro-Level Discourses.*** Amaiya seemed unaffected by Discourses of Education circulated at RPMS, perhaps because of her marginalized status as a student. She was also critical of school science, indicating a view that science involved engagement in scientific practices, but she did ascribe to discourses of scientists as special and nerds. She seemed most impacted by discourses of race and gender, and particularly by discourses of urban students as ghetto.

***Discourses of Education.*** Amaiya rarely mentions careers, college, or any other economic benefits of education. She also does not talk about grades or test scores often, possibly because hers are much lower than most of her peers, possibly because she feels responsible for her low grades, or possibly because her grade did not hold much importance in her life. When specifically asked about grades, she would shrug or give short answers. She describes herself as "lazy" and says she "don't do nothing," distancing herself from the good students who complete

all of the assignments. Amaiya does not seem influenced by discourses of individuality or competition, as she shows loyalty to peers and often seeks out and provides help to others.

*Discourses of Science.* Like other participants, Amaiya describes science as fun and involving experiments. She critiques what happens in her science classroom as not being science, saying, “The stuff that we do in class, I don’t think its science... It didn’t feel like science.” However, she struggles to say what they should do in class, or what science should look like, referring instead to the edible science experiments from sixth grade as an example of something fun in science. When first asked, Amaiya says she doesn’t know what would make someone a good scientist, but later defines a scientist as someone who is smart and intelligent, and specifically calls the students who she views as the good science students the nerds.

*Discourses of Race and Gender.* Amaiya describes a good student as someone who, “Don’t talk, don’t do nothing. Just do the work,” indicating a discourse that black girls need to be quiet and passive to be good students. Amaiya is strongly influenced by discourses of urban education and urban students as ghetto, often calling other students ratchet (which she explains is similar to ghetto) and admitting that she herself can, “Get off track and be loud and be hood.” In a discussion about white teachers at the school, Amaiya explains that they leave the school because of the students, “The way we act, we talk too much and we don’t be listening, we just let her talk and we still be talking, and we play around.” However, Amaiya also critiques the view that this is because of her race, explaining that at one field trip, “The folks we went with, they was crunk with us. It wasn’t just us. It was more, it was black and white, it was mixed with us.” She also expressed the view that a student could be smart and ratchet, and that while she thought her teacher would like students who, “Follow every rule, not talk, do everything,” this was an impossible ideal.

*Negotiation of Discourses in Figured World of Science Class.* In science class, Amaiya struggled to gain recognition as a Good Student, often negotiating this with the Helper Discourse, and, when she did not receive that recognition, engaged in the Ghetto Girl Discourse. She also negotiated the Tough Girl and Good Friend Discourses in class.

*Good Student and Ghetto Girl.* In class, Amaiya tries to engage in the Good Student Discourse, but often engages in the Ghetto Girl Discourse, particularly when her bids at the Good Student Discourse are unrecognized by the teacher or she is confused or not able to follow along in class. Amaiya often started class attentive, but rarely had her notebook or other supplies for class, and although she always attempted assignments, she seldom finished them. Amaiya often became disruptive when she had trouble engaging as a Good Science Student. For example, on days when her class had a test, which Amaiya generally did not do well on, she would call out loudly across the room in class or pull her hood up over her head and put her head down on her desk. Several times, I observed Amaiya start class trying to focus and complete work, but then get bored or frustrated with an assignment and begin to engage in the Ghetto Girl Discourse. For example, in one class with a substitute, Amaiya left her group of friends, who were not working on the assignment, to sit with some other STEM Girls to work. However, after completing the first part of the assignment and realizing that the rest of the assignment was one they had already done, Amaiya called it stupid and joined her friends on the other side of the room, who were loudly talking and playing around. Additionally, although she would occasionally flip through a textbook during an assignment, indicating a Good Science Student Discourse, Amaiya generally relied on the internet to look up answers when she couldn't find them in the book. Amaiya also tried to engage in the Good Science Student Discourse through a

science fair project, which, although she was initially excited about, failed to complete when it seemed confusing and overwhelming to her.

*Helper.* Engaging in the Helper Discourse helped Amaiya gain positive recognition in class when she was not able to gain recognition as a Good Student. This was particularly noticeable during second semester of seventh grade. After having been suspended for 10 days for fighting, Amaiya returned to school and began volunteering often in science class to pass out materials, often jumping up to help before other students had a chance. She took these tasks very seriously, keeping track of who had supplies and making sure they were all neatly collected and stored at the end of class.

*Recognition from others.* Because the Ghetto Girl Discourse is not privileged in this figured world, Amaiya's use of this Discourse often led to some sort of reprimand or even exclusion from class, particularly during the first semester of seventh grade. During this semester, Amaiya and the teacher were both present for 13 of the days I observed. During four of these observations, Amaiya was reprimanded for things like being late for class or wearing her backpack. On another four of these days, Amaiya was put out of class for the entire class period. Early in the first semester, Amaiya occasionally asked to help in class, but was not recognized by the teacher, who would select other students as helpers. However, during second semester, Amaiya began engaging more proactively in the Helper Discourse, and Ms. Smith noticed that Amaiya was more focused and commented to me that she liked to help pass things out in class. Recognizing this Helper Discourse gave Amaiya a way to engage in class when the Good Student Discourse eluded her. For example, during a standardized test, Amaiya volunteered to hand out laptops in class, which the teacher allowed her to do. During the test, after looking at

the first few questions, she pulled her hood up and put her head on her desk, completing only a few questions. Ms. Smith spoke to her briefly during the test and encouraged her to try, but in the end Amaiya only answered a few questions and kept her head down most of the time. Ms. Smith still allowed Amaiya to collect the lap tops at the end of class, allowing Amaiya a small, positive way to engage in class. This was in contrast to previous tests, where Amaiya would be loud and disruptive in class. Amaiya also told me, not long after this test, that she liked Ms. Smith better, and that she thought Ms. Smith saw her as a student who could be quiet and do her work, even if she sometimes gets off track.

*Negotiation of Discourses in Figured World of STEM Girls.* In STEM Girls, Amaiya was able to engage regularly in the Authentic Science Lover Discourse, but she still struggled to negotiate views of science as truth (i.e., one right way to do science) with her experiences in STEM Girls. Additionally, when Amaiya invited friends to join STEM Girls, she struggled to negotiate the Ghetto Girl Discourse that her friends engaged in with her STEM Girl Discourse of Authentic Science Lover, and began using a Helper Discourse to negotiate these seemingly contradictory Discourses.

*Authentic Science Lover.* Amaiya was an enthusiastic participant of STEM Girls, expressing a natural curiosity about the activities and eagerness to do new things. During STEM Girls, Amaiya often walked around the room to see what other students were working on and compare with what she was doing. For example, when we were working on science fair projects in STEM Girls, Amaiya would visit a group looking at pond samples under a microscope and ask to look in the microscope herself, then visit another group making perfume and ask to sample it, then help a third group test water samples for pollution. She also liked figuring stuff out, especially anything that had to relate to technology. For example, one day the tripod that we

used in STEM Girls for our video camera was no longer holding the camera steady. Amaiya spent about 30 minutes taking the tripod apart and reassembling it so that it would work again. When I asked her about it, she said she liked taking things apart.

Despite Amaiya's natural inclinations toward authentic science, she was still negotiating macro level discourses of education and science that prevented her from fully engaging in authentic science. In particular, during many of our activities, Amaiya wanted to make sure she got the "right answer," indicating discourses of science as truth, as well as educational discourses of accountability that construct science as a narrow set of facts to memorize and highlights the importance of being right. For example, one day we experimented with making slime. The girls used a variety of materials and were free to combine them in multiple ways to see what the effect was. Most of the students jumped right in, making several versions of slime with different materials and comparing which ones they thought were best. Amaiya, however, seemed upset that her slime wasn't "right" and wanted to look up how to make it online. In the end, she didn't even keep her slime because it didn't look like "real slime" to her. Similarly, when experimenting with different ingredients for baking, Amaiya was upset that their cookies might not taste good and wanted to look up a recipe online instead of experiment with different ingredients. This view is also reflected when Amaiya said, during an interview, "I like experiments, but I'm scared something might happen."

*Helper / Ghetto Girl.* Amaiya also engaged in the Helper Discourse in STEM Girls. At the beginning of the year, she always volunteered to pass out snack, so much so that it became her official job. She also regularly helped clean up after activities, especially making sure her group cleaned up after themselves. Amaiya also engaged in the Ghetto Girl Discourse in STEM Girls, especially during the second semester when several of her friends joined the club. These

girls were more likely to engage in the Ghetto Girl Discourse, sitting separately from the rest of the group, using their phones throughout the activity, and talking about and to boys. Although these girls were welcomed to STEM Girls, they did not engage in the Science Lover Discourse as much as Amaiya did, and at first Amaiya struggled between the two Discourses. When there was push back from other STEM Girls who thought these new girls should not be allowed to come if they weren't doing the activities, Amaiya used the Helper Discourse to help her maintain her position in STEM Girls while also still engaging with her friends. For example, she would sit to the side with her friends and sometimes use their phones, but still say to me, "I'm helping, Miss Katie, I got my stuff!" In another example, at a party we had in STEM Girls, Amaiya's friends sat at a separate table from most of the STEM Girls. Amaiya moved between the two tables, engaging in conversation with both. When there was about 10 minutes left, Amaiya quietly got up and began cleaning and putting up the leftover food. She then helped her friends clean up their table and reminded the other STEM Girls to clean up as well. While cleaning up, Amaiya cleaned out and stored the 2 liter bottles, which we had been saving to make rockets in STEM Girls, intertwining the Helper Discourse and Science Lover Discourses.

*Recognition from others.* With Amaiya, I often explicitly praised the Authentic Science Lover Discourse in order to provide recognition that would potentially help her see herself as a science person. For example, when she was worried about her slime or cookies not turning out "right," I would talk to her about what we could learn from the process and how she could make slime that was even better than the "right" way. When she spent her time fixing the tripod for the video camera, I publicly thanked her and pointed out the engineering skills she had used. Other students rarely acknowledged Amaiya as a Science Lover, however, they did acknowledge

her role in STEM Girls and the Helper Discourse by deciding her job in STEM Girls should be to pass out snack each day.

***Science Identity Development.*** At the beginning of the year, Amaiya described herself as someone who likes to talk and play, but also someone who likes to be alone and by herself. She doesn't see herself as a science person, saying, "Science is not for me." She says science seems hard and that you have to do a lot of writing, indicating a discourse of science as special and elite, i.e., too hard for a regular student. Amaiya also says that she doesn't know what Ms. Smith thinks about her, because she hasn't been there many days and Amaiya missed several days herself, but other students probably would describe her as "goofy."

When asked to describe science, or a good science class, Amaiya says it has a lot of experiments and a good science class will be decorated with science stuff, "stuff people be excited to see," and describes classrooms with live animals, microscopes and other scientific tools, indicating a desire to engage in scientific practices.

At the end of first semester, Amaiya still thinks science should be fun and involve experiments, but describes her science class as boring and lame, saying, "We don't have nothing to do, just listen." Amaiya also seems frustrated with her class because, "The stuff that we do in class, I don't think it's science. It didn't feel like science." Here, Amaiya is negotiating discourses of science as engagement in scientific practices with her actual experience in science class. When asked now if she sees herself as a science person, Amaiya says "yes and no." She explains, "I like experiments, but I'm scared something might happen," referring to examples of experiments she did in STEM Girls. She doesn't think her teacher sees her as a science person because she acts goofy in class and doesn't pay attention. When asked if someone couldn't be both goofy and a science person, she says, "No, cause you might knock something over,"

indicating a discourse of school science as neat and orderly. At first, Amaiya isn't able to describe what would make someone a good scientist. Eventually she decides being smart and intelligent and maybe other things too, saying, "Smart, um, intelligent, I can't think of nothing else, but I'd put them and some more."

By the middle of second semester, Amaiya no longer thought of herself even partially as a science person. She says, "It's just too much... I like science, I just couldn't be a scientist," indicating the influence of discourses of science as special and elite. She still describes her science class as boring, saying, "We ain't been doing nothing but taking notes. Just taking notes." Although she notes that the teacher has been letting them use iPads in class for the notes, which she likes, and she still hopes that they'll do experiments in class. Her view of herself has changed now, saying that while she might get off track and be loud, sometimes she is quiet and focused (which matches her previous definitions of a good student). She thinks her teachers probably see her the same way, however, when asked what a good science student would look like, she now has a more extreme definition, saying her teacher would describe a good student as, "Someone who follows every rule, does not talk, do everything [all assignments]," following discourses of African American girls being loud and in need of control. She goes on to describe someone that is focused all of the time, and never gets off task, although she admits she doesn't think that's really possible. When talking about her teacher, Amaiya thinks she is mostly fair and that she, "Treats students how they act." She explains that one student "acts slow" so Ms. Smith "treats her like she's slow." It's possible that Amaiya is recognizing the dichotomy between special and not special students in the class and is attempting to position herself as special by pointing out other students who are not special.

***Amaiya Summary.*** Throughout the year, Amaiya struggles to find ways to position herself in ways that gain positive recognition from the teacher, eventually using the Helper Discourse to accomplish this goal. Although this helps her participate in class, and in particular avoid exclusion from class, as well as see herself as a good student, it does not support the development of a science identity. Despite attempts to support her view of herself as a science person in STEM Girls, she ultimately was not able to get recognition, other than from me, and did not see herself as a science person.

***Bobbie.*** I met Bobbie in the after school program when she was a sixth grader. She joined STEM Girls in the second semester of her sixth grade year (the first semester of STEM Girls). From the beginning, Bobbie was confident and outspoken in STEM Girls. She told me on the first day she came to STEM Girls that she was an advanced student and wanted to be with other advanced students, which is why she joined STEM Girls. She was also recognized by her peers as one of the best students, in all classes including science. For example, Ashanti describes Bobbie as a good science student because, “She always gets her work done fast and they be right most of the time.” She also said Bobbie was a good scientist because, “She is a good student.” Destiny says Bobbie is, “A good student in all of her classes.”

Bobbie wore the school uniform, like the other girls, but found ways to express her own style. She usually had her hair in braids and often had her nails done. Her uniform clothes were taken care of and fit her well. She wore tall riding boots or name brand shoes with her uniform most days, and during her seventh grade year received a popular, name brand bag that she carried with her everywhere and placed prominently on the table next to her during class and lunch.

***Influence of Macro-Level Discourses.*** Bobbie ascribes strongly to most of the macro level discourses of education, science, race, and gender circulated at RPMS. She focuses on

discourses of personal responsibility and the economic goals of education, science as the truth and school science as orderly and serious, and African American girls as in need of control.

*Discourses of Education.* The educational discourse that seemed to most prominently influence Bobbie was the idea of personal responsibility. She often mentioned that students were solely responsible for their education, even suggesting that students should bring money and/or supplies for their teacher in order to have resources for class. Describing her sixth grade science class, Bobbie says, “We should at least show we want to do the lab by bringing something in to do the lab.” She also describes good students as those who focus and get their work done, and says about other students, “If they don’t listen, that’s their fault.” Discourses of the economic goals of education were also present in Bobbie’s description of herself, as she regularly mentioned her career goal of becoming an archaeologist.

*Discourses of Science.* Observations of Bobbie indicate the influence of discourses of science as the truth and school science as ordered and serious. In science class, Bobbie relied heavily on the textbook, sometimes even referencing textbooks from the eighth grade science class when she couldn’t find an answer in her seventh grade textbook. She kept meticulous notes in her science notebook and focused intensely on whatever task the class was working on.

Bobbie also indicated that she viewed science as special and exclusive, particularly when discussing experiences such as field trips. Bobbie was regularly chosen by teachers to attend STEM field trips, some of which were attended by only a few students from RPMS.

Bobbie also saw science as a specialized way of thinking about the world, describing science as “mysterious,” and talking about science in confusing and sometimes incomprehensible ways. In another example, in one interview Bobbie explained why she liked science by telling this story about an experience she had with science in elementary school:

So, we had got ready, everybody was just laughing, and this one boy he dropped something and the glass broke. It was in like a little cylinder. And for some reason the glass just started dissolving. So everybody was like, whoa! But the good thing is that, since I was a good student, and I was one of the helpers, and I told everybody to put their jackets on before.

Here, Bobbie's story is confusing from a science perspective, as it is unlikely that elementary students would be using strong chemicals and not logical that any chemical stored in a glass container would then dissolve that container when dropped. It is interesting that when describing what is on the surface an important science experience for her, Bobbie chooses to mention that the boy who dropped the container was laughing, indicating that the students were not being "good," but that she was a good student and kept everyone safe. When telling this story, she also described an experiment as, "hands on, and you put on safety things so you won't get hurt in any way." This indicates confusion about the purpose of an experiment, and that she privileges the order and structure of school science by focusing on wearing safety equipment.

*Discourses of Race and Gender.* Several times, Bobbie expresses the view that girls are expected to be "decent and calm" and that RPMS, as an all-girls school, should "teach girls to be professional and appropriate." She also describes herself as "helpful" and gives examples of how she likes to help teachers during or after class. This indicates the influence of discourses of gender that girls need to look a certain way (professional and appropriate) and be nice and helpful. Additionally, Bobbie often complains that in an all-girls school, there is inevitably going to be a lot of drama and fighting. She says about RPMS, "I knew it was gonna be drama just because we're girls and that's what girls do. I knew it was gonna be fights." Bobbie also

consistently separates the good students and bad students, describing her science class as, “One side that was basically focused, doing their work like they’re supposed to. And the other side, talking out loud, being disrespectful... you always got that one half of the class that’s gonna act up and just don’t care.”

*Negotiation of Discourses in Figured World of Science Class.* In science class, Bobbie engages in the Good Science Student Discourse, one which she was familiar and comfortable with. However, when she failed to receive recognition from the teacher as a Good Science Student, she would engage in the Tough Girl Discourse. Bobbie also consistently engaged in the Good Friend Discourse in science class, working closely with two friends and also supporting other students in the class.

*Good Science Student and Tough Girl.* In science class, Bobbie was often observed negotiating the Good Science Student Discourse and the Tough Girl Discourse. She was always prepared for class, with all of her supplies neatly organized, and completed all of her assignments very quickly. She generally made good grades, although did not do as well as she would like to on benchmarks and other tests. However, she was also critical of the teacher, particularly during the first semester when she had a negative verbal exchange with the teacher during almost half of the observations, beginning with the very first day. While most students were likely to remain quiet when reprimanded by the teacher, Bobbie was more likely to respond verbally, although not necessarily aggressively.

Bobbie also used body language to express a switch from Good Science Student to Tough Girl Discourse, pulling a hood up and tightening it over her face, sinking down low in her seat, and letting her head roll back. Bobbie also describes herself as “mean,” explaining that she will

be blunt with her friends when she feels like she needs to be, “Like, if you say something really dumb, I’m going to say, ‘You’re stupid, why would you say that?’”

*Good Friend.* Bobbie also consistently engages in the Good Friend Discourse in science class. She always sits with two close friends and all three work together to complete assignments when possible. Interestingly, even though I often observed these three girls engaging in thoughtful discussion about the class material or discussing how what they were learning connected to their lives, this Discourse was disprivileged in the Figured World of Science Class. Often, the girls were told to stop talking and work independently.

*Recognition from others.* Bobbie struggled to gain recognition from Ms. Smith as a Good Science Student, and using the Tough Girl Discourse often resulted in verbal altercations. For example, early in the semester Ms. Smith reprimands all of the students who brought a book bag to class, despite having let them bring bookbags to previous classes. Bobbie is the only student who tries to protest. I recorded the following exchange in my field notes for that day:

Bobbie starts to respond, "I put my bag in here every single - " but Ms. Jones cuts her off and says, "I didn't ask you anything, either. You can step out if you need to get your mind right," In an angry tone. T makes face and looks around room, she's still standing up at this point, but she sits down and puts her head in her hands. She is mumbling something, but I can't hear her. MJ can, though, and says, "What? You want to be too much? How about an F? Is that enough? Close your mouth." This last part is almost, but not quite, yelling.

In this exchange, Bobbie responds to Ms. Smith’s initial reprimand with the Tough Girl Discourse, by protesting her directions. Ms. Smith responds by growing increasingly angry and

threatening Bobbie's grades for speaking up. Ms. Smith also regularly described Bobbie to me as being "haughty" and thinking she is "grown."

Despite a lack of recognition from Ms. Smith as a Good Science Student, other students in her class obviously view Bobbie as a Good Science Student. Other than identifying her as a good student, other students also ask her for help or feedback on work. For example, while developing questions about the science content they were learning, I observed the following exchange between Bobbie, B, and another student, K:

K: Do this make sense, who discovered ecology?

B: No, baby.

K: What about who discovered the food chain?

B: I mean, no one really discovered it, it was just there. You could say who gave it the name.

K nods and writes down this question.

*Negotiation of Discourses in Figured World of STEM Girls.* Like the other participants, Bobbie was able to engage in the Discourse of Authentic Science Lover in STEM Girls, and did not engage in the Discourse of Imitation Science Lover. She was more likely to engage in a Tough Girl Discourse, which was closely intertwined with the Good Friend Discourse for her, in STEM Girls than in her science class.

*Authentic Science Lover.* In STEM Girls, Bobbie's most common Discourse was Authentic Science Lover. Bobbie said she joined STEM Girls because, "Basically it's all about experiments and labs," She was an active participant, focusing intensely on most activities

beyond what was expected and expressing a lot of excitement. For example, when designing 3-d boats on the computer, her design was much more elaborate than most of the other students', and she excitedly told me, "I learned how to do this – it's actually cool!" Bobbie was also somewhat critical of the type of science that happened in her science classes. Even though she liked her 6<sup>th</sup> grade teacher, she didn't like doing edible science activities, saying, "I don't like the ones that use food with it because... I want to see something pop out of a container or something. I don't want to have to eat it." However, when asked about an experiment she had done that wasn't food, Bobbie wasn't able to come up with an example and instead described an activity about soil using gummy worms and oreo crumbles.

Over the course of seventh grade, Bobbie's participation in STEM Girls changed as a result of several factors. First, she invited two friends to join STEM Girls and began working almost exclusively with them, distancing herself from other students. She frequently complained about other students joining STEM Girls, saying it was too crowded and the other students weren't doing anything. Additionally, because she was active in other after school programs, such as band and dance, she began missing STEM Girls to attend rehearsals and practices during the second semester. Although she still came to STEM Girls when possible, it was difficult for her to complete the activities with less time and she wasn't able to engage in the scientific practices as deeply as she had previously, when her attendance was more consistent.

*Tough Girl and Good Friend.* In STEM Girls, Bobbie also consistently engaged in the Discourse of Tough Girl, more overtly than in science class. She often described herself as "mean" and, especially during sixth grade, bickered with other students almost constantly during STEM Girls. Several times, she got into shouting matches with other students. During seventh grade, although Bobbie distanced herself from the other STEM Girls and worked mostly with her

friends, she was still vocal about who did not belong in STEM Girls to the point of shouting at other girls several times. When a divide between her group of friends and Amaiya's friends began to form, she became fiercely loyal of her friends. However, unlike Amaiya, instead of fighting, or threatening to fight, she reported any altercations to the principal. Bobbie acknowledged to me that getting in a fight and getting suspended clearly made you not a good student, something she did not wish to happen.

***Science Identity Development.*** At the beginning of the year, Bobbie described herself as outgoing, kind of mean, very smart, but sometimes playing around. She confidently identified herself as a good student, particularly in her science class, and defined good students as those who, “get their work done, aren't disrespectful, and don't talk back.” Although she wasn't sure if Ms. Smith saw her as a science person or a good student, she felt that other teachers saw her as, “Smart, helpful, hardworking, and funny.” In particular, she mentioned her business and technology teacher, who often invited her to go on STEM fieldtrips. Bobbie also clearly distinguished herself and her friends as the “good ones” and described other students as, “Ones that make you want to slap them,” explaining that some students were too loud and didn't get their work done in class. In an interview at the beginning of the year, I asked if she saw herself as a science person. She confidently replied, “Yes, because my future career is dealing with sciences in some way. I want to be an archaeologist.” However, Bobbie's negotiations of discourses of school science and authentic science made her question this, saying, “I do see myself as a science person, but it's kind of weird because I only like the experiments. I don't like when teachers have to talk and we have to read textbooks and all that extra.”

By the end of the first semester, Bobbie's views of herself had not changed much. She still described herself as a good student and still saw herself as a science person because of her

career choice, saying, “Yes, because I want to be an archaeologist so I see myself as a science person.” Bobbie also continues to distance herself from the students she views as the “bad ones.” She describes herself as an “advanced person” and refers to the “group of people that don’t know how to act.” Her view of what makes a good student is also similar to earlier in the year, describing someone who will, “listen, be respectful, and get the work done.” However, Bobbie is more critical of her science teacher and her science class by this point, saying that Ms. Smith probably doesn’t see her as a science person because, “She just wants us to do work and expects us to learn from it.”

Midway through second semester, Bobbie’s view of herself as a student has begun to change. She lists the characteristics of a good student as, “Positive attitude, willing to get the work done, able to work with others.” While still focusing on the goal of completing work, Bobbie has added some possibly gendered expectations of remaining positive and getting along with others to her criteria. Interestingly, she also says that she and her friends are not good students, they are only “okay.” When asked why, she tells a story about herself and her friends getting into trouble in a class for talking too much. Again, Bobbie is reflecting a gendered, and raced, discourse of needing to be quiet in order to be a good student. Bobbie also says that, although she still sees herself as a science person because, “Yeah, cause, my career, I want to have a good future, is an archaeologist,” she doesn’t think Ms. Smith sees her as a science person because, “She probably wouldn’t be able to tell. She’s not the type to give you compliments.” Bobbie explains that Ms. Smith responds to students who are “acting a mess” but “she’s not going to say okay you’re doing a good job.” She also explains that other students probably don’t see her as a science person because she doesn’t get excited during class, a contrast to her description of her sixth grade class.

***Bobbie Summary.*** Bobbie was the only focus participant who maintained a view of herself as a science person through the seventh grade, despite the fact that she didn't think her teacher saw her as a science person. This is possibly because she received enough recognition from other teachers and students as Good Student that she didn't need the recognition from her current science teacher, although she still made bids for recognition. Bobbie was clearly positioned as a special student at RPMS, and maintained that positioning throughout seventh grade, consistently distancing herself from the not-special students. However, despite Bobbie's view of herself as a science person, she struggled between Discourses of Authentic Science and Imitation Science Lover throughout the year.

## 5. DISCUSSION

This chapter discusses the potential for science identity development at RPMS considering the macro-level discourses identified at the school and the impact of these discourses on the meso-level figured worlds of school science and after school science and the micro-level Discourse negotiation of individual students. I begin with an overview of the study, including a consideration of the sub-research questions addressing macro, meso, and micro level discourses/Discourses. I then consider the overarching research question, how do multiple levels of discourse/Discourse impact students' science identity development? Next I present a discussion of the findings in terms of significance for science education, followed by a discussion of the findings using critical race theory (CRT) as a lens for understanding. I then present the limitations of the study, implications for science teaching, and suggestions for future research.

### Overview of Study

Macro-level discourses of education (Bazzul, 2012), science (Lemke, 1990), gender (Renold, 2006), and race (Morris, 2007) have been identified as important influences in school environments. These discourses are related to micro level processes of identity development because they control the combinations of being, doing, and saying that are recognized as indicating a certain type of person in a given context. This research uses the model of figured worlds, such as the figured world of the science classroom, as the simplified cultural models through which macro level discourses are transmitted to individual students. Although each of these discourses has been examined individually, this research looked at the intersection of the various discourses in the science classroom and their impact on individual students. Using a theoretical framework of Critical Race Theory, the specific research questions addressed are:

1. What are the macro-level educational, scientific, and gender and racial discourses circulated at an all-girls, primarily African American middle school?
2. How do these discourses impact the figured worlds of science at the school and in an after school science club?
3. How do students ascribe to, resist, and negotiate these discourses in different contexts?

The site of this research is a public, all girls 6<sup>th</sup>-12<sup>th</sup> grade school in a large urban school district. This is a small school (around 500 students), entirely comprised of students of color who are on free or reduced price lunch. This site was specifically chosen because of the study's focus on African American females. Although the school is not officially a school solely for African Americans, it has been at least 98% African American since it's opening. For this research, data were collected during the school day, and during an after school program. The primary contexts for data collection are the seventh grade science classroom and the science club at the after school program.

Data were collected between August, 2015 and April, 2017. The data collected for analysis included participant observation in the after school science club and science classrooms (two-three times per week), other school observations, school artifacts, including signs and bulletin boards in the school, informal conversations with students and teachers, formal interviews with students, and focus groups with all members of the science club.

The primary design of this study is based on Carspecken's (1996) model of critical ethnography. Carspecken argues that qualitative research should do more than simply reconstruct or describe a phenomenon, it should seek to understand the relationship between culture and social structures. In this research, a critical ethnographic approach was used to

understand larger, macro-level discourses in both the school and after school setting, and their influence on a seventh grade science classroom and the students in the class.

Data were analyzed in three stages. In the first stage, observation data, school artifacts, and teacher conversations were coded to determine the presence of specific educational, scientific, racial, and gendered macro level discourses. This was a partially iterative process, starting with discourses identified in the literature; when macro level influences were identified in the data, they were compared to existing literature and included in sequential rounds of coding.

The meso level of discourses circulation were examined using the model of figured worlds. Gee (2014b) describes figured worlds as typical pictures or stories of what is normal in a given context. In this research, the figured worlds of the science classroom and after school science club were explored. The following set of questions were the focus of the second stage of analysis: How does the figured world of the science classroom (after school science club) work to: build relevance or significance for certain things, enact specific practices, recognize (or not) specific identities, build or destroy social relationships, create, distribute, or withhold social goods, and privilege and disprivilege different ways of knowing?

In the third stage of analysis, data specific to select participants were examined using Gee's (2014) Discourse tool. Gee defines Discourses as all the ways of thinking, doing, and being as a specific person in a specific context, and argues that people use Discourses to enact situationally specific, recognizable identities; i.e., to position themselves in specific ways. The Discourse tool was used to explore how specific participants are using language, actions, interactions, beliefs, values, clothing, tools, objects, and technologies to enact specific identities in specific contexts.

**Macro-level discourses.** A summary of the macro level discourses identified in this research is presented in Table 4. Many traditional views of science and science education that have been identified in the literature (Aikenhead, 1996; Lemke, 1990) were also observed in this research, including discourses of science as special, exclusive, and elite. Neoliberal discourses of education for economic goals and the importance of accountability, responsibility, individuality, and competition (Bazzul, 2012; Tobin, 2011) were also observed in this research. Discourses of race specific to urban education were observed, including views that students need discipline and punishment, urban schools are violent places, and students at urban schools are ghetto (Jacobs, 2015; Milner, 2012). Finally, traditionally gendered discourses of girls as passive and overly feminine, including looking nice and being helpful, were observed in this research as well (Archer et al., 2012).

The intersection of these macro level discourses was also observed in this research. As previously identified in research, the intersection of racial and gendered discourses positioned African American girls as in need of control and too loud (Fordham, 1993; Morris, 2007). Additionally, these discourses intersected with discourses of accountability creating a unique ideology of special and not-special students, with special students being those who are passive, quiet, non-violent, and not ghetto. When the intersection of all four categories of macro level discourses was considered, a discourse of science as being for the identified special students emerged.

Table 4.

*Macro-level discourses observed at RPMS.*

<u>Science</u>	<u>Education</u>	<u>Race (urban education)</u>	<u>Gender</u>
Science is special, exclusive	Economic goals of education	Students need discipline and punishment	Girls need to present themselves in feminine ways
Science is a specialized way of thinking	Importance of accountability in education	There is a prevalence of violence in urban schools	Girls need to be nice and helpful
Scientists are different	Importance of responsibility in education	Students at urban schools are ghetto	
Science is the truth	Goals of individuality and competition		<b>Black girls need control</b>
School science is ordered and serious			<b>Black girls are too loud</b>
Good science students are nerds			<b>There are special and not-special students</b>
<i>Science is engagement in scientific practices</i>			<b>Science is only for the special students</b>

**Meso-level Results.** In this figured world of school science, science is constructed as a static collection of facts to be absorbed by students. Students are regarded as passive recipients of information. Because of the view of students as needing control and discipline, which leads to the lack of engagement in scientific practices, students are positioned as outside of science altogether and are shown a world of science that is not to be understood or engaged in by people like them.

In the figured world of after school science, several of the discourses influencing the figured world of school science were disrupted, and discourses of science as engagement in scientific practices were introduced. This led to a figured world that supported girls' having fun, being themselves, and developing identities as members of the science club. Students were also able to connect science to their lives and communities, and began to see the value in knowing and learning through experience. However, the figured world of school science was still

privileged by the students in many ways; although they enjoyed the after school science club, they still prioritized grades and achievement in school.

Table 5 presents the Discourses, or combinations of ways of saying, doing, and being that indicated the particular identities that were identified in this research. It is important to note that many of these Discourses focus on behavior and grades, as opposed to student interests or activities.

Table 5.

*Description of Discourses available to students at RPMS.*

<u>Discourse</u>	<u>Description</u>	<u>Positioning in Figured World of Science Classroom</u>
Good Girl	Quiet, polite, neat Full uniform, tidy and well-kept Follows school and classroom rules	Privileged
Good Student	Quite, polite, prepared for class with notebook, textbook, pencil Asks appropriate questions, completes all assignments, does well on tests	Privileged
Good Science Student	Good student + Presents science fair project well, with a neat board and pleasing speaking voice Works quickly, without talking or interacting with peers	Privileged
Helper	Volunteers to pass out supplies, clean up	Privileged
Good Friend	Loyal to peers, will defend to others Helps others with school work	Marginalized
Ghetto Girl	Loud, call out in class Wear hoodies/jackets over uniform, uniforms barely meet requirements Physically playful More likely to get in trouble / less likely to make good grades Often on phone, preoccupied with boys and social standing	Marginalized

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Mean Girl	Tough: gets into fights (verbal or physical) with others Blunt with peers and friends Stands up for self	Marginalized
Authentic Science Lover	Curious, tries new things Wants to explore, make things	Marginalized
Imitation Science Lover	Presents stereotypical view of science, i.e., beakers and goggles Uses scientific vocabulary, sometimes inaccurately Shallow understanding of science	Privileged

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**Micro-level results.** On a micro-level, each focus participant negotiated the Discourses available to them in the figured worlds of School Science and STEM Girls in unique ways. Ashanti engaged in Good Girl and Authentic Science Lover Discourses in science class, by working quietly and passively and working hard on her science fair project. However, she did not receive recognition from the teacher for these Discourses. As a result, she began focusing on the Good Science Student Discourse, emphasizing completing work quickly, studying for tests, and improving her grades. In STEM Girls, Ashanti continued to engage in, and gain recognition for, the Authentic Science Lover Discourse as well as the Good Girl Discourse, as she distanced herself from girls who she thought should not be allowed to join STEM Girls.

Similar to Ashanti, Destiny also engaged in the Authentic Science Lover Discourse in both figured worlds. However, Destiny did not engage in the Good Girl Discourse in science class, calling out answers and failing to ask for permission to move around the room, but was able to negotiate engagement in the Good Science Student Discourse by doing well on assignments and tests and using humor with her teacher. In the Figured World of STEM Girls, Destiny continued to engage in the Authentic Science Lover Discourse.

Amaiya resisted the Good Girl Discourse in the figure world of science class, engaging instead in the Ghetto Girl and Good Friend Discourses. However, after receiving negative recognition from her teacher and administrators at the school, including being excluded from class and suspended from school, Amaiya began engaging in the Helper Discourse as a way to participate in class. In the figured world of STEM Girls, Amaiya also engaged in the Helper Discourse, but added the Authentic Science Lover Discourse with some prompting from me. After several of her friends joined STEM Girls, Amaiya was also more likely to participate in the Ghetto Girl and Good Friend Discourses.

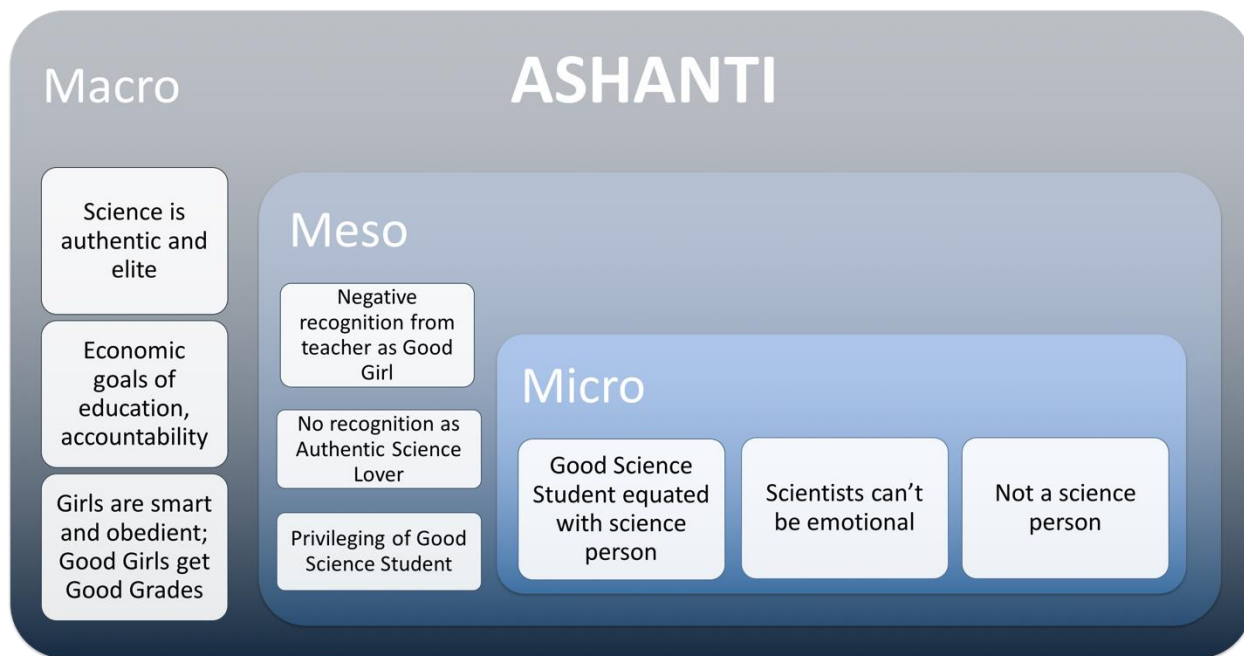
Bobbie engaged strongly with the Good Student and Good Science Student Discourses, and was recognized by other students and many teachers for these Discourses. However, Ms. Smith did not recognize Bobbie as a Good Science Student and, as a result, Bobbie engaged in the Tough Girl Discourse, defending herself against Ms. Smith's unfair attacks. In the figured world of STEM Girls, she negotiated the Authentic Science and Imitative Science Discourses and, when challenged, engaged in Good Friend and Tough Girl Discourses.

### **Multiple Levels of Discourse and Science Identity Development**

This section addresses the overarching research question of this study: How do multiple levels of discourse/Discourse impact students' science identity development? Each of the focus participants negotiated the macro-level discourses and meso-level figured worlds in different ways, but in each case this negotiation impacted the participants' science identity development. This section describes this impact for each of the focus participants.

**Ashanti.** Ashanti was influenced by macro-level discourses of science as authentic (at the beginning of the year) but exclusive, as she constructed spaces like STEM Girls to be only for privileged students. She also was influenced by educational discourses of the economic goals

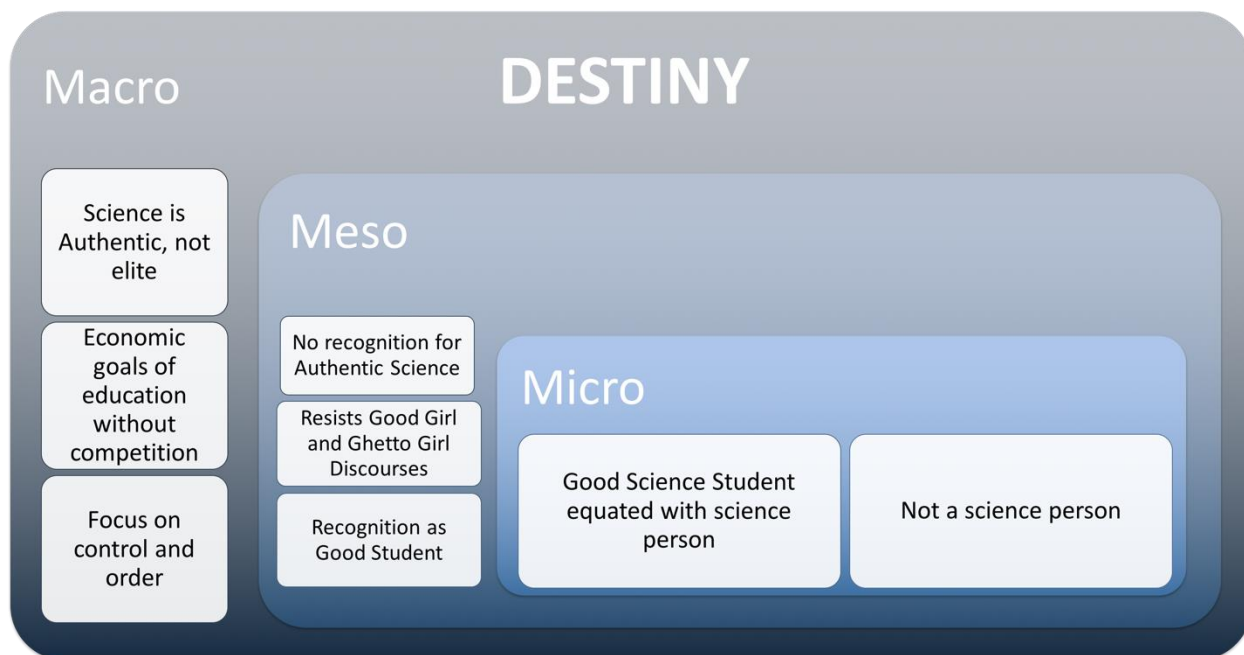
of education, particularly a focus on future careers, and accountability, placing importance on grades and scores on standardized tests. This influenced Ashanti's negotiation of Discourses in the figured world of the science classroom, as she tried to gain recognition as a Good Girl and Authentic Science Lover initially, but did not get positive recognition from her teacher. Instead, Ashanti focused in engaging in the Good Science Student Discourse, which, on a micro level, she began to equate with a science person. Based on negative recognition from her teacher to her bid as an Authentic Science Lover, Ashanti began engaging in discourses of science as serious, believing scientists can't be emotional. As a result of this, Ashanti ultimately no longer positioned herself as a science person by the end of the year. However, based on the Good Science Student Discourse, she did believe others saw her as a science person because she could answer questions correctly.



*Figure 6.* Impact of multiple levels of discourses/Discourses on Ashanti's science identity.

**Destiny.** At the beginning of the year, Destiny was influenced by macro level discourses of science as engagement in scientific practices, and critiqued discourses of science as elite and

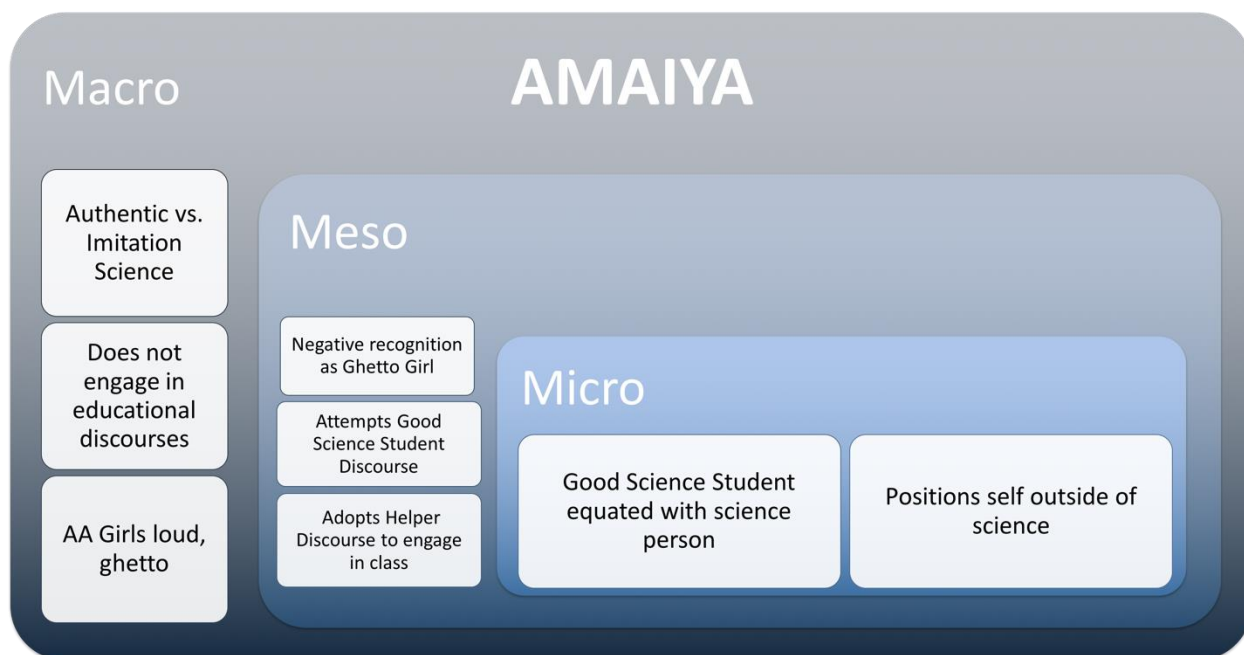
scientists as special. However, by the end of seventh grade, Destiny was influenced by discourses of science as the truth, as indicated by her equating knowing vocabulary words with being a science person. This led to engagement in the Discourse of Imitation Science, when Destiny used vocabulary words in inappropriate ways and made up science sounding words. She was also influenced by educational discourses of accountability, seeing herself as a Good Student because she made good grades and did well on standardized tests, but resisted discourses of competition in education. Destiny also engaged in discourses of school being violent, and students acting ghetto, but resisted discourses that students had to behave to be smart. At the meso-level, Destiny engaged in the Discourse of Authentic Science Lover in the figured worlds of both school science and STEM Girls, but did not gain recognition for this in her science class. Instead, she began focusing exclusively on the Good Science Student Discourse in class, although without engaging in the aspects that overlapped the Good Girl Discourse. She also equated aspects of this Discourse, such as knowing vocabulary, with being a science person. This impacted Destiny's science identity, and, by the end of the year, she no longer saw herself as a science person.



*Figure 7.* Impact of multiple levels of discourses/Discourses on Destiny's science identity.

**Amaiya.** Amaiya was influenced primarily by macro level discourses of African American girls being ghetto and loud. She did not engage in any discourses of education and struggled to negotiate authentic science and imitation science throughout the year. On the meso level, Amaiya struggled to participate in the Good Student Discourse, and was not able to work fast enough or quietly enough to gain recognition as a Good Science Student. She often then engaged in the Ghetto Girl Discourse, which received negative recognition from the teacher and often exclusion from class, making it even more difficult for Amaiya to participate in the Good Science Student Discourse as she missed assignments and content in class. The only way for Amaiya to gain any non-negative recognition, and remain in class, was to engage in the Helper Discourse. Amaiya did not see herself as a science person at the beginning of the year, but did think that maybe she could be a science person based on her enjoyment of experiments in STEM Girls. However, by the end of the year Amaiya no longer thought she could be a science person, even though she still enjoyed STEM Girls, because of the amount of work (specifically reading

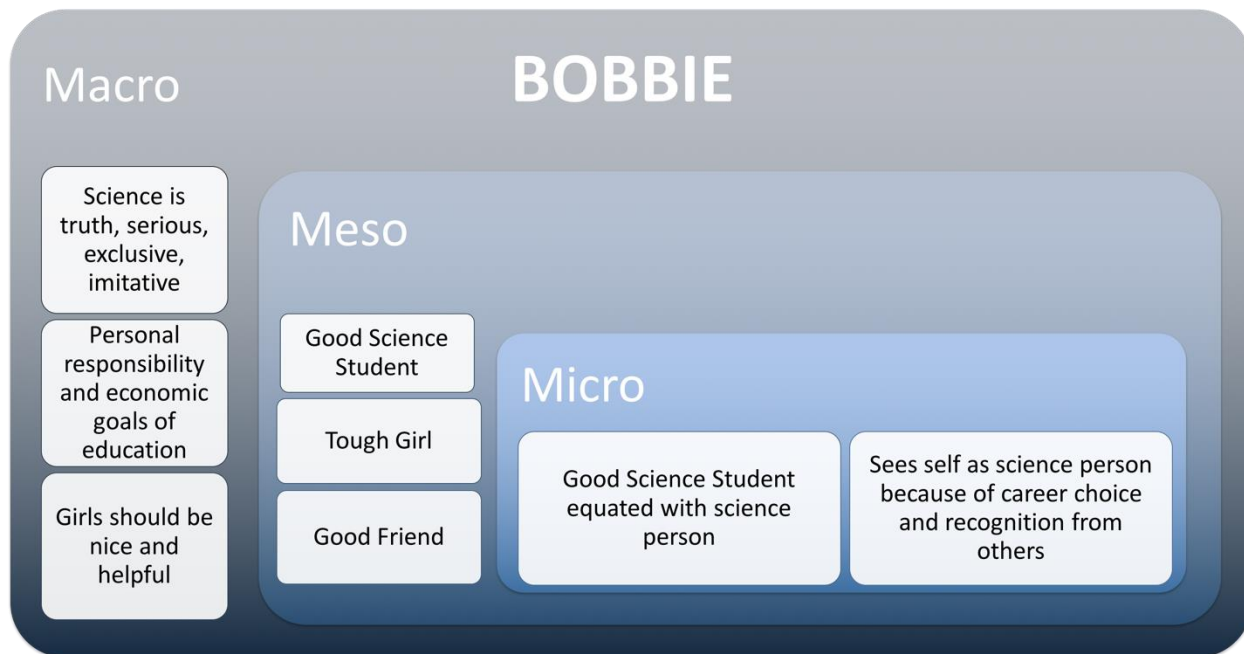
and math) involved in her science classes. Similarly to Ashanti, she did think that others might see her as a science person but for Good Science Student qualities: she was able to focus and be quiet sometimes in class.



*Figure 8.* Impact of multiple levels of discourses/Discourses on Amaiya's science identity.

**Bobbie.** Bobbie engaged in many discourses of science: science as elite, ordered, serious, the truth. She also engaged in an imitative view of science, and was unable to authentically explain what science is or what scientists do even after participating in STEM Girls. She also engaged in discourses of economic goals of education, focusing on career choice, and discourses that girls should be nice and helpful. This enabled her to easily participate in the Good Science Student Discourse in the figured world of science class; however, unlike in previous classes, Bobbie did not gain recognition from her teacher as a Good Science Student. As a result, Bobbie engaged in the Tough Girl Discourse, defending herself against her teacher. Despite not engaging in the Authentic Science Lover Discourse, Bobbie was the only participant who

consistently saw herself as a science person, although this was based on her career choice and an imitative view of science. Other students and teachers also saw Bobbie as a Good Science Student and science person.



*Figure 9.* Impact of multiple levels of discourses/Discourses on Bobbie's science identity.

**Patterns in science identity development.** Examining the paths of the focus participants over their seventh grade year, connections between macro, meso, and micro levels of discourse/Discourse are seen to work to position the girls as outside of science (Figure 10). On the macro level, there is a lack of authentic science discourse, as well as a focus on the educational discourse of accountability and racial and gendered discourse of control of African American girls. This impacts the meso level, the figured world of the science classroom, which privileges the Discourse of Good Science Student and omits the Discourses of Authentic Science Lover, leading to the development of a Discourse of Imitation Science Lover. On the micro

level, students begin equating the Discourse of Good Science Student with their descriptions of a science person, and no longer position themselves as a science person when they don't fit the Discourse of Good Science Student.

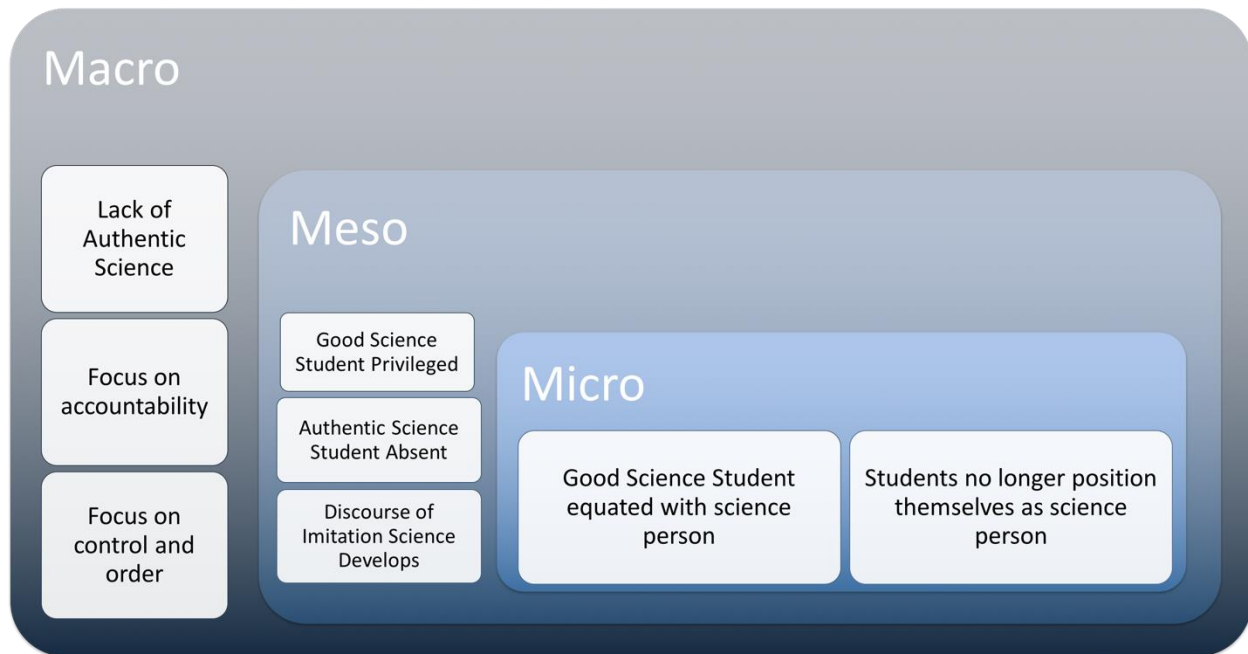


Figure 10. Connections between macro, meso, and micro levels of discourse/Discourse.

*Role of the teacher.* When considering patterns among the participants' science identity development, it is important to note also the role of the teacher in each trajectory. Although this teacher was an African American female with a background of working as a scientist, she actively, though perhaps unwittingly, discouraged her African American female students from seeing themselves as science people. This was done implicitly and explicitly. Implicitly, the teacher withheld recognition from students engaging in the Authentic Science Discourse in class. For example, during the science fair process, students did not receive any positive acknowledgement for authentically engaging in scientific practices. She also explicitly discouraged students directly in her interactions with them. For example, this was evident when Ashanti was chosen to go on to the school science fair. Being chosen for the school science fair

could be a natural situation in which Ashanti would gain recognition as an Authentic Science Lover. Instead, the teacher specifically told her that she could not go to the science fair and “get all pouty and start crying.” Less than a month later, Ashanti, who had described herself as an emotional person previously, decided she couldn’t be a science person because scientists, “can’t be gloomy.” The teacher’s words to Ashanti not only undermined any positive recognition she may have received as a result of the science fair, they explicitly told Ashanti that she could not be herself, i.e., emotional, and be a science person as well. This highlights the influence and importance of the teacher on these participants as middle school girls.

### **Discussion of Findings**

The results of this research highlight several important ideas for science education: the importance of engagement in scientific practices for identity building, the development of discourses of imitation science, and the institutional power of school science.

#### **Importance of engagement in scientific practices and nature of science (NOS).**

Although student engagement in scientific practices has been shown to support student understanding of science content and processes (National Research Council, 1996) this research indicates other benefits, including the development of science identities and understanding of the nature of science. This is supported by the community of practice framework for learning (Lave & Wenger, 1991), which argues that in order to develop identities of mastery, novices must have opportunities to engage in authentic activities, and must receive recognition for that participation from significant others. Although not an exhaustive list, this research generally considers engagement in the science and engineering practices defined in the Next Generation Science Standards (NGSS Lead States, 2013) as indicating engagement in authentic science activities. Significant others are generally adults with influence over the students, such as science teachers

or other authority figures at the school. This research shows how limiting students' participation in scientific practices not only prevents an Authentic Science Lover Discourse, it also prevents students from understanding the nature of science and creates confusion for students about what a "science person" is, as demonstrated by students shift from viewing a science person as someone who likes science and likes experiments to someone who gets correct answers in class. Instead of presenting the nature of science as a social and culturally embedded enterprise, in which scientists rely on their own creativity to make sense of data and generate knowledge, science is presented as a static set of facts that students are expected to memorize and recite. Students need meaningful ways to gain recognition from their science teacher and other authority figures as a science person, i.e., someone who engages in scientific practices, not just as a good science student, i.e., someone who can regurgitate facts. It also indicates a need for science teachers to redefine what constitutes a good science student. In this classroom, the image of the nature of science promoted equates science with a textbook, a product of science, instead of science as engagement in processes. Participants regularly attributed the lack of authentic scientific experiences in their science class to student behavior, indicating a view of engagement in scientific practices as a reward for being good. Not only did this lead to a complete lack of scientific practices in class, it conceals from students the nature of science – students did not view experiments as a way to learn new information, only as a reward or fun, hands on activity to supplement the real learning, which came from the textbook.

**Science for Everyday Life.** Engagement in scientific practices can also help students see science as something relevant or meaningful in their lives, particularly if they have agency to ask and answer questions that are important to them. In this research, the teacher failed to make connections to students' everyday lives, even when students attempted to make those

connections themselves. One rationale for this approach may be the lack of time and pressure teachers feel to cover a standardized curriculum so that students perform well on a standardized test.

Aikenhead (2006) discusses the importance of challenging elitism in school science by questioning discourses that present science as abstract, impersonal and boring, presenting “dishonest and mythical images” (p. 27) of science and scientists. Aikenhead also argues that this puts teachers and students in the “political position of having to play school games to make it appear as if significant science learning has occurred even though it has not” (p. 28), suggesting that students in many science classes are not intellectually engaged and, even when they are able to pass classes and make good grades, they are not actually learning. For example, both Destiny and Bobbie made A’s in their science class and generally did well on standardized tests, but struggled to make connections between the science they were learning in class and topics in STEM Girls or in their everyday lives.

**Development of Imitation Science.** The lack of scientific practices in this school, combined with disconnect between school science and everyday life, produced another, more surprising finding: the emergence of a discourse of imitation science. Students who wanted to engage in science, who had for some reason decided they like science, had no way to authentically engage in science and, as a result, engaged in a superficial imitation of what they thought science was, including using science vocabulary words without understanding the meaning, and describing fictitious science experiences as dramatic experiences. The focus on imitation was seen throughout the figured world of the science classroom, as students were recognized for parroting answers to the teacher and rote memorization of vocabulary words. Even when completing a science fair project, which seems like an obvious time to engage in

scientific practices, students were recognized for following specific procedures to imitate experiments found online. Although not evident in their seventh grade science class, all of the participants described activities in previous classes that I refer to as “edible science.” These activities are hands on and involve manipulating materials that are then eaten. These activities were almost exclusively given as examples of experiments by the participants. In Bobbie’s case, even when she attempted to critique these activities as “not really science,” she had no other experiences to relate to. When asked what a real science experiment would look like, she described a cookie and gummy worm soil activity, another example of “edible science.”

**Institutionalized Power of School Science.** Although the figured world of STEM Girls introduced and support the Discourse of Authentic Science Lover, and students were actively engaged in this Discourse during STEM Girls, it did little to impact their views of science or science identities. This is consistent with results from other out of school time (OST) science programs, which have demonstrated that even when positive science identity development is observed in OST programs, it is difficult to maintain the identity development in other contexts (Basu & Barton, 2007; Gonsalves, 2013; Rahm, 2008). In this research, the institutional power of school science is so important in this school, and in society, that even an after school program that explicitly sought to disrupt marginalizing discourses was not able to support the development of science identities in the participants. Of the three focus participants who saw themselves as science people at the beginning of the seventh grade, only one still saw herself as a science person at the end of the study eight months later and her identification was based on career goals and discourses of imitation science, which did not change over the course of the year. The other participants adopted discourses from the figured world of school science,

including views that they couldn't be a science person if they did not know lots of vocabulary and that science was too hard for them.

**Role of the teacher.** Although the focus of this research was the experiences of the middle school girls, the influence of the teacher on these experiences was crucial and, in some cases, pivotal in their identity development. As in many classrooms, the teacher was the primary significant other who could provide the recognition necessary to support science identity development. However, in this classroom the teacher often withheld that recognition, as in the case of the lack of acknowledgement of girls' participating in the science fair. As Bobbie pointed out, she did not think the teacher would know if she was a science person because she was not the type of person to give positive feedback. Instead, the girls' sought recognition through grades, which were based largely on vocabulary words standardized tests. Additionally, specific interactions between the teacher and participants could be seen to directly impact the student's ability to see themselves as a science person. This was seen in Ashanti's trajectory: after the teacher told her not to pout at the science fair, Ashanti revised her view of who could be a scientist to limit people who are "gloomy," and, therefore, exclude herself from science.

It is important to note that this teacher was intelligent and well-trained, and had been teaching in a middle school for several years. Outside of class, I enjoyed talking with her and she shared many innovative ideas for teaching. She was funny and thoughtful about teaching and education. However, within the constraining discourses of the school, this teacher had few options other than to focus on standardized tests and a good presentation of students during classroom evaluations if she wished to keep her position. According to her, any attempts to engage in authentic science had to be reserved for after standardized testing; by that point, many of the participants had already decided that they weren't science people.

### **Using Critical Race Theory to Understand Multiple Levels of Discourse**

Ladson-Billings (1998) suggests that Critical Race Theory (CRT) gives educational researchers tools for “deconstructing oppressive discourses” and “unmasking and exposing racism in its various permutations” (p. 17). This research sought to use CRT to identify how macro level discourses of science, education, race, and gender work to create oppression for African American, middle school girls in science spaces. This section includes a reflection on the results of this work through the lens of CRT and a discussion of the importance of intersectionality, in particular Patricia Hill Collins (1991) framework of controlling images.

**Macro-level discourses.** The macro level discourses of race and gender identified in this research reflect the permanence of racism in US society: discourses of African American girls as too loud, in need of control, violent, and ghetto were prominent in all educational spaces. Although this result agrees with previous research on African American girls in education (Fordham, 1993; Morris, 2007; Youdell, 2003), it also extends this finding to examine the intersection with discourses of science, which is often presented as objective, neutral, and colorblind. In particular, macro level discourses had a direct impact on the students’ science experiences by influencing the figured world of science class and the Discourses available within the figured world. The Good Girl and Good Student / Science Student Discourses were unique to African American girls and not only marginalized certain students from school science, but also failed to prepare any students (even the ones identified as Good Science Students) for actual science, thus continuing a cycle of exclusion of African American women from science degrees and careers. This is an example of what Ladson-Billings (1998) refers to as the master scripting of education, or the idea that the official school curriculum functions to maintain white supremacy throughout society. Ladson-Billings refers explicitly to the discourse of science as a

normative category of whiteness; by perpetuating unjust macro level discourses of science, education, race, and gender we are also perpetuating the exclusion of African American women from science. Additionally, viewing whiteness, and in this case science education as a category of whiteness, as property allows us to see how science education was withheld from students through what Ladson-Billings (1998) calls “restricted access to curriculum” (p. 24). The learning experiences that the girls in this study had access to were based on passive note-taking, not on the dynamic engagement in scientific practices that are indicators of rigorous, high quality science learning (NGSS Lead States, 2013).

As Archer et al. (2012) has shown, girls must conform to feminized, passive discourses of gender in schools to be recognized as good students and Morris (2007) and Youdell (2003) demonstrated how African American students in particular had to conform to discourses of race and gender. This research showed that in addition to that, discourses of education and science influenced the Discourse of Good Science Student to include a focus on working quickly, completing all assignments, and doing well on standardized tests. Additionally, conforming to these discourses was one of only a few ways to get positive recognition at the school, for example by being nominated for the BP5 award.

**Meso- and Micro- Level Discourse Negotiation: Role of controlling images.** Collins (1991) described controlling images as tools to “justify and maintain oppression” (p. 76) of African American women and explained that they are, “Designed to make racism, sexism, poverty, and other forms of social injustice appear to be natural, normal, and inevitable parts of everyday life” (p. 77). This research demonstrated how limited Discourses were available to African American middle school girls. Considering the Discourses available to students provides insight into the ways in which African American women are subject to controlling

images throughout society. Each of the controlling images Collins (1991) identified have equivalents in the Discourses identified at RPMS. First, Collins' (1991) description of the controlling image of the Mammy is that of the obedient, passive African American woman who accepts her subordination and does not resist the oppressor. This was reflected in the Discourse of the Good Girl, who remains quiet and obedient even in oppressive situations. Collins (1991) describes the controlling image of the matriarch as an assertive, even aggressive woman who is strong and in control of her household. In RPMS, this is similar to the Discourse of the Tough Girl, who is not afraid to stand up for herself, even to teachers. Finally, Collins' (1991) controlling images of the welfare mother, the poor or working class African American woman who relies on government assistance, and the jezebel, the African American woman who is sexually aggressive, are both reflected in the Discourse of Ghetto Girl. Like the welfare mother, the Ghetto Girl Discourse often reflected a lower socioeconomic status, particularly in appearance. The Ghetto Girl often did not have well-kept or complete school uniforms, and were also identified by a lack of expensive hair styles (i.e., sometimes referred to as "nappy headed"). Like the jezebel figure described by Collins (1991), the Ghetto Girl was also identified in this study as being overly sexualized, having boyfriends and referring to sexual activity not generally thought of as appropriate for middle school girls.

Collins (1991) also describes three reactions that African American women can have to controlling images: internalization, denial and assimilation, or resistance and self-definition. The focus participants of this research demonstrated each of these responses in various ways. For example, the response of internalization was seen in Ashanti's response to negative recognition from Ms. Smith. Ashanti is not empowered to question whether the negative treatment was fair or not and instead internalizes the message that she needs to be good and quiet in order to be a

good student. This was exemplified in the interaction between Ashanti and Ms. Smith in which Ashanti was reprimanded in front of the class simply for entering the room silently and, instead of responding in anger, Ashanti explained that she needs to “stand still and be quiet... so I can make good grades.”

The response of denial or assimilation is seen when an African American woman claims that she is not like other African American women and, therefore, not subject to the controlling images that oppress them. Bobbie demonstrated this response in her consistent distancing of herself from the bad students. Collins (1991) explains that this response happens when, “African American women reject connections to other Black women and demand special treatment for themselves” (p. 103). This was seen particularly in science contexts as Bobbie, as well as other students, insisted that certain students could not behave and did not belong in STEM Girls.

The response of resistance and self-definition, although not fully observed in this research, was still evident in small spaces as the girls negotiated unjust macro level discourses. For example, Destiny sought to define a student who could be both smart and not perfectly well-behaved when she explained, “The kids in my class, they’re smart. They might have some behavior issues, but they’re smart.” She also worked to create new definitions of scientist that differed from traditional, elitist discourses of science, explaining that, “Just because you’re a scientist doesn’t mean that you’re a genius who knows everything.”

Collins also states that, “Silence is not to be interpreted as submission” (p. 108), and this was observed throughout this research. Many times girls faced oppressive situations silently in their classrooms, but were able to critique their situation later. For example, when Amaiya says, “That stuff we do in class, I don’t think it’s science,” she’s critiquing her experience even though she is not voicing her opposition in class.

Finally, Collins (1991) argues that substituting positive controlling images for negative controlling images is still problematic as it does not address the way in which African American women are externally defined. For example, in this research, controlling images of “STEM Girl” and “Good Student” were evident, and even provided short term benefits for students, such as positive recognition and participation in field trips. However, these images were defined and assigned to girls externally, and still served as means of controlling and dehumanizing the girls. Collins (1991) argues that instead of externally defining positions for African American women, the women should be allowed to self-define, or determine individually and internally how they wish to position themselves in society.

## 6. CONCLUSIONS

This chapter first discusses the implications of this research for teaching science, including focusing on the incorporation of scientific practices in science classrooms and the need for teacher awareness of macro-level discourses and the unique positioning of African American girls in education and science. The chapter then addresses the limitations identified in this research. Based on these limitations, as well as new questions identified during this study, areas for future research are discussed.

### **Implications for Teaching Science**

In the classroom studied here, science is portrayed as authoritative, precise, unemotional, and quiet. Although previous research has identified these characteristics of science (e.g., Aikenhead, 1996; Lemke 1990), this study demonstrates how this portrayal of the nature of science resulted in the African American, middle school girls who were students in the class not identifying themselves as science people when they don't fit image of a science person promoted by the multiple levels of discourses at RPMS. It can be argued, based on this research, that what is needed is a more authentic portrayal of the nature of science (NOS), which is essential for African American girls to develop science identities that are not in conflict with other personal and cultural identities. Based on this, three specific implications for science teaching are presented here: engagement in scientific practices, disrupting marginalizing discourses to support students, and teacher understanding of positioning of students.

**Engagement in scientific practices and nature of science.** This research suggests several implications for science teaching. The first, based on the importance of engagement in scientific practices for science identity development, is the need to include scientific practices as part of learning and make explicit connections between engaging in scientific practices and being

a scientist. In this research, engagement in scientific practices was not observed in the school, and students had trouble even defining what an experiment is. With the incorporation of scientific practices into regular classroom learning activities and the inclusion of explicit reflection and discussion around the nature of science, students could develop a more authentic view what science is and what scientists do, which could in turn support their science identity development. Additionally, opportunities to participate in science experiences, which provide students with recognition as a science person, should not be limited only to students who meet specific and rigorous behavior expectations. For example, excluding students from science field trips sends a message to students that good behavior, influenced in this school by discourses of race and gender that require African American girls to be nearly silent and passive to gain recognition, is a necessary prerequisite to engaging in science. Rethinking the role of the science fair in light of these findings also suggests that it could be a more powerful tool to support science identity development with a few simple adjustments. For example, students should be encouraged to select their own topics based on everyday experiences and personal interest and projects should be evaluated based on how well students engage in scientific practices to complete the project, privileging attributes like creativity, ingenuity, and persistence. Of course, incorporating these suggestions for science fair projects assumes that students will have more access to and experience with scientific practices in their classroom in order to prepare them for a successful science fair experience.

**Disrupting marginalizing discourses to support students.** Beyond providing opportunities to engage in scientific practices and making explicit connections to being scientists, teachers also need the awareness and tools to disrupt marginalizing discourses that equate behavior, grades, and science in school. This involves creating avenues for positive

recognition that go beyond behavior and preparedness or, in the case of the science fair, recognition that goes beyond a neat board and pleasant speaking voice. Teachers should also avoid overt connections between behavior and grades, i.e., assigning zeroes as grades when students are not quiet or giving extra credit for good behavior.

**Teacher understanding of positioning of students.** Finally, teachers need an awareness of the unique positioning of African American girls in education as well as the macro-level discourses of science and education that potentially influence science classrooms. For example, although teachers have little control over state-mandated standardized tests, understanding the impact of these tests on students' experiences in the classroom and ability to see themselves as Good Science Students and even science people might encourage teachers to approach the tests in different ways. Additionally, understanding historical positioning of African American women as too loud and in need of control might support teachers' reflection on their responses to student behavior.

### **Limitations**

Several limitations of this research were identified. Most notably, this research was conducted in a unique space: an all girls, primarily African American middle school. Although this provided a rich context for exploring the experiences of middle school, African American girls, the results are not meant to be applicable to other contexts, such as coed or multiple race spaces. Additionally, only one teacher and class, and a small handful of students, were considered in depth here. While this helps us understand the experiences of this particular group of students in great depth, it does not provide a similar amount of breadth to the study.

Additionally, although steps were taken to minimize researcher bias, including regular debriefings with other researchers, member checking, and relying on multiple data sources, it

was impossible for me as a researcher to remain completely neutral. This was particularly true during STEM Girls, as I worked closely with the girls to develop community in the program. However, I believe there were benefits gained from my close relationships with the girls, who trusted me enough to very honestly share difficult stories about their lives.

Finally, this research focused primarily on the students' perspective. Although I had informal conversations with several staff members at the school, and formal interviews with the teacher, their perspective was not privileged in the analysis and results. A more complete picture of the macro-level discourses circulated at the school, and the ways in which they influenced the meso-level figured worlds of various classrooms, would be attained by including these different perspectives in the research.

### **Future Research**

Several areas for future research emerged as part of this research: the role of teachers in the circulation of macro-level discourses, an exploration of student negotiation of discourses/Discourses in other contexts, and the development of ways of supporting students' negotiation of Discourses and ability to self-define in science spaces. Increased understanding of how each of these factors influence students' science identity development would be useful in designing and implementing effective and inclusive learning environments.

Just as student views of science and education are influenced by macro level discourses of science, education, race, and gender, so are teacher's. This research did not explore how teachers negotiate these macro-level discourses or what Discourses are available for science teachers in the figured world of public schools and classrooms. Future research that examines

how teachers' negotiation of macro level discourses and micro level negotiation of Discourses informs their instructional choices in the classroom is necessary.

This research examined one very specific context: an all girls, primarily African American middle school. Examining additional contexts is important to fully understanding the impact of multiple level of discourses on science identity development. In particular, coeducational schools and classrooms as well as those with multiple races represented should be considered, as well as non-science spaces such as other classes and community and family spaces. Additionally, exploration of the race and gender of teachers would also provide additional understanding of the ways in which macro-level discourses are circulated.

The figured world of science in this study appeared to reinforce oppression of the girls and perpetuated a discourse of elitism of science, allowing only special students to participate in science. Ways of authentically engaging in science in the classroom were limited. Although more authentic views of NOS were presented in STEM Girls, it was difficult to counter the institutionalized power of the school and classroom. Further research is needed that identifies formal educational environments that promote authentic images of NOS and explores science identity development through multiple D/discourses in these environments.

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