OUTSIDERS WITHIN: A PORTRAITURE OF THE LIVED SCIENCE EXPERIENCES OF BLACK FEMALE ELEMENTARY PRESERVICE TEACHERS

by

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(Under the Direction of

Cory Buxton)

ABSTRACT

This study examined how the informal and formal science experiences across the lives of four Black female elementary preservice teachers impacted their science teaching identity development. Informed by Endarkened Feminist Epistemology, along with Critical Race Feminism, this study utilized Portraiture as a methodology to paint the mosaic of science identities participants were and were not able to construct through science learning as 'outsiders within' science spaces which traditionally celebrate White males as doers of science. Two questions framed this research: 1) What are the lived science experiences of Black females in an elementary certification program at an historically Black college and university? 2) How do the science experiences of Black female pre-service teachers shape their identity as teachers of elementary science? Four Black female elementary preservice teachers, Shonnie, Tiffany, Jackie, and Josie, offered a unique perspective on constraints and opportunities to develop robust science experiences. Culturally responsive research methods such as life history interviews, focus group discussions and PhotoVoice submissions centered participants' voices as they described structures which enabled and constrained science identity development. Voice Centered Relational Analysis

and the construction of I-Poems prioritized participants' voices listening to their telling of their science selves and the opportunities they were afforded to perform scientifically as doers of science and teachers of elementary science.

Five themes arose to produce counter-stories about Black female students' engagement in school science: 1)Participating in inquiry science was important to Black female students' interest/ability to see themselves as scientists, 2) Relationships with teachers impacted Black female students' interest/ability to see themselves as scientists 3) Significant academic struggles impacted how Black female students saw themselves as scientists 4) The participants in this study expected the science methods portion of their teacher education program to scaffold their elementary science teaching abilities regardless of previous experiences with science and 5)Regardless of the impact of the participants' lived science experiences, each teacher candidate expressed a personal commitment to figure out how to teach science well to her future students. Results indicate the necessity for teacher preparation programs to do more to scaffold science teaching identities of Black female elementary preservice teachers whose science identity has been constrained through the impacts of traditionally accepted stereotypic images science by employing critical instructional strategies in the elementary science methods course, as well as purposeful placement of preservice teachers with strong Black teachers of elementary science.

INDEX WORDS: portraiture, Black females, Black girlhood, elementary teacher preparation, preservice teachers, science education, Endarkened Feminist Epistemology, Critical Race Feminism, legitimate peripheral participation, identity work

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DEDICATION

This work is dedicated to my mother; a resilient young girl who traveled across the seas to a new country and culture; battling perceptions of her Jamaican tongue, her race and her gender, choosing to use her silence and speech to become a lifelong doer of science. Mom, by watching you speak, I have learned to use my voice. This is for my young sisters who persist in spaces that do not readily welcome their presence, my young sisters who "talk back" against controlling images which seek to constrain their opportunities, my young sisters who "talk together" to support one another. This work is my contribution to the battle cry of #blackgirlmagic, which unapologetically demands the acknowledgement of our brilliance and our promise.

ACKNOWLEDGEMENTS

I wish to thank my parents, my brothers, their wives and my nieces and nephews for being consistent supporters of my journeys in education. Their prayers and words of encouragement have been a force to bolster me through this final degree. I thank my grandfather, still a great orator at 102, as well as my many aunts, uncles and cousins. As the youngest grandchild in a large extended family, I remember many family gatherings where I sought to be heard, to contribute to the conversation and raise my voice loud enough to stand by my contributions. Thank you for helping me establish my voice in the cacophony of our loud, impassioned Jamaican discussions.

I've been lucky to have some great friends who became part of my support system throughout this process. The laughter, tears, dreams and frustrations landed softly and were returned with kind words of encouragement to persist. A special shout out to my sister scholar Kristen Duncan, who walked this journey with me, at times walking side by side and other times lighting the way to show me the next spot to safely place my foot through this climb. I am grateful for our sisterhood.

Thank you to my committee members who supported the development of this research study and ensured I presented valuable work. Dr. Cory Buxton, your work in science equity inspired me to apply to UGA and I have learned a great deal from your LISELL work as you highlight the strength and needs of students who have been pushed to the margins of traditional school science. Dr. Bettina Love, you've shown me the true embodiment of Black Feminism, sisterhood through mentorship and the importance of "talking back" against various structures of

oppression. I'm grateful for you taking me under your wing to talk through the challenges of academe. Dr. Deborah Tippins and Dr. Malcolm Butler, your support to refine my understanding of elementary science teaching and learning helped focus this project. I am inspired by your innovative research agendas and multiple contributions to elementary science education.

A special thank you to my participants who shared their lives with me to help light the path for others. I was blown away by your ability to think critically about your lived experiences and am honored that you entrusted me with your stories. Thank you for sharing your selves through your stories and affirming the importance of this work. I can't wait to reconnect and hear about the teachers you have become.

Finally, a thank you to Spelman College, a special place that provides sanctuary for Black girls becoming women. I was lucky enough to be a student and return as a scholar and instructor here. This space gives us respite from a world that may not celebrate us and provides a sustaining sisterhood. Some call it the birthplace of #blackgirlmagic. May you continue to provide sanctuary for our young sisters.

Through years of toil and pain,
may thy four walls remain,
beacons of heavenly light,
undaunted by the fight,
and when life's race is won,
thy noble work is done,
oh God forever bind,
our hearts to thine!

-Spelman College hymn

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CHAPTER 1- Introduction

As a Black female elementary teacher educator, I am compelled to understand how the raced and gendered lived science experiences of Black female elementary teacher candidates have shaped their ability to develop robust elementary science teaching identities. By utilizing critical race theory (CRT), critical race feminism (CRF), and positional identity theories to examine the identities and science life histories of Black female elementary teacher candidates, the' voices of these women are presented to join the existing literature to develop a fuller understanding of the experiences of elementary preservice teachers across the United States.

Historically in the United States, female students, students of color and students from low income-backgrounds often do not experience quality science education, receive instruction from teachers who hold low expectations for them, learn from under-developed science curriculum and learn in spaces without appropriate science materials and technology. (Atwater, 2000; Fraser-Abder, Atwater & Lee, 2006). Learning science in these under resourced spaces may constrain opportunities to develop strong science identities necessary to persist in science and pursue science degrees in college and beyond possibly resulting in low science achievement and underrepresentation in science college degrees or careers. Schools often face pressure from high stakes testing further constraining traditionally marginalized students' access to quality science instruction (Causey -Bush, 2005; Nichols, Glass & Berliner, 2005; Onosko, 2011; Viruru, 2006). Even in instances where minority students attend schools with robust science instruction, factors such as ability grouping and/or tracking can restrict access to quality science experiences

(Atwater, 2000; Fraser, Atwater & Lee, 2006; Lee & Buxton, 2010; Russell, 2005; Yerrick & Gilbert, 2011). Regarding minority achievement in science, Lee and Buxton (2010) concluded, Tracking or ability grouping also results in inequitable learning opportunities as non-mainstream students are generally overrepresented in lower tracks where content is less challenging, science course offerings are less varied, and expectations of student achievement are lower…Both the number and the scale of the challenges facing students in urban schools diminish the likelihood that non-mainstream students will receive equitable science learning opportunities when compared to their mainstream peers.

Next Generation Science Standards (2013), the most recent document compiled to guide science education in the United States, has cited four compelling reasons to improve science instruction in schools: (1) fewer U.S. graduates are completing rigorous science undergraduate and professional degrees, thus the U.S. is less competitive economically through the under developed workforce that is unable to evaluate and propose solutions to newer environmental and technological challenges; (2) U.S. students are outperformed by their classmates across the world ranking 23rd in science achievement; (3) all careers in the modern world require a greater depth of science knowledge and (4) U.S. citizens need to be scientifically and technologically literate to play an active part in an educated society. Basic national expectations of science instruction in kindergarten through twelfth grade have been set forth by *Benchmarks for Science Literacy* (AAAS, 1993), *National Science Education Standards* (NRC, 1996), as well as the newly proposed *Next Generation Science Standards* (Achieve, 2013) which admonished schools to provide all students quality science instruction as early as kindergarten; however, in many schools this is not the case. Often science is only emphasized once students matriculate to middle school and onward where there is a designated class period, allotted time and a teacher

assigned specifically to deliver science instruction. Although science is included in elementary curriculum and science standards exist to guide instruction from kindergarten through fifth grade, the authors of *Bayer Facts of Science Education X* (2004) found 29% of elementary teachers self-reported teaching science twice a week or less.

Even in elementary schools where science is being taught, authors of *The 2012 National Survey of Science and Mathematics Instruction* found the majority of science instruction provided in kindergarten through fifth is delivered through lectures, worksheets, textbook readings and whole class discussions (Banilower et al., 2013). The aforementioned instructional strategies are teacher-centered in contrast to hands-on, inquiry based, student-centered science instruction. Authors explained scientific inquiry is

"the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world." The *National Science Education Standards* (NSES p. 23)

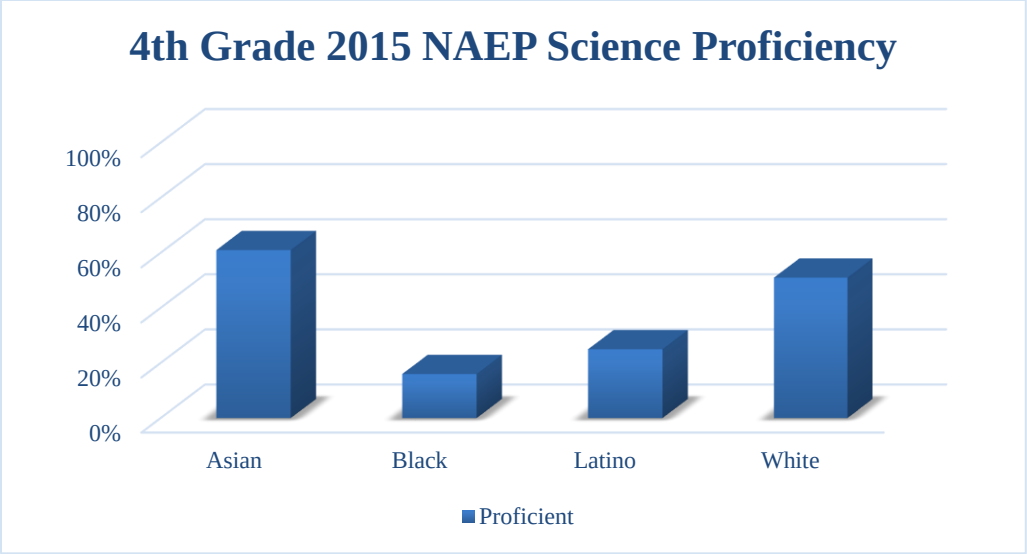
Although research abounds proving the necessity of hands-on, inquiry based science instruction at an early age, (Minner, Levy & Century, 2010; Johnson & Ash, 2012) many factors inhibit this type of instruction in elementary classrooms. Historically, elementary teachers in the United States operate as generalists; tasked with teaching all subjects in kindergarten through fifth grade. Elementary teachers are expected to have a strong grasp of multiple content areas in order to instruct students in reading, language arts, mathematics, science and social studies. While some may feel that science content delivered on the elementary level is basic and does not require extensive training, science education researchers have argued that teaching this subject

well takes a great deal of knowledge about content knowledge, pedagogical knowledge as well as pedagogical content knowledge (Anderson & Clark, 2012; Appleton, 1999; Hanuscin et al., 2011; Holmes, 2012).

Existing research on the science schooling experiences of elementary teachers has highlighted limited science knowledge (Abell & Roth, 1992), negative science experiences and subsequently, negative attitudes towards science (Appleton, 2005; Ellsworth & Bus, 2000; Kelly, 2000; Tosun, 2000). Science instruction during primary grades establishes the basis for a strong K-12 science foundation (NRC, 2012; NSTA, 2002) and high quality science experiences in primary grades (K-5) are imperative for subsequent positive secondary and post-secondary science experiences; thusly, it is critical that elementary teachers create science learning environments that develop necessary scientific understandings to facilitate scientific literacy (King, Shumow & Lietz, 2001).

Statement of the Problem

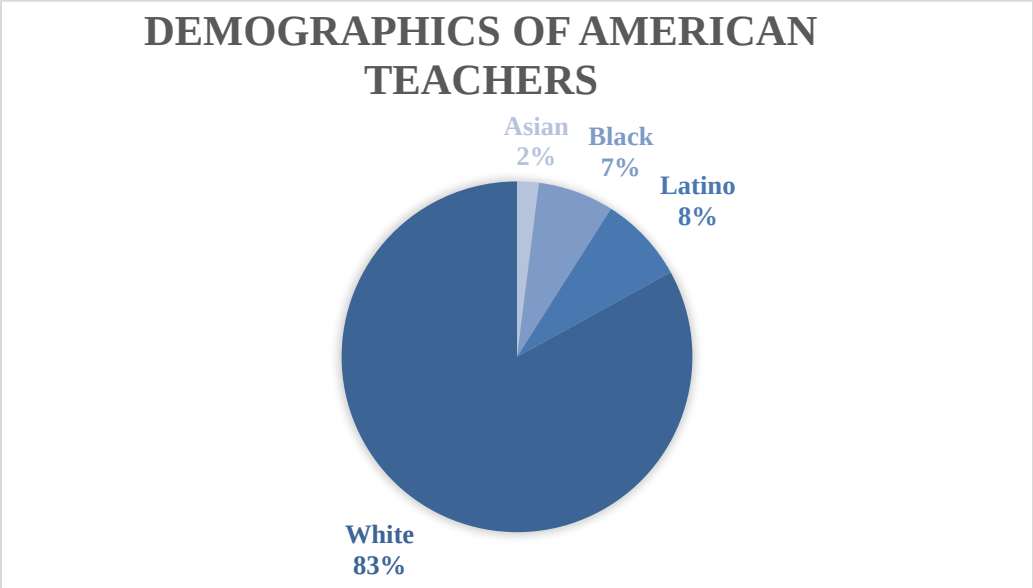
According to data from the 2015 National Assessment of Educational Progress (NAEP) assessment of national academic proficiency, science achievement lags across the nation. For these assessments, NAEP defined 'basic' performance as a partial mastery of content knowledge, 'proficient' as solid academic performance and 'advanced' as superior performance. The cut scores for science were set in 1996 and a closer look at the data still identifies underperformance for all students in science. None of student groups demonstrated proficiency on this test with only 61% of Asian students, 16% of Black students, 25% of Latino students and 51% of White students scoring in the proficient range. Looking back to the definition of proficiency highlights a crisis for all students as no student population has demonstrated solid academic performance in science during their formative years.



Science education researchers have grappled with understanding the causes of inequities in science education as a whole and elementary science instruction in particular. Researchers addressed the fragmentation of science instruction in elementary schools as mathematics and reading instruction have garnered the majority of instructional time in the era of high stakes testing and accountability (Griffith & Scharmann, 2008; Milner, A., Sondergeld, T., Demir, A., Johnson, C., Czerniak, C., 2012; need more citations). With the inception of No Child Left Behind (2001) and the subsequent Race to the Top (American Recovery and Reinvestment Act of 2009) schools have had to prove Adequate Yearly Progress (AYP), showing growth in mathematics and reading achievement as a measure to ensure quality instruction. Griffith and Scharmann (2008)cited five major factors that impacted the science instruction elementary teachers provided: (1) administration required elementary teachers to cut science instruction for a greater focus on math and reading, (2) administration required elementary to provide no science instruction for a greater focus on math and reading, (3) teachers chose to cut science instruction for a greater focus on math and reading, (4) less professional development was available to

enhance science instruction and (5) the available budget to procure science materials was less than 24% of math or reading (Griffith and Scharmann, 2008).

From there, researchers turned their gaze to consider internal motivators which effect elementary teachers' delivery of quality science instruction. Many studies have been conducted on the science teaching identities of secondary science teachers (Eick & Reed, 2002; Fletcher & Luft, 2011; Hobbs, 2012; Miranda, 2012; Moore, 2008; Pedreiti, Benize & Hewitt, 2008) as well as the science teaching identities of elementary science teachers (Avraamidou, 2014; Katz et al., 2013; Siry & Lara, 2012; Upadhyay, 2009). Few studies have been conducted on science teaching identities of elementary teacher candidates (Kim & Tan, 2011; Melville, Bartley & Fazio, 2013; Olitsky, 2013) and most research participants that informed these studies are middle class, White women which traditionally comprise the American teaching force. According to the 2013 survey by the *National Center for Education Studies* of 2011-2012 public school teachers, White teachers overwhelmingly make up the population of American teachers.



. From these demographics, the majority of research specific to elementary science teaching, as well as research on teacher candidates in elementary science classrooms, is situated from the perspectives of White, middle class females. Given this limited scope of these studies being overwhelmingly quantitative in design, the existing literature does not allow for a robust understanding of the complexity non-white non-female elementary teacher candidates and their science backgrounds/science teaching identities.

Previous studies have contributed to a general understanding of the development of elementary science teaching identities, but few had focused on the science teaching identities of Black female elementary teacher candidates. Mulholland and Wallace (2003) presented important insights into the border crossings of elementary teachers learning to teach science, crossing from non-science person to science student, pre-service teacher to in-service teacher. While this study illuminates the difficult transitions elementary teacher candidates make as they become classroom teachers, no supporting background or cultural information was supplied to generate a more complex picture of the challenges these teachers faced in crossing these interesting borders.

Other research on the development of elementary teacher candidates has addressed how teachers' attitudes towards and beliefs about the teaching and learning of science are shaped by their own experiences and influence teaching practices (Bryan, 2003; Eick & Reed, 2002). Findings have shown that previous science schooling in kindergarten through high school has a large influence on the science selves elementary teacher candidates bring to elementary teacher preparation programs (Appleton, 2005; Goodnough, K., Hung,, W., 2009, Kazempour, 2014). Both positive and negative science educational experiences can enhance or constrain a person's

identity as a person capable of doing science, which can determine the teacher candidate's daily commitment to teach science in her classroom.

Kazempour (2014) extended the literature on elementary teacher candidates' science teacher development through a thorough qualitative case study of a White female elementary science teacher's attitude, self-efficacy, and epistemological beliefs. This study provided information on the participant's science schooling history, but other than acknowledging her demographics in the methodology, nothing else was documented to address social and cultural constraints that could have played a role in her negative attitude and low self-efficacy towards teaching science.

Although research on teacher beliefs, science knowledge, border crossing and science teaching attitudes have been cursorily explored, I assert one's identity as a doer of science and teacher of science impacts the skills, beliefs, emotions and orientations she brings to the elementary science teaching methods course as well as her lived elementary classroom and science teaching opportunities. Forbes and Davis (2008) charted the development of elementary science identities teaching through the elementary science methods course; however, again in this study, the majority of participants were White. Although they contributed to a larger understanding the development of science teaching identity, this study does not acknowledge how previous constructions of classroom science identities impact science curricular role identity for the elementary pre-service teachers in the study (Forbes & Davis; 2008).

A larger amount of secondary science teacher education research has focused on the way social and cultural constructions have shaped minority teachers' development of science teaching identities. Moore's (2008) study on positional identity of three secondary science teachers productively informs future research on elementary science teaching development and

particularly this research study in a novel and applicable manner. Using positional identity, (Holland, Lachicotte, Skinner, & Cain, 1998) Moore brilliantly linked the gendered, raced and classed life experiences of three Black female secondary science teachers to the constructions of their science teaching identities. This study aptly questioned the impact of social and cultural positions on the curricular decisions of the participants. Through a retracing of these teachers' life histories, Moore (2008) identified the ways their experiences with race and gender impacted their efforts to provide high quality science instruction to their students. By addressing the intersections of race, gender and other social constructs in the life histories of these secondary science teachers, Moore (2008) supplied counter-stories of resilience and exceptional science teaching often omitted from traditional teacher education literature. Through narrative, life story and life history research, Moore (2008) showed the importance of analyzing science-teaching identities within a particular socio-cultural context as well as the importance of research on the intersection of positional identities and teacher professional development.

This research study supplies a similar benefit to elementary teacher education research through an investigation of the intersection of positional identities of Black female elementary teacher candidates and science teacher education. Attention to the multiple identities and positionalities of elementary pre-service teachers has created exciting possibilities for research and teacher education, an area where Black female teachers are often overlooked, working to scaffold the development of elementary teachers with a robust science teaching identity.

As much of elementary teacher education gazes broadly and some studies in elementary science teacher education offer cursory understandings of identity, there are exemplars in the literature that can inform the creation of an in-depth look at the science teaching identity development of Black female elementary teacher candidates.

In science as well as the larger society, this particular demographic is the minority in multiple respects: being young, Black and female. The socially constructed image of a scientist is an older, White man (Chambers, 1983; Farland-Smith, 2001; Finson, 1995; Mead and Metraux, 1957) while elementary-aged Black girls as well as Black female elementary pre-service teachers embody the polar opposite image. It is necessary to interrogate how this widely accepted image of the scientist impacts the science identities of young Black girls who become Black female elementary teachers of science as well as other factors which prioritize science teaching and learning as a White, male dominated arena. Few researchers have taken up the charge to investigate the needs of Black female students' science engagement offering important contributions to shape the understanding of factors which constrain and support science school engagement (Brickhouse, Lowery & Schultz, 2000; Carlone, 2014; Kane, 2012; Tan, Calabrese-Barton, Kang & Oneill, 2013; Valeras, Jane & Wyile, 2011). This study demands the inclusion of Black females as doers of science and details the significance considering the effects of social constructions of race/class/gender on the development of elementary science teacher identities in the research on teacher development.

Subjectivity Statement

As a researcher engaged in the study of the lived science experiences of Black female elementary teacher candidates, I have had many life experiences which have shaped my views of the educational opportunities available to Black girls and women in America. I am a biracial (biological mother-White Canadian, biological father-Black Jamaican), Black identifying (adopted and raised by two Black Jamaicans), lower-middle class raised, Canadian born female who immigrated to the southern region of the United States, specifically the state of Alabama, when I was four. Identifying and acknowledging these multiple identities informs my

understanding about the multiple and evolving nature of identity.

Being a light-skinned, adopted Black female who was identified as a gifted student at a young age, I had very particularized raced, gendered and classed schooling experiences growing up in the South. At a young age I noticed educational inequalities when I was transferred to a pre-dominantly White school to have access to the gifted program. In each grade I noticed the small number of Black students enrolled in advanced courses with me, especially in high school when I pursued an advanced science track. During my senior year of high school I was the only Black girl and Black student enrolled in my Advanced Placement Biology class in a graduating class of over 300.

Although I didn't have the language to articulate the inequities I saw, I understood how it made me feel to be the 'token Black girl' and applied to Spelman College, a private, female, historically Black college in Atlanta, Georgia. There I majored in Child Development with intentions on becoming an elementary teacher. Through the elementary certification program I spent hundreds of hours in field experience placements in the city of Atlanta, at Title One majority Black schools where I observed a great deal of math and reading instruction but little science instruction and fewer science lessons that involved student interaction with science experiments. I began to wonder, what led to this lack of science instruction in so many different schools? Therefore, for my senior thesis, I conducted a small interview research study with a few elementary teachers I had shadowed to find out what factors impacted their self-efficacy towards teaching science in their elementary classrooms.

Once in my own classroom as an elementary teacher I was very intentional to provide quality science experiences to my students and the school at large through an afterschool science club and monthly Sci-Fri (Science Friday). My colleagues sought me out to share their

frustrations with science instruction citing limited time, resources and knowledge as hindrances to science instruction in their classrooms. I continuously heard teachers share how they didn't feel like they were 'science people' as the main reason why they didn't or couldn't teach science. Entering my doctoral program I sought to further understand this issue and the pernicious cycle that it perpetuated. Reading the literature on the preparation of elementary teacher candidates specific to science education, I understood that weak science teaching identities are commonplace with many elementary teachers; however, the coursework I completed in classes on *Brown v. Board of Education,* Critical Race Theory as well as independent studies on Black Feminist Thought, supplied me with the language and knowledge to question how race, gender and other social markers intersect to impact the science experiences of Black female elementary teacher candidates and how these raced, gendered and classed experiences have shaped their science teaching identities. This study is an effort to speak back to these experiences, blending my experience with the experiences of Black female elementary teacher candidates to initiate a very particular conversation focused on the development of Black female elementary teachers of science.

Purpose of the Study

This dissertation study was motivated by the desire to investigate the unexplored science teaching identities of Black female elementary teacher candidates. There is limited literature on the science teaching identities of Black female teachers in secondary grades and an even smaller amount of literature is available on the science teaching identities of Black elementary teachers. Guided by the theoretical framework of Critical Race Feminism and utilizing a variety of culturally sensitive qualitative methods this study adds to the research through a careful examination of the lived science experiences of these Black female elementary teacher

candidates. This study expands existing literature on elementary teacher identity, elementary science teaching identity and science identities in general which often excludes the perspectives of Black female elementary teacher candidates.

This study focused on four Black female college seniors who were enrolled in a traditional early childhood education certification program at Spelman College, a private, female historically Black college in Atlanta, Georgia. While many research projects create a pseudonym for the location of the research site, the historical richness of this site has implications which directly impact the presentation of this research by situating this institution as a space that broadly supports science identity development of Black young women. Participants were engaged in student teaching at various elementary schools around Atlanta, Georgia and upon completion were certified to teach pre-kindergarten through fifth grade. This study examined their lived science experiences, questioning how these raced and gendered experiences shaped their elementary science teaching identities.

Significance of the Study

The purpose of this study was to investigate the lived science experiences of Black female elementary teacher candidates to explicate the links between their previous lived science experiences and their developing science teaching identities. By qualitatively exploring the raced, gendered and classed experiences of these young Black women at various points in their education, teacher educators can deepen understanding of Black girls and women in science classrooms, Black women as elementary teacher candidates and Black women as future teachers of elementary science. Through a careful listening to the voices of these young Black women as they addressed their identities as ‘doers of science’ and analyzed their identity construction as future teachers of science, this study contributes to the existing research on teacher education in

an innovative way, extending conversations about elementary teacher preparation. This study contributes new information to a wide range of educational stakeholders, primarily enhancing information for elementary teacher education programs and also science education researchers focused on creating equitable science educational opportunities.

Contribution to the Research

This research study contributes to multiple areas of research. Through the discussion of the participants' science school experiences, this study adds to the literature on science for young Black girls in elementary school, secondary schooling as well as required teacher education coursework in college. This study interrogates meaningful activities in elementary science methods courses, with a critique of coursework, teacher disposition and field experiences that help shape science teaching identities. Secondly, this study contributes to the literature on teacher education through the stories of underrepresented teacher candidates. This study is intentional in its desire to highlight the voices of Black women as an often-ignored group in teacher education. Thirdly, this qualitative study intentionally employed culturally sensitive research methods that are not as common and practiced as many traditionally valued Eurocentric research methods. By employing these methods, I am supporting the necessity and usefulness of nontraditional research methods that deliberately prioritize the participants' telling of their own stories.

Contribution to Teacher Education

This study offered multiple contributions to the practice of teacher education. First, teacher education programs could develop coursework that intentionally allows space for reflections on the previous schooling experiences of teacher candidates in a way that allows them to interrogate the raced, classed or gendered experiences they have had. Teacher education

programs that enroll minority students must provide opportunities for these reflections in each course, supporting the methods instructor and allowing teacher candidates a chance to critically address and bolster teaching identity in that content area. Second, as the course instructor and students engage in conversations about these raced, gendered and classed experiences instructors should provide instruction to scaffold science content knowledge, pedagogical knowledge and pedagogical content knowledge.

Organization of the Study

In Chapter 1, I asserted it is imperative to broaden the existing knowledge on the science teaching identities of elementary teachers by considering the raced, classed and gendered science experiences of Black female elementary teacher candidates. The current literature is insufficient in its narrow analysis of the science teaching identities of elementary teacher candidates by focusing generally on the perspectives of White young women who make up the majority of America's elementary teacher education programs. The raced, classed and gendered science schooling experiences of Black female teacher candidates must be included in the literature to construct a more robust understanding of the development of science teaching identities of elementary teacher candidates. Through this study employing emancipatory research methods which allow participants to tell stories of their lived science experiences, we are better able to consider science teacher education for elementary teacher candidates on a whole.

The guiding research questions for this dissertation project were:

1) What are the lived science experiences of Black females in an elementary certification program at an HBCU?

2) How do the science experiences of Black female pre-service teachers shape their identity as teachers of elementary science?
   a) How do the kindergarten through 12^{th} grade science experiences of Black female pre-service teachers impact their identity as teachers of elementary science?

b) How do college science experiences of Black female pre-service teachers impact their identity formation as teachers of elementary science?

The following chapters detail the theoretical frameworks guiding this study as well as the qualitative research methods that were employed. Chapter 2 presents the theoretical framework of Critical Race Feminism (CRF), detailing its roots in Critical Race Theory, Black Feminist Thought and Intersectionality. A detailed exploration of historical and social oppressions experienced by Black women and girls will explain the necessity of applying this particular lens to explore teacher education. Next, the section on identity construction in science education as well as teacher education will detail the conceptual framework that guided this study. Chapter 3 presents the methodology of portraiture, methods of life history interview, Photovoice, and focus group interviews to investigate this phenomenon. An explanation of the data analysis and the study timeline are also detailed in chapter three. Chapter 4 presents four portraits, the individual portraits of four participants combining their I Poems, Photovoice responses and other data to paint a rich portrait of each participant's lived science experiences and development of her science teaching identity. The concluding chapter presents the discussion and conclusion of this study.

CHAPTER 2- Review of Literature

In this chapter the literature concerning critical race theory, critical race feminism/Black feminist thought and identity theory are detailed to situate the theoretical framework for this study. The discussion will begin with critical race theory and its constructs. Critical race feminism and its ties to Black feminist thought will follow. Next, the literature on identity formation specific to Black girls in science classrooms will be presented in order to show the linkage as well as the necessity for applying research on identity to a project investigating the development of identity in shaping Black female teacher candidates' science experiences and teaching identities. By foregrounding Critical Race Feminism in this study, I argue that understanding the effects of racism and sexism on young Black girls in science classrooms through their personal story-telling is central to robust research on the science teaching identities of young Black female elementary teacher candidates.

Critical Race Theory

Critical Race Theory (CRT) stems from Critical Legal Studies (CLS), as a way for legal scholars to foreground racism as a structural concept that has constrained social, educational, financial and occupational opportunities for nonwhite persons. Where CLS scholars focused their critique on the myth of meritocracy in America, CRT centered racism as the prevailing cause of discrimination. Critical race theorists acknowledge the pervasiveness of racism in society and emphasize the impact racism has on societal ideologies and practices (Delgado & Stefancic, 2001; Solorzano & Yosso, 2002; Sleeter &Bernal, 2004; Yosso, 2006). CRT became a necessary

legal framework as the energy from the Civil Rights movement had begun to subside and fewer changes were being made to address racial injustices.

Derrick Bell, the premier scholar credited with the creation of CRT, argued that racism is pervasive in American society in his book, *Race, Racism and American Law* (1973), one of the first projects to depict how the American legal system consciously and continuously discriminates against Blacks. While many regard Bell as the father of CRT, both Richard Delgado and Kimberle Crenshaw have made significant contributions to advance the current understanding and application of this theoretical framework. It is important to understand how these three legal scholars have explicated the utility of this framework. The next three sections highlight significant advances to CRT made by these scholars.

Derrick Bell

Bell established three purposes for the scholarship of CRT. First, he sought to contribute to intellectual discourse about race and racism in American society. Extending the theory of CLS, Bell's scholarship stimulated activism to challenge racial injustice. The work of CRT did not end with initiating dialogue; instead, it demanded that action follow these conversations. Furthermore, a goal of Bell's CRT was to better understand interest-convergence, the notion that rights of Blacks were attended to only in cases that benefit the national economic interest and White people (Bell, 1980). Bell often used fictional narratives to explain how racial inequities permeate American society by creating fictional characters such as Geneva Crenshaw in 1987's *And We Are Not Saved* and the interactions between aliens and the American government in 1992's "The Space Traders". Scholars have both critiqued and celebrated Bell's use of legal storytelling, as it broke from positivistic, evidence-based arguments used in traditional legal cases. Initially some discredited Bell's storytelling as fictitious and unreliable but with the

maturation of CRT, scholars continue to acknowledge the importance of challenging dominant ideology through nontraditional research methods including fictional accounts.

Richard Delgado

Richard Delgado (1990) extended Bell's work on CRT by supplying guiding themes of this critical framework:

(1) an insistence on "naming our own"; (2) the belief that knowledge and ideas are powerful; (3) a readiness to question basic premises of moderate/incremental civil rights law; (4) the borrowing of insights from social science on race and racism; (5) critical examination of the myths and stories powerful groups use to justify racial subordination; (6) a more contextualized treatment of doctrine; (7) criticism of legal liberalisms; and (8) an interest in structural determinism-the ways in which legal tools and thought-structures can impede law reform. (p. 95)

Another significant contribution to CRT is Delgado's scholarship advancing Bell's work on storytelling and voice. As the first theme of CRT, Delgado proved the importance of "naming one's own reality"; arguing that these stories are both a means for deconstructing racialized realities while operating as a vehicle for self-preservation of marginalized persons. To be clear, neither Bell nor Delgado created storytelling; however, these scholars introduced this tool as a research method in legal studies.

Kimberle Crenshaw

Kimberle Crenshaw introduced the concept of intersectionality to CRT. As a Black female professor at Harvard Law School, she saw many instances where CRT did not fully contextualize the ways multiple types of discrimination converge against nonwhite females. Crenshaw (1988) asserted:

On the simplest level, an intersectional framework uncovers how the dual positioning of women of color and as members of a subordinated racial group bears upon violence committed against us. This dual positioning, or as some scholars have labeled it, double jeopardy, renders women of color vulnerable to the structural, political, and representational dynamics of both race and gender subordination. A framework attuned to the various ways that these dynamics intersect is a necessary prerequisite to exploring how this double vulnerability influences the way that violence against women of color is experienced and best addressed. (p. 112)

Crenshaw (1993) further developed an intersectionality framework using three constructs to critique race and gender in U.S. law and popular culture: (a) structural intersectionality, the structures in society that allow domination of women of color (b) political intersectionality, the political and discursive practices that allow domination of women of color, and (c) representational intersectionality, the way women of color are represented through media. Crenshaw's work is illustrative of the interdisciplinary aspect of CRT as she utilized Collins' (1990) Black feminist thought (BFT) concept of intersectionality generally employed in social sciences and applied it to legal scholarship. By considering the interplay of race, class and gender, Crenshaw established a conceptual framework to better interpret the law for women of color who faced discrimination due to race, gender and/or class. Crenshaw's work opened the door for the offshoot of Critical Race Feminism by specifically acknowledging discrimination that occurs at the intersection of race and gender.

Critical Race Feminism

Critical Race Feminism (CRF) grew out of CRT from the need to foreground the experiences of women of color who experience oppression due to discrimination due to race and gender. Adrien Katherine Wing, who is credited with establishing CRF, attributed the creation of this

theoretical framework to a special issue of Berkeley Women's Law Journal, which centered on the views of Black female law professors as they sparked a new dialogue about discrimination and oppression being motivated not only by racism, but also, simultaneously, by sexism. From this Wing (2002) stated,

This intentional focus on the intersection of race and gender became increasingly imperative, as existing legal paradigms have permitted women of color to fall between the cracks, so that they become, literally and figuratively, voiceless and invisible under so-called neutral law or solely race-based or gender-based analyses (p.2).

By naming this branch of critical studies Critical Race Feminism it unabashedly acknowledges an emphasis on women of color, while confessing its roots in CLS, CRT and feminist jurisprudence. Critical Race Feminism espouses some of the same essential characteristics of CRT such as storytelling, a multidisciplinary approach and critical race praxis. Regina Austin, also a legal scholar, joined the call to advocate on the behalf of women of color using stories of our histories. Starting from the argument that limited legal precedence had been set to litigate cases involving both racism and sexism, she called for other women scholars of color to testify.

"To testify" means several different things in this context: to present the facts, to attest to their accuracy, and to profess a personal belief or conviction. The minority feminist legal scholar must be a witness in each of these senses. She must document the material legal existences of minority women. Her work should explore their concrete problems and needs, many of which are invisible even to minority lawyers because of gender and class differences. (Austin, p. 144, 1989)

Wing (2002) clarified CRF theorists' use of storytelling techniques as their methodology since:

Many of us prize our heritages in which the oral tradition has had historical importance-where vital notions of justice and the law are communicated generation to generation through the telling of stories. Also, using stories enables us to connect to those who do not understand hyper technical legal language but may nonetheless seek understanding of our distinctive voices. (p.6)

CRF is multidisciplinary, using scholarship across history, anthropology, political science and economics to understand the multiple contexts in which women of color have been marginalized while concurrently seeking possible ways to improve these injustices. By using scholarship across multiple disciplines, multiple lenses are employed to analyze inequalities and conceptualize solutions. Wing stressed that CRF scholars are invested in both critical race theory and critical race praxis, extending beyond the theorizing of why race and gender discrimination is natural in our society, but also attending to the practical things that can be done to reduce these occurrences.

CRF also draws from legal trends in feminist jurisprudence but challenges essentialism in feminist studies; which often assumes the essential voice of the feminist movement is white middle or upper-class women, ignoring the contributions of women who are not white and are not middle or upper classed. Unlike previous work in feminist studies privileging a limited, single story, Wing (2003) declared CRF is based in the notion of anti-essentialism, critiquing the notion of one privileged voice, instead, including the voices of women of color, simultaneously acknowledging that voices from women of color are varied, multiple and equally important. This has been the stance of many Black Feminist Theorists dating back to the 1900s when Black women began to articulate the ways in which they were treated differently from their White female counterparts (Lorde, 1984; Guy-Sheftall, 1995; Collins, 2000; hooks, 2007). The

discussion that follows details Black Feminist Thought to show the connection to Critical Race Feminism and the historical need for this framework.

Black Feminist Thought

As early as Sojourner Truth's 1851"Ain't I a Woman", Black women have enumerated the many ways they had been excluded from the protections that White women face as the 'weaker sex'. Wing acknowledged CRF was influenced by Black Feminist Thought (BFT) as contemporary works by bell hooks, Audre Lorde, Patricia Hill Collins and Alice Walker helped illuminate the necessity for this nuanced scholarship. Each of these Black feminists detailed the unique plight of Black women. hook's (2004) theory of the "white supremacist capitalistic patriarchal culture" contended power in the United States is most often innately bestowed upon rich White men while Collins (2000) shared the plight of Black women in the United States who "encounter a distinctive set of social practices that accompany our particular history within a unique matrix of oppression characterized by intersecting oppressions" (p. 26). In the 1977 "Black Feminist Statement" from the Combahee River Collective, this group of Black feminists clearly declared their mission by writing,

The most general statement of our politics at the present time would be that we are actively committed to struggling against racial, sexual, heterosexual and class oppression and see as our particular task the development of integrated analysis and practice based upon the fact that the major systems of oppression are interlocking (But Some of Us are Brave, p.13).

CRF then attends to intersectionality, demanding that attention is paid to the intersection of race and gender identities. Wing (2003) suggested the employment of *multiplicative identity* to describe the concept that women of color are not merely white women *plus* color or men of color *plus* gender. Instead their identities must be multiplied together to create a holistic One when

analyzing the nature of the discrimination against them (p.7). Black feminists have proven the multitude of ways Black women have been systematically disenfranchised while CRF provides the legal scholarship to introduce legal precedence to right these historical wrongs.

The previous pages detailed the inception and maturation of CRT and CRF. The next section addresses the application of CRT and CRF to educational research; proving the value of using these theoretical frameworks to better understand the school experiences of Black children, specifically Black girls in America.

Critical Race Theory in Education

Historically, American schools have maintained a tenuous relationship with minority students. Often the landmark case, *Brown v. Board of Education* is regarded as an equalizing force that rectified all the injustices meted out to Black students, however, a closer analysis rejects this assertion (Carter, Flores & Reddick 2004; Kluger, 1975; Patterson 2001). Researchers have found that despite the widely touted successes of the ruling, glaring inequities still exist. Although the Supreme Court ruled segregated schools unconstitutional, mainly through housing policies and white flight, schools have become resegregated within the last 25 years (Chemerinsky, 2002; Frankenberg &Sigel-Hawley, 2008; Goldring & Smrekar, 2000). Outdated books, lack of materials, high-stakes testing and the practice of tracking Black students continue to create unequal academic opportunities.

W.E.B. DuBois, a race scholar of the 20th century, challenged the ideal of school integration and acknowledged that social conditions of the time did not allow him to feel comfortable about the emotional and educational wellbeing of Black children in integrated schools.

The Negro needs neither segregated nor mixed schools. What he needs is education. What he must remember is that there is no magic, either in mixed schools or in segregated schools. A mixed school with poor and unsympathetic teachers, with hostile public opinion, and no teaching of truth concerning Black folk is bad. A segregated school with ignorant placeholders, inadequate equipment, poor salaries, and wretched housing is equally bad. Other things being equal, the mixed school is the broader, more natural basis for the education of all youths. It gives wider contacts; it inspires greater self-confidence; and suppresses the inferiority complex. But other things seldom are equal, and in that case, Sympathy, Knowledge and Truth, outweigh all that the mixed school can offer (Du Bois, 1935, p.335).

Although through integration Black students would have had access to the same facilities and books as their White peers, DuBois understood that the emotional and psychological events following integration would be injurious to Black children. School segregation was ruled illegal about 20 years later following *Brown v. Board of Education* (1954) but this ruling fell on deaf ears throughout the majority of the United States as the ruling required "all deliberate speed" without requiring a date or set criteria to ensure full integration (Kluger, 1975; Patterson, 2001). As there was no set of rules or governing body to ensure uniform accordance to the ruling, the effects of *Brown* varied widely across the country in the years following the ruling.

After *Brown* was passed in 1954, Black educators and legal personnel continued to work tirelessly to attain educational equity for Black students. Scholars continue to debate the terms equality and equity with many race-minded scholars arguing for equity over equality to address the persistent deficits caused by racism. Recently, school districts and educational policy makers have turned to standardization, testing and accountability as means to ensure educational equality.

In 1992 Cornell West, a leading contemporary race scholar, asserted “race still matters”, which led Gloria Ladson-Billings and William Tate to propose CRT as a theoretical framework in the early 1990’s to understand how CRT illuminates educational inequities. (Ladson-Billings & Tate, 1995; Ladson-Billings, 1998; Tate, 1995 & 1997). CRT allows researchers to better understand how race affects macro-level practices such as segregation, desegregation, re-segregation and high-stakes testing/accountability measures as well as micro-level practices in schools and classrooms. Marshalling CRT allows educators to propose policy reform to meet the needs of students of color. CRT also offers a way to understand multiple identities that students embody without reducing their experiences by essentializing them to a single story about ‘all Black students’, ‘all Black boys’ or ‘all Black girls’.

Zamudio, M., Russell, C., Rios, F., & Bridgeman J. (2011) also asserted CRT matters in educational practices and ideology. CRT in education argues that race matters, history matters, voice matters and praxis matters. CRT in education is not limited to research on Black students and throughout the years various movements have emerged from this framework such as Latino Critical Race Theory (Latcrit), Tribal Critical Race Theory (Tribalcrit) and Asian Critical Race Theory (Asiancrit). Zamudio et al., (2011) declared, “CRT is the medicine for education, and as educators, we still have a choice to remedy our schools, thereby saving a generation of students from the intellectual numbness that comes from entertaining false assumptions of race in society” (p.6). Ladson-Billings (1998) alleged CRT can be a tool to analyze five areas of education that sustain schooling inequities: curriculum, instruction, assessment, school funding and desegregation.

Curriculum

Curriculum is what is taught in schools; the content students learn through textbooks, lectures and other school materials. The majority of curriculum taught in public schools privileges a white, male, upper class voice as the standard for knowledge creation over perspectives from other genders, classes or cultures. By privileging one voice in schools, the stories, histories and knowledge of Blacks are ignored and erased (Ladson-Billings, 1998). This is seen through even recent policies to sensor Black literature in schools and efforts to challenge the language for teaching about the Transatlantic Slave Trade. In addition to the distortions in the curriculum, Black students often aren't granted access to advanced courses and rigorous instruction. Most schools serving Black students rarely have the same admittance to gifted education and Advanced Placement classes as their White counterparts at other schools (DeCuir-Gunby, 2008; Solorzano & Ornelas, 2004; Taliaferro, McBride-Davis, Slate, Moore & Barnes, 2015). These prejudiced measures constrain learning opportunities of nonwhite students by only granting Eurocentric or severely limited access to educational information

Instruction

Instruction refers to the teaching strategies educators employ to teach curriculum. Often teachers approach schooling Black students with a deficit mindset, assuming Black students are academically and culturally deficient (Brown & Brown, 2012; Delpit, 1996; Ford, 2011; Grantham, 2003; Ladson-Billings, 1997). Black students that are placed in remedial courses are instructed to be passive acceptors of teacher given knowledge rather than encouraged to delve into the curriculum and think critically about content. Vaught & Castagno (2008) showed the persistence of racialized thinking by teachers even after an anti-bias in-service teaching training. These teachers were invited to but proved unable to confront issues of Whiteness and were

unable to understand how racism impacted low student performance. Ladson-Billings (1999) detailed the historical discourse in American education that positions Black children culturally depraved and disadvantaged while tracing this discourse into teacher preparation programs. She admitted using a CRT lens in the preparation of teachers for diverse student populations is difficult yet important work as it "can be a way to explain and understand preparing teachers for diversity that moves beyond both superficial, essentialized treatments of various cultural groups and liberal guilt and angst" (p.241).

Assessment

Scholars have critiqued the accountability trends in current U.S. education reform which consistently have debilitating effects on nonwhite students (Townsend, B.L., 2002; Kitchen, R., Ridder, S.A., Bolz, J., 2016). Yearly standardized tests rarely give a complete picture of what a student has learned and hardly ever accounts for in-school or out of school factors that could impact the student's test performance. Educational policies enacted from No Child Left Behind and Race to the Top saddle schools with high stakes testing, unfairly affecting Black students as these schools have less educational freedom and creativity, relying on test prep and remediation to drive instruction (Heilig, Darling-Hammond, 2008; Hong, Youngs, 2008; Valenzuela, 2013). Although these national mandates are said to be applied to all schools across the U.S., these accountability trends are most damaging to schools with a predominantly Black student body whereas White schools rarely employ the same test prep instructional practices and retain a robust curriculum.

Funding and Desegregation

Bell's (1980) theory of interest convergence in CRT is particularly applicable in regards to school funding. He used two rules to explain how racist structures are challenged only to their ability to preserve the status of whites:

Rule 1. The interest of blacks in achievement racial equality will be accommodated only when the interest converges with the interest of white in policy-making positions. This convergence is far more important for gaining relief than the degree of hard suffered by blacks or the character of proof offered to prove that harm.

Rule 2. Even when interest-convergence results in an effective racial remedy, that remedy will be abrogated at the point that policymakers fear the remedial policy is threatening the superior societal status of whites, particularly those in the middle and upper classes. (p.69)

Interest-convergence is clearly demonstrated through the passing of *Brown v. Board of Education.* This ruling did not take funding away from White schools and redistribute it to Black schools; instead this ruling kept school funding at White schools, shut down deteriorating Black schools and in essence redistributed those funds to White schools. While there have been some gains made towards the physical integration of schools, 50 years after this landmark ruling glaring inequities still exist. Currently, Black students attend schools that are mostly comprised of minorities, and 40 percent of schools are segregated through efforts such as white flight and magnet and charter schools (Orfield, 2009). The master narrative about segregation and integration of American schools does not fully address the historical causes that have led to the persistence of inferior educational opportunities for Black students (Guryan, 2004; Hanushek, Kain, & Rivkins, 2009; Ludwig, 2008; Rothstein, 2013; Valenzuela, 2013).

To some, using CRT as a framework in education may seem very cynical and unfruitful. During early application of CRT, educational scholars admitted that societal ills made it difficult to actually move towards any meaningful reform leading to superficial manifestations of multicultural education (Dixon & Rousseau, 2005; Ladson-Billings, 1998). Nevertheless, more and more scholars use CRT in different arms of educational research as a way to grapple with racial inequalities that are still pervasive in American schools proving CRT to be a quite beneficial lens through which to understand disparities in various content areas against various groups of students.

CRT has successfully been employed to critique the impacts of racism with research regarding teacher education (Brown, 2014; Evans-Winters & Hoff, 2011; Ladson-Billings, 1999; Sleeter, 2017), Latin@ education (Aleman & Aleman, 2010; Urrieta & Villenas, 2012; Irizarry & Raible, 2014), math education (Berry, 2008; Caspary & Boothe, 2013), and science education (Wallace & Brand, 2012; Teo, 2014; Walls, 2016).

Critical Race Feminism in Education

The application of Critical Race Feminism is still new to the analysis of the education of Black girls but is ripe with promise. While studies about the education of Black girls have been conducted, most often early research operated from a deficit viewpoint, centering educational problems on perceived inferiority of Black culture, Black families and Black girls. In one of the first studies by a Black female researcher analyzing the schooling of Black girls, Fordham (1993) explored the high school experiences of Black girls and the ways they rebelled against constructs of 'Blackness' and 'femaleness'. Fordham contrasted Grace Evans' (1988) notion of "those Loud Black girls", which asserts that being a 'loud Black girl' was a conscious performance of

presence, an effort to not be dismissed or ignored by teachers with Fordham's 'phantoms of the opera", a performance of academically successful black girls in which they were either:
1) becoming and remaining voiceless or silent or, alternatively, (2) impersonating a male image,- symbolically,- in self-presentation, including voice, thinking, speech pattern, and writing style, in the formal school context when formally interacting with their teachers in classrooms, assemblies, club meetings, and so forth (Fordham, p.10, 1993).

Fordham (1993) asserted academically successful Black females were deliberately silent to "deflect the latent and not too latent hostility and anger that might be directed at them were they to be both highly visible and academically successful" (p.10). Fordham hypothesized invisibility as an important component in the success of these Black girls in high school. However, the notion that Black girls had to give up a part of themselves and become silent in order to be successful offers no critique and lends no suggestion to more holistic preservation of the selves of Black girls.

Evans-Winters (2011) put forth two questions to uncover acts of resiliency in the schooling of Black girls, asking, "1) How do African American female students cope, resist, and buffer adversity? 2) How can educators apply these findings to urban classrooms?" (p.4-5). A call for more culturally responsive and culturally sensitive research shifts the focus from resistance scholarship to resilience scholarship, acknowledging the cultural, interpersonal and personal characteristics of young Black girls that allow them to exercise agency in the face of oppressions from racism, sexism and classism (Evans-Winters, 2011). Evans-Winters and Esposito (2010) communicated the benefits of using Critical Race Feminism in education to explore the nuanced experiences of Black girls arguing the necessity of this theoretical

framework to address oppressions faced by this particular group of students. These scholars posited the following truths about the schooling of Black girls:

1. Girls of African descent have the least amount of power in America.
2. More educational research must be conducted to offer better instructional strategies and curriculum to support the needs of Black girls.
3. Racist and sexist school policies negatively impact Black girls from images perpetuated in the media. These images harm Black girls and constrain opportunities for success.
4. Although Black girls have been marginalized for their race, gender and age, research focused from this group's perspective could offer possibilities for students of other groups.
5. Critical Race Feminism offered the most appropriate framework to study educational issues faced by Black girls through its intersectional gaze a society. (Evans-Winters & Esposito, 22-23, 2010)

As CRF is a relatively new theoretical framework being applied to the field of education, it is valiant that Black female scholars have begun to use this lens to investigate the schooling lives of Black women. Regina Austin (1989), one of the first legal scholars to analyze a court case by employing Critical Race Feminism in *Chambers v. Omaha Girls Club*, explained the unnecessary interrogations scholarly women of color face regarding the legitimacy of their perspectives but still implored Black women scholars to "get serious about ourselves" and "testify" about our experiences "presenting the facts and arguing their accuracy" (p.541).

Black female researchers who have taken up the charge of employing Critical Race Feminism in education research share efforts to help their Black female students construct counter-stories to 'talk back' to their perceived injustices. Kynard (2010) shared her story of resilience, detailing her schooling in middle and high school where she and a group of Black female classmates held themselves to high academic standards. By developing this intentional community of resistance as a young girl in school, Kynard was later able to develop and sustain a "hush harbor", a virtual space for her undergraduate students to develop counter-stories to combat the institutional racism they faced in their daily lives. Similarly, Berry (2009) revealed how her embodiment of a CRF theoretical framework allowed her to advocate for a female pre-

service teacher who was perceived as an ineffective teacher due to her 'inability to effectively use the English language'. Berry was able to work with the student emphasizing the student's teaching strengths as a way to produce a counter-narrative in response to her alleged instructional inadequacies.

In the same manner, Sealey-Ruiz (2013) investigated how Black mother re-entering college programs created counter narratives about schooling to increase their academic success. One important aspect of Sealey-Ruiz's research is how the mothers initiated conversations about counter-stories and demanded that the data collected from their interviews be used to 'talk back' against the stereotypical images of Black mothers. Remarkably, one participant even stated that it was her personal mission to break down some of the oppressive stereotypes that she faced as a Black woman.

Montoya (2006) a legal scholar, argued the need to apply CRF to explore schooling experiences as early as pre-school asserting even the earliest schooling opportunities are affected by gender and race oppressions which impact the educational outcome and potential career options available to women of color. More scholars who conduct educational research must take up this challenge of researching and proposing policy changes to provide a more equitable schooling experience for young Black girls. Scholars who conduct research from a CRF theoretical framework can begin to introduce counter-stories detailing academic resilience, agency and success of Black girls to combat malicious prevailing master narratives. The next section details master narratives about Black women and girls and shows how these master narratives have led to constrained opportunities in the schooling lives of Black girls in America.

Master Narratives about Black Women and Girls

Social realities produce master narratives about life, explaining why things are the ways they are, assuming these understandings are valid and normal, and work to maintain the status quo. These master narratives, also termed metanarratives or grand narratives, are "the overarching message behind the conglomeration of concepts, stories, images, and narratives that serve as the bases for, and aid in the maintenance of a culture, institution, or systems, claim to know what is and what is not" (Zamudio et al., 2011). CRT scholars work to tease apart master narratives, crafting counter-stories which work to reject traditional expectations placed on marginalized groups. Delgado (1989) posited,

My premise is that much of social reality is constructed. We decide what is, and, almost simultaneously, what ought to be. Narrative habits, patterns of seeing, shape what we see and that to which we aspire. These patterns of perception become habitual, tempting us to believe that the way things are is inevitable, or the best that can be in an imperfect world. Alternative visions of reality are not explored, or, if they are, rejected as extreme or implausible… there is a war between stories. (p.2416)

Master narratives about marginalized groups can have insidious effects in school, while continuing to subjugate and alienate students who have traditionally been pushed to the margins, granting limited access to quality educational opportunities. Master narratives in education support White middle-class students while depicting students from other raced, gendered and classed backgrounds as academically and socially deficit. The master narrative about 'successful students' dangerously supplies a multitude of norms and characteristics that are celebrated in most American schools. Students who exist outside of this narrative are often ignored, disciplined, tracked or otherwise not allowed to reach their full academic potential. Subscribing to master

narratives about subordinated groups can negatively affect teacher expectations, leading to patronizing beliefs about and attitudes towards students (Fernandez, 2002; Vaught & Castagno, 2008; Yosso, 2005; Zamudio, et.al, 2011). As the majority of educators in primary, secondary and postsecondary schooling are White, master narratives developed about students of different races can serve as gate-keepers, limiting teachers' expectations about certain students without seeing individual academic possibilities (Vaught & Castagno, 2008).

In the previous section, two narratives of Black girls in school were presented: the more prevalent 'Loud Black girl' and the lesser 'silent Black girl'. This 'Loud Black girl' narrative was born out of the Sapphire/angry Black woman narrative which pits Black girls and women at the opposite spectrum of traditionally accepted conceptions of gender performances; females performing as quiet, reserved, demure and soft spoken. The section that follows presents a brief exploration of these historical, pervasive master narratives about Black women that inevitably become/have become master narratives about Black girls: Mammy, welfare mother/welfare queen, Jezebel/hoochie/hoe and Sapphire/angry Black woman (Cole & Guy-Sheftall, 2002; Harris-Perry, 2011; Hill Collins, 2000; Love, 2011). These narratives were inextricably created and woven into the fabric of American history leading to dangerous narratives about Black girls and women in present day.

'Mammy'

The Mammy narrative characterizes an asexual, usually overweight, older Black slave woman who is committed to caring for the White family who owns or employs her. This character is disempowered, operating only as the protector of her White family, nestling them in her ample bosom placing them above her own biological children. The Aunt Jemima character drawn on pancake boxes and syrup bottles can be seen as a current representations of this

image'. A search of 'Mammy' on Google will produce multiple artifacts of this image showing how much of a staple this Mammy character is treasured in American history. In the more recent media, Tyler Perry's 'Madea' and Martin Lawrence's 'Big Momma' reifies this master narrative, introducing it to a contemporary audience and perpetuating this stereotypic image.

In consideration to how this stereotypic image could be injurious to Black girls and the development of their identity, no one is concerned with the needs of Mammy. She serves the needs of everyone, giving of her emotional and physical resources with no reward.

'Welfare Mother/Welfare Queen'

Another controlling image of Black woman and girls is the welfare mother/welfare queen, stereotyped as lazy and shunning work but collecting money from the state and instilling in her children the same lack of work ethic and dependency on state provisions. This image is particularly damaging as "stigmatizing her as the cause of her own poverty and that of African American communities while shifting the angle of vision away from structural sources of poverty and blames the victims themselves" (Hill-Collins, p. 86, 2000).

Considering how this stereotypic image could be dangerous for Black girls in school, teachers could automatically view them as lazy due to an assumption regarding their mother or their home life. As the young Black girl is cast as lazy, teachers could refuse to expend any additional effort on that student.

'Sapphire/Angry Black Woman'

Sapphire is a controlling image which was actually constructed for a television show. This character is traced back to the 1930's *Amos 'n' Andy* radio show and subsequent television show which showcased an aggressive, irrational independent, hostile Black woman who was verbally abusive to her husband, King Fish. Harris-Perry (2011) suggested an additional image

of the Black woman: the angry Black woman who is always angry about something, irrationally angry, verbally abusive and argumentative. After conducting a focus group of Black women under thirty-five, Harris-Perry found that these women believed society viewed them mostly through this angry Black woman stereotype and also found that it was emotionally stressful for the women to navigate the space between their own perceptions and the way the world perceived them through this angry Black woman myth.

'Jezebel/hoochie/ho'

The Jezebel/hoochie/ho image is the polar opposite of the Mammy image as Jezebel is sexually aggressive, loud and uses her body/sex to attain drugs and money. This image is born from the biblical story of Jezebel seducing her husband King Ahab away from worshiping the god of Israel through her makeup and fine clothes. The Jezebel image was used to excuse the rape and exploitation of slave owners, justifying the sexual attacks as natural due to the slave woman's innate hyper sexuality and slave owners' need to create more slave children/property (Hill-Collins, 89-90, 2000).

The hoochie/hoe image is the contemporary representation of the Jezebel, made popular through hip-hop and White-controlled media. Trendy songs and music videos with scantily clad Black models portray insidious imagery suggesting Black women use their bodies to get money and attention from men. Since this particular image is promoted throughout media that young girls have access to, often young Black girls begin to mimic this hoochie character (Hill-Collins, 2000). Richardson's (2009) brutally honest account of her journey from childhood to adulthood, growing up poor, Black and female explains the messages she received about her body growing up stating, "the black female body is ascribed as a body without knowledge, a body to be commodified, a body that will serve at the pleasure, ultimately of the system of white male

patriarchy" (p.763). These images are just a few of which abound that young Black girls have to contend with as they grow and define themselves.

Love's (2011) work with Black girls in an afterschool program in Atlanta demonstrates how images in the media impact the ways Black girls see themselves and Black women as a whole. During dialogue about images of Black women in hip hop videos, the young girls employed negative lenses to view the women in the videos as 'freaks' selling their body for money. These students also critiqued the fact that there were only Black women in the videos asking where the White women were and stating that White women valued jobs, education and their bodies more than the Black women in the videos. When Love asked the girls how they thought Black women in videos were perceived, they responded in a quite telling manner, showing that the way the women in the videos were viewed were linked to how they as Black girls were viewed. Responses included, "We freaks, we hos, we do anything for money", "We be looking like freaks", "Probably that we're [Black women] freaks and we reveal a lot" (Love, p.86).

Another salient point to which Love (2011) attended is the girls' understanding that "the use of the word "we": represents a collective notion that dominant culture sees all Black women, regardless of whether they appear in rap videos, as freaks and hos because video models represent Black womanhood to the masses" (p.86). This collective notion of Black women and girls can be debilitating if this is the viewpoint which Black girls are seen by their teachers. If teachers perceive their Black female students as hypersexualized, unconcerned with their school work and again existing outside of the accepted gender norms (quiet, demure, soft-spoken, and respectful) teachers can chose to not engage Black girls in their classrooms, assuming that education holds little importance in their lives.

Ladson-Billings & Tate (1995) affirmed, "Historically, storytelling has been a kind of medicine to heal the wounds of pain caused by racial oppression" (pp.64-65). Here we see the healing capabilities of storytelling as a method that can challenge traditional stories about Black girls in schools. By trusting Black women and girls to tell their stories and allowing them opportunities to talk about and talk back to their schooling experiences, researchers can better understand their specific needs and propose appropriate educational transformations. Once again, highlighting the raced and gendered experiences of Black girls and women does not posit one singular story for all Black women. The next section will further explain intersectionality, the concept that allowed for the simultaneous consideration of race and gender as well as the importance of considering other socially constructed factors that could have limiting impacts on the lives and opportunities afforded Black girls and women.

Intersectionality and the Criminalization of Black Girls in School

Where Black feminist thought and Critical Race Feminism introduced intersectionality by considering the interlocking systems of oppression (Collins, 1989) due to race, gender and class, more recently Bowleg (2008) referred to intersectionality as

The notion that social identities and social inequity based on ethnicity, sexual orientation, and sex/gender (and one could add a host of other identities such as class, disability status, etc.) are interdependent and mutually constitutive, rather than independent and unidimensional [or additive]. (p. 312)

This understanding of intersectionality distinguishes the differences of discrimination experienced by a middle-class Black female lesbian, a working class Latina or First Nations woman with a disability. Considering the totality of multiple oppressions in these women's' lives paints a more robust picture of social inequities they may face. Strayhorn (2013)

emphasized intersectionality serves three primary purposes. First, intersectionality is interdisciplinary and draws on multiple areas of study. Second, intersectionality is a powerful framework to unpack social inequalities by considering the ways individuals are socially marked by interlocking systems of oppression and privilege. Finally, intersectionality unabashedly seeks to transform multiple societal conditions of oppression. By acknowledging multiple oppressions through the lens of intersectionality, these subordinated social realities can be interrogated in efforts to dismantle systems of privilege.

This nuanced conception of intersectionality is of particular importance to studies involving Black girls and women. Brown's (2009) research on Black girls also attended to intersectionality as she proposed hip hop feminist pedagogy which privileges the embodied participation of Black girls through creative expressive culture and agency. In line with Black feminism and CRF's work across multiple disciplines, hip hop feminist pedagogy builds on Black feminist scholarship, hip hop studies and work across other critical studies. Brown (2009) cited aspects of musicality and movement from Kyra Gaunt's *The Games Black Girls Play* (2006) as the inspiration for her proposition of this new pedagogy that supports that holistic representations of Black girlhood. From this stance, the loudness of Black girls voices and bodies (Evans, 1988; Fordham, 1993 & 1996; Lei, 2003) are not seen as offensive, disruptive and necessary of punishment. Utilizing the intersectionality of this offered pedagogical stance the intersections of Blackness, femaleness, socio-economic status, age, and cultural representations as well as identity performances are taken together to propose new possibilities for the schooling of Black girls which highlights their creativity, thirst for knowledge and bids to participate in their own learning (Brown, 2009).

Similarly, Love's (2011) work with Black girls in an afterschool program located in Atlanta, Georgia, is a poignant example of this. The ways in which her students talked about the culture of hip hop and specifically 'Down South' Atlanta-based hip hop encompassed issues of gender, class, race, geographic location as well as their young teen status. Love (2011) even attended to her own sexuality and the way it shaped her interactions with the students although she identified as a Black female with ties to the hip hop community and had a history of time spent 'Down-South'. Had the girls in the study been from families of higher social class or located in a different region of the United States, the findings from that study may have been very different. Love's reflexivity is evident as she shared the ways her Black feminism intersected with her identity as a lesbian and wondered how the masculine performance of her gender and sexuality impacted her interactions with her participants.

Scholars have conducted research on the conflation of intersecting identities on Black girlhood (Brown, 2009) and young-Black-female-hood (Richardson, 2009) asserting productive new conceptions of the lives of marginalized Black girls and women. Carrying on the work that Joan Morgan started through her exploration as a hip-hop feminist in *When Chickenheads Come Home to Roost* (1999) Lindsey (2013) offered critical discourses central to the empowerment of Black girls. Pursuing a research agenda that which generously supplies grace and compassion to the reading of the lives of young girls and women by Black female scholars is refreshing and breaks from traditional scholarship which consistently operates from a deficit perspective rather than a strength perspective. In a time when Black female bodies are being policed and disciplined in alarming rates much higher than their White counterparts, this compassionate view is imperative to understand the structural constraints placed on the lives of Black girls in America.

Returning to Critical Race Feminism, George (2015) highlighted effects of school discipline, stereotypes, and school pushout on the schooling of Black girls and women. Acknowledging the monumental work of Dr. Monique Morris, Dr. Jamilia Blake, and Kimberle Crenshaw in problematizing the hyper-policing of Black girls and women for non-normative gender performances, George (2015) investigated implicit biases held by educators and school administrators which lead to disproportionate discipline for subjective infractions linked to perceived defiance and disrespect. Institionalized racial discrimination and the effects of zero-tolerance policies in schools is further investigated in Morris's (2016) latest book, *Pushout: The Criminalization of Black Girls in Schools*. This book considered the struggles Black girls face in schools being judged by their attitudes, controlling images such as the aforementioned Sapphire and Jezebel, contrasted by the agency and resiliency they employ once they become victims of zero-tolerance rules, marginalization, criminalization and extreme discipline action through expulsion. Morris (2016) found even while Black female students were incarcerated, they retained hopes and dreams of the future, longing for the ability to learn during their time locked up. The participants in her study reported being re-traumatized during their incarceration as they "talked back" to the low-quality instruction they received in the juvenile court school. Completing work quickly, talking without raising their hands and perceived challenges to the teacher's authority were punishable infractions that continued to impede educational attainment in hyperpunitive learning environments. The next section employs one of component of Critical Race Feminism, storytelling, as an extremely beneficial tool to consider the impact of the intersection of raced and gendered expectations of Black girls in schools, the criminalization of Black girls, traditional images of a scientist and celebrated school science engagement.

Critical Race Feminism and Science Engagement: Kiera's Story

In 2013, Kiera Wilmot was a 16-year-old Black female high school student at Bartow High School in Florida when she received an assignment from her science teacher to conduct a science experiment and bring it into class to present. From her own account, the teacher gave the example of a baking soda and vinegar volcano, but told the students not do that particular experiment because it was too juvenile as part of the elementary school science curriculum.

Kiera chose an experiment of combining aluminum foil and toilet bowl cleaner in a water bottle. While she should have waited until science class period, she chose to show her classmates the experiment before school. Reports show that she conducted her experiment in an area where the principal and security officers were located, so one could sensibly assume that she wasn't trying to be secretive. When she combined the two materials, the bottle started to hiss, a noise was created from the chemical reaction as well as a small amount of smoke. Kiera recounted being shocked at the outcome of the experiment and later in the school day she was called to the office, handcuffed, arrested, expelled and charged with felony possession of a weapon with a possible penalty of 20 years in jail.

The principal stated that Kiera was a model student who had never been in trouble before; nevertheless, citing the zero tolerance policy, her science experiment was cast as hazardous, premeditated and malicious. After the ruling, Kiera was sent to Bill Duncan Opportunity Center, a detention center for youth where she faced bullying and harassment from students calling her a member of the Taliban for making the "bomb" at school. Several national organizations rallied in support of Kiera, raising awareness about her case and the manner in which she was criminalized for conducting a science experiment that resulted in no harm being done to persons or property at the school. The internet exploded with online petitions to reverse

the judgment against her with scientists and science teachers weighing in on the case, demanding to understand how her experiment was problematic and inappropriate while sharing their own stories of far worse outcomes in their own science learning experiences.

Eventually the support for Kiera was so powerful, her expulsion was lessened to a ten-day suspension. Additionally, the summer following the incident a former astronaut and engineer, Homer Hickam, awarded Kiera a full scholarship to attend a NASA space camp. Furthermore, she was able to return to school, graduated the following year with plans to begin STEM undergraduate program at Florida Polytechnic University. Her lawyer informed her that it would take five years for the conviction to be cleared from her record, so although many parts of her life have resumed normalcy, she is still haunted with a felony conviction.

How do the previous sections help us critically consider Kiera's story? How do we question the ways race and gender were interwoven throughout this particular story; which criminalized this science experiment rather than celebrating her desire to engage in scientific exploration? How does an understanding of the Draw-a-Scientist-Test and subsequent information about stereotypical views of a scientist allow Kiera's actions to be labeled criminal rather than appropriately scientific? Furthermore, if Kiera were a White female, would the response have been the same? If she had been a White male, would she have been vilified? It makes sense to assume that if Kiera were a Black male, she could have faced similar repercussions since Black males are punished more severely than students of other demographics, but what about Kiera being female and Black triggered such a response in regard to her harmless experiment?

When we consider the body Kiera inhabits and hold that up to the stereotypic characteristics of a scientist, we see that she is positioned in complete opposition to the traditionally accepted view of a scientist. Previous sections of this study purport the three most common characteristics

of a scientist is older, White and male whereas Kiera is young Black and female. The stereotypic qualities such as lab coat, symbols of research, and technology show the image of a scientist is often limited to a singular person working in a chemistry lab so Kiera using rudimentary resources from home, dressed in plain clothes and not working in the official capacity of a chemistry lab again allows her to be positioned in direct opposition of a celebrated scientist.

This recent conceptualization of intersectionality is pertinent to the theoretical framework guiding this research project on Black female elementary PSTs enrolled in a private female historically Black college located in the South. The variations and similarities of their identities as Black women are essential to unpacking their lived science identities as well as the development of their science teaching identities. The next section will present the conceptual framework on social constructions of identity to show how intersectionality and specific oppressions due to race and gender influence a resilient formation of identity.

Identity Construction

Identity construction is a fluid process, informed both by internal and external forces. Hall (1997) indicated identity is a production, an unending process constantly impacted by outside labels and representations available to us. Equity science education researchers attend to the development of students' science identities as informed by their raced, gendered and classed identities. The most productive literature on identity in education which takes into account the intersection of multiple social constructions look to Holland et al., (1998) and Lave and Wegner (2001) for an identity framework establishing the links between positional identity and identity in practice. This is a productive framework with which to consider how social constructions of race and gender and other intersecting oppressions positioned the Black female elementary pre-

service teachers in this study with respect to their previous science schooling experiences as well as how they have and will position themselves as future teachers of elementary science.

Positional Identities and Identities in Practice

Positional identities are ways people understand and enact positions in the worlds in which they participate. Group members wielding power assign status and position to individuals in figured worlds socially in a hierarchy (Holland et al., 1998). Higher status positional identities in science classrooms indicate 'positive or welcomed' identities. These welcomed positional identities are developed in and through practice but also shaped by social expectations of 'good science students'. A set of particular scientific actions and behaviors are celebrated in traditional American classrooms to signify good science students. These students are usually quiet, take copious notes during teacher directed lectures, complete science assignments neatly and on-time and correctly utilize discourse particular to science content.

Lave & Wegner (2001) proposed "identities in practice" (IdP) as a way to explain how identities develop as one engages in a specific community, while learning and practicing the ways of talking, knowing, doing and being in that particular community. As learners become participants in these particular communities, the participant's development of skills specific to that unique community dictates her position in that community. The previous science schooling experiences of this study's participants dictated the formation of their science identities in practice and their current experiences in teacher education have shaped and continue to shape their elementary teacher identities in practice as they continue to matriculate through the program.

Tan & Calabrese Barton (2008 a, b) asserted girls cultivate multiple, fluid "identities-in-practice" as they navigate various academic and social settings. They acknowledge that due to

pre-established norms and rules of engagement in these settings girls shape their identity through varied levels of student participation. Additionally, Tan & Calabrese Barton (2008) proved different science class structures facilitate the development of different science selves. When teachers deliver science content through lectures and teacher led science experiments girls have diminished opportunities to engage in science communities and develop these "identities in practice". Even in relation to the types of science work, girls may have limited opportunities to engage deeply in classroom science communities. While small group science work may seem to provide more opportunities for individual students to deeply engage with and develop stronger science identities, if female students are always assigned peripheral roles such as note taking and reporting they will not have the robust experiences necessary to deepen their science identities.

The varied experiences that comprise teacher education programs similarly allow different opportunities for student engagement. Teacher education courses that are mostly lecture allow for a different level of engagement than a methods class, which invites students to develop lessons and demonstrate them in class. Field experience placements with assignments to teach a 15 minute lesson to a group of three or four children is a vastly different experience than student teaching, placing the pre-service teacher in control of whole class instruction for an extended amount number of weeks. Particular to learning how to become a teacher of elementary science, if a PST is not able to observe the cooperating science teacher construct and deliver quality science lessons, if the PST is not able to see the cooperating teacher use science teaching materials and if the PST is unable to teach science, use science teaching materials and engage with science teaching vocabulary, she has diminished opportunities to cultivate a strong elementary science teacher identity in practice. This is not to say that the PST will never strengthen her elementary science teacher identity in practice, since identity is fluid and she

could be exposed to more supportive science professional development once she enters her career.

History in Person

Identities in practice (IdP) are created within and against institutional and social constructions. The intersection of historical- institutional struggles with historical-personal struggles create an individual's "history in person", carried by that individual as they shape their IdP. Tan et al., (2013) demonstrated how Black girls in middle school struggle to develop resilient science identities in the face of multiple historical, institutional and societal prejudices. Science equity research incorporating "history –in- time" allows researchers to foreground concerns about societal oppressions which limit access to quality science educational experiences. Specific to studies on young Black girls in science, this concept invites scholars to understand how Black girls author IdP as they navigate power dynamics in science classrooms.

Narrated and Embodied Identities in Practice

After considering positional identities and power dynamics against which Black girls construct their science IdP and Black women construct their elementary science teaching IdP, there is a 'doing' of this identity through both a 'telling' and an 'embodiment'. Sfard and Prusak (2005) interrogate the narratives one tells about herself and the performances that accompany that telling of oneself. Black girls tell stories about their identities as science persons or not science persons through what they include and omit when describing their past school science experiences. However, these told science identities do not stand alone, but Black girls have multiple science IdPs: their narrated IdP, one's "actual identity" and one's "designated identity" all of which are fluid and evolving (Tan et al., 2013). These three identities suggest that one's narrated IdP may not be an accurate representation of their science selves, just as their designated

identity may not be an accurate representation of their science selves. This understanding is transferrable to identity work in science education, teacher education as well as identity work in elementary science teacher education.

Using Critical Race Feminism as a theoretical framework allows science education researchers to analyze the structural and cultural factors that perpetuate racism and sexism within American social structures and practices negatively impacting Black girls' science identities in practice. Employing CRF allows equity minded science education researchers to ask the question: What is the relationship between raced, gendered and science learning identities? Additionally, how does using CRF as a framework to understand elementary pre-service science teachers' identities in practice. As Black girls navigate science communities of practice and figured worlds, there may be opportunities to interact with science learning materials, scientific discourse and to perform science behaviors. In order to fully understand the complexity of Black girls' science IdP, researchers must consider both their narrated and embodied IdP to understand the science stories these girls are telling about themselves. As the links were shown before, the narrated and embodied elementary teaching IdPs of Black women are linked to the science IdPs they developed in previous school settings.

Why Critical Race Feminism in Science Teaching Identity Work?

There is a growing body of scholarship on the resilient development of science identities of Black girls (Buck et al., 2014, Pinder & Blackwell, 2014; Pringle, Brkich & Adams, 2012; Valeras et al., 2012; West-Olatunji, et al., 2008). Moreover, the number of scholars extending this identity work to understanding the identity constructions of Black female elementary science teachers is modest. Thinking back to the stereotypical images constructed about Black girls and

women, it is obvious how these negative constructions could be injurious to young Black girls' identity construction.

W.E.B. Du Bois introduced the concept of "double consciousness", asserting that Black people have to navigate America through two mind frames: that of a Black person and that of an American. Unlike White American citizens, Black people had to look through two lenses, continuously debating back and forth about this duplicity. He states, "One ever feels his twoness,- an American, a Negro; two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder" (1903, p.164). DuBois' concept of double consciousness is often quoted, but Anna Julia Cooper, a premier Black feminist thinker, posited a triple identity as early as 1890; this triple identity involves the intersection of being Black, female and American. She asserted "But to be a woman of the Negro race in America, and to be able to grasp the deep significance of the possibilities of the crisis, is to have a heritage, it seems to me, unique in all the ages" (p.117). This understanding is linked to Hill-Collins 'matrix of oppression' which unmistakably states that Black women often experience multiple oppressions simultaneously due to race, gender and class.

The schooling experiences of young Black girls can be greatly improved if researchers employ theoretical frameworks that explicitly foreground critiques of both race and gender to understand the ways institutional oppressions have constrained educational opportunities. "The master's tools will never dismantle the master's house. They may allow us temporarily to beat him at his own game, but they will never enable us to bring about genuine change" (Lorde, p.112). This quote is often used in Black feminist scholarship acknowledging that the current structures set in place to confront oppression will not change unjust structures that formed

existing inequities. This quote clearly shows why a new theoretical framework must be applied to the research on science schooling experiences of Black women and their subsequent development of elementary science teaching Identities in Practice. Critical research conducted from a Black feminist thought framework foregrounding racism and sexism as well as other intersecting oppressions would be particularly beneficial to the body of literature on Black girls' science education and elementary science teacher education of Black women.

Black feminist scholars have identified the main components of Black Feminist Thought (BFT) as resisting oppression and empowering African American women within the context of social justice by accounting for the intersections of race, class and gender (Collins, 1990; Guy-Sheftall, 1995; hooks, 1996). This theoretical framework extends the lens of analysis to look at the ways Black female students have been denied quality school science experiences. In addition to this understanding, BFT privileges the voices and stories of the people telling them, acknowledging that these lived experiences make them experts on their own lives. From this understanding, it is obvious how advantageous it would be to research Black female elementary PSTs experiences in science classrooms and teacher education classrooms. Collins (1990) argued Black women scholars' task involves "asking the right questions and investigating all dimensions of a Black women's (or girls) standpoint with and for African-American women (girls) (p.37). hooks (1989) admonishes Black women (and girls) to 'talk back' to oppressive situations, forcing people to hear them, laying the groundwork to forge new justices in the face of multiple injustices. By providing a higher level of insider knowledge, Black women researchers may be better able to understand nuanced experiences that the young girls may have difficulty articulating. This space could be transformative for the students as they are able to express themselves in a safe space to reveal or deny this identity. Rather than continue the trend of deficit

literature, studies employing these critical frameworks join the voices of scholars who expose the resilience of Black girls and provide solutions and replicable curricular ideas to better serve them.

Gloria Ladson-Billings, a leading scholar on multicultural education, recounted early memories of school science in an address to National Association of Research on Science Teaching (NARST) in a keynote address entitled, "I Used to Like Science… and then I Went to School". She recounted science in her life, how she was very inquisitive and connected to science growing up but interactions with teachers who judged and discredited the knowledge and experiences she brought into the science classroom severed her tie to school science. She ended with a charge to improve science education and appropriately I have refocused this charge to specifically address Black girls:

We are no longer in a society that can afford for *Black girls* to be scientifically illiterate. We are no longer in a society that can afford to weed out *Black girls* or push them through arbitrary sieves called biology, chemistry, and physics. We are no longer in a society that can afford to send *Black girls* to a course called general science that actually would better be called "reading about science." We need every *Black girl* to leave our schools excited about and engaged in science so that they can have more career and vocational choices open to them and so that they can actively participate in the decision making that democracy requires. We need to turn school into a place where our *Black girls* can continue to like science.

CHAPTER 3- METHODS

Introduction

A portraiture was constructed from the science life histories of four elementary teacher candidates enrolled in a teacher preparation program at Spelman College, a small private historically Black female college in Atlanta, Georgia to study the developing science teaching identities of Black female elementary teacher candidates. This project sought to understand how lived science experiences of Black female elementary teacher candidates developed or constrained their science teaching identities. It has been well documented in research that many elementary teacher candidates and current teachers are uncomfortable teaching science in their classrooms due to poor science experiences in their prior schooling, less than rigorous science methods courses and myriad obstacles once teachers enter their own classrooms (Mulholland & Wallace, 2002; Palmer, 1995; Watters & Ginns, 2000). To develop a full picture of the needs and perspectives of elementary teacher candidates, multiple and varied experiences must be included in the literature regarding teacher candidates, not just a presentation of data from traditionally represented members of the teaching force. This project adds to the literature in this field by focusing tightly on the experiences of Black female elementary teacher candidates, illuminating the ways race, class and gender impact their development of science teaching identities.

Research Questions

This project investigated the lived science experiences of Black female elementary teacher candidates linking these experiences to the development of their science teaching identities. The research questions which guided this project are:

1. What are the lived science experiences of Black females in elementary certification programs?
2. How do the science experiences of Black female teacher candidate shape their identity as teachers of elementary science?

a) How do the kindergarten through 12th grade science experiences of Black female pre-service teachers impact their identity as teachers of elementary science?

b) How do college science experiences of Black female pre-service teachers impact their identity formation as teachers of elementary science?

This chapter describes the research design, qualitative data collections methods employed and the interpretive framework that guided the analysis of the data collected. Finally, trustworthiness and limitations of the study are discussed.

Research Design

The history of research has experienced many paradigm shifts, moving from positivism to post-positivism, to critical theories, constructivism and participatory research. Lincoln and Denzin (2011) offered a clear explanation of each of these paradigm positions. They understood positivism and post-positivism are characterized by an aim to predict and control, researching as a "disinterested scientist" assuming no researcher influence on data. Critical theories seek to critique and transform oppressive structures, researching as a "transformative intellectual" advocating for the group being researched. Constructivism seeks to understand and reconstruct, operating as a "passionate participant" aware of the researcher's experiences and thoughts as a way to impact findings. Lastly, participatory paradigms acknowledge the primacy of practical knowing, critical subjectivity and living knowledge. Researchers who investigate from a participatory paradigm value their voice through self-reflective action and utilize secondary voices to craft more robust theories.

Crotty (1998) presented a great deal of information on conducting the qualitative research

process. He outlined four interlocking concepts that help the researcher situate herself in the research process by first deciding her epistemology, which informs her theoretical framework, as well as the methodology and methods used to conduct research. Crotty (1998) asserted methodology is the strategy, plan of action, process or design behind the decision to utilize particular methods to elicit certain research outcomes.

As a Black woman researcher proposing a study at a college historically created for young Black women, I employ an Endarkened Feminist Epistemology (EFE), (Dillard 2012) which is informed by a foregrounding of both race and gender. Dillard (2012) invites researchers to conduct research in "paradigms that encompass and embody cultural and spiritual understandings, memories and histories that shape our epistemologies and ways of being" (p.58). Dillard's (2012) EFE restructures common understandings of knowledge, resituating origins of knowledge in the historical roots of global Black feminist thought. This epistemology centers the oppressions and resistance of African ascendant women, and "honors the wisdom, memory, spirituality and critical interventions of transnational Black woman's ways of knowing and being in research, with the sacred serving as a way to describe the way of doing it, the way that we approach the work" (p.60). One of the EFE metaphors of research, 'research as responsibility', resonates with me as a researcher as I feel a responsibility to research my Spelman sisters with care and respect, in a manner that engages their body, mind and spirit and honors the knowledge these Spelman students bring to conversations about science teacher education and teacher education as a whole. This epistemology guided my theoretical framework, Critical Race Feminism, my selection of Portraiture as methodology, the intentional selection of voice-amplifying research methods and finally the employment of Voice-Centered Analysis to read data.

While there has been critique of this epistemology, the researchers who have offered up these critiques may underscore the importance of elevating theory of knowledge in the study of Black women. Dillard (2006, 2012) a Black woman proposed this theory of knowledge to helped explain the legitimacy of lived experiences of other Black women to have her contribution questioned by a Black man, Handel Wright (2003) who suggested Dillard's conceptualization of Endarkened Feminist Epistemology had somewhat of a limited use as there were other conceptions available to use for research on Black women. Wright asserted, "Rather I am interested in how sociocultural difference may operate within an endarkened feminist epistemology; in how the concept, discourse, and project would work in relation to existing, presumably allied discourses and projects such as (racially unmarked but remarkably white) feminist epistemologies; as well as in what effect it will have in the larger context of educational research" (p. 201). Wright, a researcher who conducts research utilizing a postmodernist epistemology employed the work of Britzman, Rorty, Spivak and other leading postmodern theorists to assert Endarkened Feminist Epistemology is too limiting, centering the differences of the Black female experience in a way that perpetuated her alienation. Wright instead proposed what he termed to be a parallel articulation which questions "what difference difference makes" in an effort to address the multiplicities of Black female lives that he felt EFE did not adequately include.

Another postmodernist researcher, Patty Lather, considered the usefulness of EFE also bringing Wright's rebuttal into critique as way to reconsider the messiness of identity. Like Wright, Lather (2008) considered what was lost by an epistemology which prioritizes one 'othered-ness' over another. Lather, a White woman, suggested decentering one's experience in an effort to better understand the experiences of others. While there are many useful aspects of

postmodern thought and the work of these two researchers, for the fact that they embody spaces (Black male and White woman) that are outside of the experiences EFE seeks to validate, I wonder how worthwhile these critiques are for achieving the goal of developing an epistemology that celebrates and substantiate the unique experiences of Black women. I, along with other Black female researchers, assert the importance and necessity to use EFE to explain, corroborate and legitimize the experiences of Black women and girls.

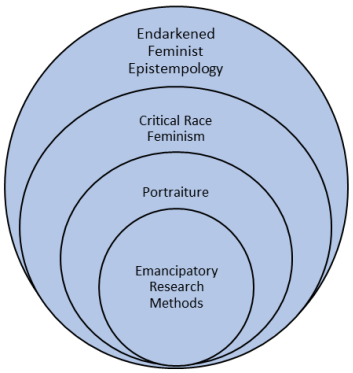


Figure 3.1 Research Design

Methodology

Four methodologies that I initially considered using to investigate the experiences of black female pre-service elementary teachers are phenomenology, ethnography, autoethnography and portraiture. Each methodology has distinctive characteristics and applying a particular methodology would result in a different emphasis to the research findings.

Portraiture is a research methodology created by Sarah Lawrence-Lightfoot (1989). As a Black female researcher Lawrence- Lightfoot desired a research methodology that offered more possibilities than the limiting positivist methodologies traditionally celebrated in Western research. Even with the possibilities offered by post-positivist methodologies, Lawrence-

Lightfoot still felt that traditionally celebrated research was exclusionary, crafted to be read by a select group of intellectuals, impeding access to the general population. Lawrence-Lightfoot created portraiture as a methodology, a way for "subjects to be seen, fully attended to, recognized, appreciated, respected and scrutinized…I wanted them to feel both the discovery and generosity of the process as well as the penetrating and careful investigation" (Lawrence-Lightfoot, 2005, p.6). Portraiture borrows from aspects of other qualitative methodologies but stands alone in its application as research method and methodology. The next sections present a brief review of methodologies similar to portraiture and an explanation of the ways these methodologies could not fully address the needs of this research study.

Phenomenology as methodology.

Phenomenology is a methodological approach informed most significantly by the ideas of German philosopher Edmund Husserl and extended by theorists such as Merleau-Ponty, Heidegger, Gadamer and Ricoeur. Phenomenology is the study of the world as experienced by an individual and the connection between human experiences and behavior phenomena (Giorgi, 2010). Phenomenology involves detailed explanations of a participant's life world and attempts to explore the personal perceptions or accounts of an object or event (Smith & Osborn, 2003). There are many approaches to phenomenology such as descriptive phenomenology, interpretive phenomenology, life world phenomenology and hermeneutic phenomenology and often Husserl's and Heidegger's approaches to phenomenology are regarded as the major thrusts in this methodology. Husserl argued that the world is only known through people's thoughts and equates life to one's 'lived experiences', asserting the researcher can uncover the "essence" or true meaning of a phenomenon. Heidegger extended Husserl's concepts of the "life world" or "lived experience" as he argued it was not enough to describe the phenomenon but also

necessary to interpret the experiences surrounding the phenomenon.

Phenomenology seeks to communicate the essence of a phenomenon from the standpoint of those who have lived/experienced it (Creswell, 2003). Rather than suggesting a hypothesis or developing theories, phenomenological researchers highlight nuances in the phenomena to ascertain a better understanding of the researched experience (Schram, 2006). Phenomenology suggests findings which may be generalizable to other contexts, but foregrounds the context and participant selection of the present study. Moutakas (1994) explained two main differences in phenomenological research: empirical phenomenology and heuristic phenomenology. Empirical phenomenology poses open-ended questions then employs reflexive analysis and interpretation to explain phenomenon. Heuristic phenomenology begins with a specific question to answer or problem to address. This type of research searches for meaning of experience to identify the nature of ideas.

While phenomenology could be a helpful methodology to understand the particular science experiences of pre-service teachers at Spelman College, the epistemological and ontological assumptions of this methodology may not align with my positionality in this study. Vagle (2009) clarified issues of validity and intentionality germane to this methodology showing that phenomenological researchers wrestle with issues of interpretation through the process of bracketing; however, "although bracketing takes on different nuances with each researcher who employs it, for the most part the technique involves a commitment to *suspending* or *setting aside* one's own pre-understandings and assumptions of the phenomenon, while studying the phenomenon" (p.589). I believe it would been extremely difficult and potentially injurious to the robustness of this study if I had tried to bracket my experiences and understandings of the teacher education program at Spelman College as my own lived experiences as a teacher

education candidate at this institution could add to the larger conversation.

Ethnography as Methodology.

Ethnography is the study of a culture through first-hand experience and exploration via participant observation. Through both participation in and observation of a culture, the researcher gains more complete understanding of this setting and the aspects that make this 'native 'system unique. There are several central concepts that distinguish ethnography, each focusing on the rich understanding of native cultures. Clifford Geertz (1973) established many of these central concepts. He theorized *webs of significance*, asserting that meaning is made through local interpretations and that seemingly similar practices could have varying purposes in different cultures. Additionally, ethnography attends to the *cultural context* of an experience once local interpretations have been established, arguing that a complete picture is not developed until attention is paid to both the local and collective interactions. Finally, Geertz recommended developing an insightful narrative of the fieldwork with *thick description*. This compels researchers to attend to multiple and possibly contradictory findings throughout data collection. The ethnographer must dig though several complex layers of local interpretations and sort of 'structures of signification' to develop a thorough and shrewd understanding of the culture (Prasad, 2005).

In order for ethnographers to fully understand the cultural context and develop a thick description of a 'native culture', ethnographers must develop both a strong familiarity with the culture being researched and be able to communicate this familiarity through their writing (Prasad, 2005). Bate (1997) indicated this as "being there"; being immersed in the culture so much that the ethnographer becomes at home with the jargon, terminology and habits of the culture being studied. Finally, Prasad (2005) argued the narrative dimension of ethnography

requires ethnographers to create a nuanced and perceptive story from the observed day-to-day occurrences to allow readers to develop insightful connections. Through prolonged contact with the field, eliciting a multiplicity of voices, avoiding cultural insensitivity/blindness, and persuasive writing a researcher can execute a duteous ethnography allowing readers an informed glimpse into a new culture.

An ethnography of the teacher education program at Spelman College would be a good start to understanding the culture of teaching and learning to teach science in this particular teacher education program; nevertheless, I would like this research to empower the students in a way that an ethnographic study may not. My positionality as a Black female former elementary teacher affords me valuable insight that I bring to this project. An investigation of my own personal experiences with this phenomenon would add to the overall project and should be included in a way an ethnography does not invite.

Autoethnography as Methodology

Autoethnography is a contested methodology with positivistic researchers arguing that autoethnographers are too close to the data as they are researching themselves and post-positivistic researchers maintaining the critical analysis of personal experiences adds a richness and alternate voice rarely elicited with traditional ethnography. Ethnographic research traditionally involves an 'outsider' studying a particular culture and reporting their findings. Often this type of research is critiqued as the outsider may 'read' the culture incorrectly, interpreting the data inaccurately due to their outsider status. As a way to attend to these inaccuracies, autoethnography is conducted as the systematic analysis of personal experience in effort to understand experiences of larger culture (Ellis, Adams & Bochner, 2011).

Autoethnography is both a process and a product, describing the way research is collected and the final way the data is presented. Ellis and Bochner (2000) defined autoethnography as "autobiographies that self-consciously explore the interplay of the introspective, personally engaged self with cultural descriptions mediated through language, history, and ethnographic explanation" (p.742). Although positivist researchers argue that research should be conducted from a neutral and objective stance, other researchers note the impossibilities of conducting research devoid of researcher bias. Therefore, autoethnography is a methodology that celebrates subjectivities and the researcher's positionality as valuable to data collection (Ellis, Adams & Bochner, 2011). There are multiple approaches to autoethnography, such as narrative ethnographies, reflexive, dyadic interviews, reflexive ethnographies, layered accounts, interactive interviews, co-constructed narratives and community autoethnographies. Each of these approaches values the voice of unfamiliar people through rigorous analysis of their personal phenomena.

Chang (2008) acknowledged three aspects of autoethnography: 1) autoethnographers conduct research in a systematic manner similar to ethnographers 2) autoethnographers interpret and analyze their experiences to achieve an understanding of others through their understanding of themselves and 3) autoethnography uses personal experiences as primary data, celebrating personal narratives as a way to understand society as a larger picture. Additionally, Chang (2008) identified three benefits of autoethnography: (1) a research friendly methodology for both researchers and readers (2) deepens cultural understandings of the self and others and (3) the ability to transform the self and others to work towards more communal living.

Autoethnography is a methodology that is both researcher and participant friendly, nevertheless, since my study sought to understand the varied lived science experiences of

multiple Black elementary pre-services teachers, an autoethnography solely focused on my experiences is not sufficient to meet that goal. Upon searching for a more appropriate qualitative culturally sensitive methodology, I found portraiture would be the best methodology to conduct research in a manner to celebrate the often ignored voices of young female women of color in teacher education programs.

Portraiture as Methodology.

Portraiture is a relatively new methodology created by a Black female scholar, Sara Lawrence-Lightfoot and first utilized in her study *The Good High School* (1983). Portraiture represents a merging of art and science in both the ways to do research and represent research findings. Lawrence-Lightfoot &Hoffman Davis (1997) acknowledged that portraiture holds the relationship between the researcher and the audience in a new light, focused on allowing the researcher to communicate her findings to audiences outside of academic walls. They asserted portraiture helps "move beyond academy's inner circle, to speak in language that is not coded or exclusive, and to develop texts that will seduce the readers into thinking more deeply about issues that concern them" (p.10). The portrait that is created through this methodology brings private stories to the public sphere and develops "a people's scholarship"- a scholarship that scientifically researches the field but presents subjects' voices in a clear, relatable and connected manner (Chapman, 2005; Featherstone, 1989; Lawrence-Lightfoot, 1997, Ngunjiri, 2007).

Portraiture is informed by both the phenomenological traditions striving to produce "complex, subtle description of context but also in searching for the central story, developing a convincing and authentic narrative" and ethnographic traditions by "watching, listening to, and interacting with the actors over a sustained period of time, the tracing and interpretation of emergent themes, and the piecing together of these themes in an aesthetic whole" (Lawrence-

Lightfoot & Hoffman Davis, 1997, p.12). Ngunjiri (2007) explained how portraiture builds on multiple methodologies in a very unique way,

Portraiture blends ideas from the philosophy of phenomenology and several interpretative methods. Following phenomenology, portraiture concentrates on explicating participants' experiences; following ethnography, portraiture gives primacy to context; following life history, portraiture involves listening for the stories of the participants; finally, following biography, portraiture focuses on the individual. (p. 4)

Through nuanced research of a particular place or event, other generalizations can be made. Again, Lawrence-Lightfoot & Hoffman Davis (1997) asserted,
"the portraitist seeks to document and illuminate the complexity and detail of a unique experience or place, hoping that the audience will see themselves reflected in it, trusting that the readers will feel identified. The portraitist is very interested in the single case because she believes that embedded in it the reader will discover resonant universal themes. The more specific, the more subtle the description, the more likely it is to evoke identification" (p.14).

Where other research methodologies may shy away from acknowledging the influence of the researcher, portraiture values the voice of the researcher confessing, "the portraitist's voice, then is everywhere- overarching and under-girding the text, framing the piece, naming the metaphors, and echoing throughout the central themes" (Lawrence-Lightfoot & Hoffman Davis, 1997). Through the methodology of portraiture, "the multifaceted nature of voice must be recognized, evaluated, and integrated within the telling of the data" (Chapman, p.34). In portraiture, voice is celebrated and critiqued, "poignant with paradox, it is everywhere and it is judiciously placed; it is central and it is peripheral" (Lawrence-Lightfoot & Hoffman-Davis, p.86). Portraiture argues there is no escaping the voice of the researcher in qualitative or

quantitative research; therefore this methodology embraces the voice as witness, voice as interpretation, voice as preoccupation, voice as autobiography, listens to voice and attends to voice in conversation (Chapman, 2005).

An attractive aspect of portraiture is the 'search for goodness'. Often research involving nonmainstream populations research and represent findings from a deficit perspective mired in pathology, focused on suggesting remedies. Research on teacher education programs, especially research around science preparation of elementary teacher candidates identifies the gaps in conceptual knowledge and pedagogical content knowledge (Appleton, 2006; Appleton & Kindt, 1999; Davis, 2009; Mulholland & Wallace, 2005; Smith, 2000). Portraiture examines the actions specific to the research location, asking what is happening and why, looking carefully for goodness; "a complex, holistic, dynamic concept that embraces imperfection and vulnerability; a concept whose expression is best documented through detailed, nuanced narratives placed in context" (Lawrence-Lightfoot & Hoffman Davis, p.142). By documenting the lived science narratives of these female elementary teacher candidates, we can better understand the complex and holistic picture of their science backgrounds and how that impacts development of their science teaching identities.

Portraiture has four main aspects that guide the research process: conception, structure, form and coherence. *Conception* in portraiture refers to the development of the overarching story. Through my utilization of portraiture I highlight the important themes while emphasizing central aspects of individual and collective experiences through the development of the narrative. In portraiture, *structure* represents the themes that scaffold the overall narrative, developing metaphors or even subtitles to guide the reader through the portrait. *Form* in portraiture speaks to the artistic aspect of this research methodology, using form as "the texture of intellect,

emotion and aesthetics that supports, illuminates and animates the structural elements" of the research project (Lawrence-Lightfoot & Davis Hoffman, 1997) Finally, *coherence* addresses the overall unity that brings together the portrait. Attending to coherence throughout this portraiture challenged me to present the distinct, individual stories of each participant while braiding them together to construct a clear articulation of the overarching project.

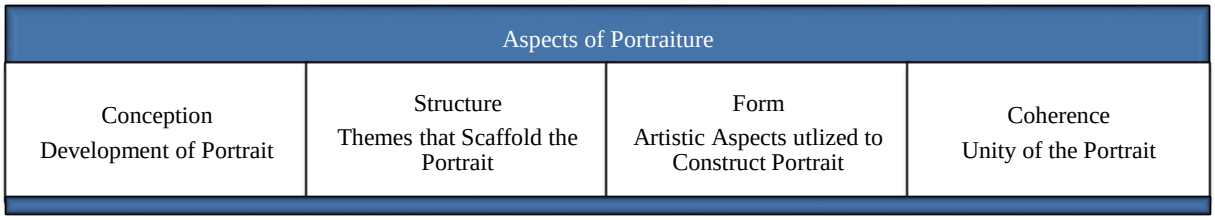


Figure 3.2 – The four aspects of Portraiture Methodology

The use of portraiture as a methodology encouraged me to purposefully attend to the voice of the participants and myself while encouraging me to present my findings in a manner that is comprehensible by persons both inside and outside of academia. Additionally, attending to voice as witness, interpretation, preoccupation and autobiography I sought to validate the experiences of the participants by showing them their lived science experiences are valid and valuable.

Context of Study

The participants in this research study were enrolled in the elementary teaching certification program at Spelman College in Atlanta, Georgia. All participants were seniors, starting their final year studying for elementary certification. The students in this program were required to take Environmental Science as the science pre-requisite for the elementary

certification major and once admitted to the program, participants enrolled in a semester long joint science and math methods course during the spring semester of their junior year.

In the spring 2014, I worked with the junior class during their Science and Math methods course, supporting a new faculty member during their weekly class. As a graduate of Spelman College, a past elementary teacher in Atlanta Public Schools and through my assistance with this class, I gained a modified insider-status although not fully integrated into the students' community. In the fall of August 2014, I explained my study to the students and asked for participants. All of the 9 seniors applied to be a part of the research study even though I explained I would ultimately only focus on 3-4 participants after data collection. I was surprised that all students wanted to be participants and found that they wanted to use the study as a space to talk through the frustrations in science they'd experienced as students and now teacher candidates. I understood their desire to participate and agreed to include the whole group in the data collection process.

During the data collection process four participant's stories were selected and I developed rich, highly detailed portraits of these elementary teacher candidates' science experiences. I acknowledge these portraits are not wholly representative of the experiences of every Black female elementary teacher candidate but acknowledge the importance of sharing the lived histories from young women who grew up in various parts of the country.

Spelman College is a historical Black private, female only college that was founded in 1881 in Atlanta, Georgia. Spelman College enrolls students from across the world with graduates from 20 different countries. Sophia B. Packard and Harriet E. Giles founded Spelman College in the basement of a Black Baptist church in Atlanta, Georgia. These two white Northern missionaries sought to improve the status of Black females by affording them an

opportunity to become educated in a state where there had been no schools founded for the education of Black women or girls. On April 11, 1881, the Atlanta Baptist Female Seminary opened with eleven students, ten women and one girl. John D. Rockefeller, a noted philanthropist, along with his wife Laura Spelman Rockefeller were very sympathetic to the cause of educating Black women and donated the funds to purchase land and other resources to establish the school. For his generosity, Packard and Giles offered to rename the Atlanta Baptist Female Seminary after Rockefeller; however, Rockefeller suggested that the honor be bestowed upon his in-law, allowing the school to take his wife's maiden name. The school became Spelman Seminary for Women and Girls and from this financial contribution became a boarding facility serving 600 students with courses in nurse training, cooking, sewing and other areas of housework. The Teachers Professional Course opened in 1892, training teachers for elementary instruction. As the Spelman Seminary continued to grow and there were more public options for the education of Black girls, Spelman Seminary became Spelman College, with the school's main goal of teacher training strengthening the elementary and secondary education programs as well as home economics and nursing training.

Today, Spelman College operates as a private liberal arts Black female college offering bachelor degrees in multiple areas such as science, philosophy, the arts, political science, foreign languages, women's studies, African studies as well as education. Although the teacher preparation program was the founding major at Spelman College, the enrollment and graduation rates from that department are extremely low. Within the past five years the education department was disbanded but reestablished and has been operating for the past three years.

Because Spelman College is an expensive school with an annual tuition rate of $36,579.00 and the current average first year salary for a teacher with a bachelor's degree in

Georgia is $31,586.00, majoring in education at Spelman College may not seem like a financially sound decision. I (as well as other classmates) have been asked by friends and family members why I would 'go to Spelman 'just' to be a teacher'. Regardless of the historical importance of Black educators in America, teacher preparation at Spelman College has had an interesting past, most recently being demoted from the status of a full department being closed temporarily then reopened with the status of a program with a smaller budget and resources. Surprisingly, in 2014 while this study was being conducted, Spelman College was named as the top contributor of Teach for America fellows in comparison to other small colleges sending 36 Spelman graduates to become Corp members in the year that Spelman's education program graduated 9 fully certified education majors. In the national press release the director of the Career Planning and Development at Spelman College stated, "Teach for America resonates with many of our students because it provides them 'a choice to change the world,'" "Leveraging both the strong liberal arts education of the College along with meaningful civic engagement experiences, Spelman women are poised and ready to create transformative experiences in the classroom that inspire students from low-income backgrounds to rise above the socio-economic limitations of their environment through academic achievement."

Dr. Beverly Daniel Tatum, then president of Spelman College, also a board member of Teach for America lauded Spelman's support of the organization stating, "For over 20 years, Teach For America has recruited exceptional young leaders from Spelman and colleges and universities across the country to join the movement for excellence and equity in education. Spelman strives to cultivate leadership and service among our graduates, and we are proud that so many Spelman women have joined Teach For America to create educational opportunities for underserved students."

Education researchers have critiques Teach for America as a program which has done little to improve the state of education even identifying ways that TFA has had injurious effects on the students served by TFA teachers (Barnes, Germain & Valenzuela , 2016; Brewer, 2014; Heilig & Jez, 2010; Schneider, 2014). Furthermore, a recent study by White and Terrenda (2016) cite TFA for displacement of traditionally prepared Black teachers in urban schools. The support of this national program by Spelman College further highlights the messiness of this research project. While Spelman College opened as a teacher training institute for young Black women in 1892, a time long as one answer to segregation and unequal/illegal schooling of Black students, the history and pride in developing Black women as certified teachers in this space has somewhat eroded.

The numbers of undergraduates enrolled in teacher education has been on a decline since the Great Recession in 2008. The U.S. Department of Education reported a 31% decrease in enrollment in teacher educator programs decreasing from 719, 081 in 2008-2009 to 465,536 in 2013-2014 and teacher education scholars predict further decline in teacher education interest with the rise of new national teacher preparation tests that are seen as expensive gatekeepers (Dove & Schultz, 2016; Meuwissen & Choppin, 2015; Mitescu, et.al., 2016; Ratner & Kolman, 2016). Many of these factors contribute to the low number of students enrolled in the elementary teacher certification program at Spelman College and raise questions about the sustainability of this program given the new pressures facing smaller teacher preparation programs across the nation. These factors impacted the sample size of participants for this research project as the junior class of education majors is comprised of only 9 elementary teacher education students.

Data Collection

For this portraiture I employed a combination of ethnographic methods. Like Chapman (2005) and Nguriji (2007) asserted, portraiture encompasses several research methodologies and characteristically offers many advantages to the study of Black women. Nguriji (2007) identified these advantages of portraiture:

I found that portraiture offered me several advantages: (a) a critical feminist approach which has the flexibility to utilize cultural forms such as African proverbs, wise sayings, and expressions in crafting the portraits, (b) the flexibility to utilize my prior educational and life experiences as a starting point for narrating the stories, (c) a process that could be emancipatory and empowering for both participant and researcher, and (d) a chance to present my voice as well as that of the participants. (p.4)

Life History Interviews

Life history interviews give participants opportunities to reflect on and recall their lives over time (Bornat, 2008). Life history interviews allow the researcher to hear participants share accounts of science across the participants' lives. Through life history interviews, the participant can delve deeply into particular experiences in reporting, schooling and family science memories in a biographical and chronological manner. Unlike traditional qualitative interviews, the interviewer should develop a limited number of questions or prompts, giving more control to the interviewee to determine how much of the life histories are told (Rosenthal, 1993). Goodson & Sikes (2001) approached life story interviews as a way to understand a person's point of view while attending to the story that they tell or do not tell about themselves. The stories we tell ourselves about who we are as science people or who we are not as science people are very important to the construction of our science teaching identities.

Life history researchers suggest a physical co-construction of a timeline by the interviewer and interviewee during the life history interview (Bornat, 2008; Goodson & Sikes, 2001; Kvale, 1996). The process of writing out the timeline of events can be empowering to the interviewee in multiple ways. The interviewee is able to see what is being recorded during the interview, rather than traditionally the interviewer jotting down personal notes. The large paper timeline allows the interviewee to see the history she is sharing and return to certain points to expound as well as question the events that were selected or omitted from the interview (Goodson & Sikes, 2001; Kvale, 1996). Additionally, Bar-On (2006) asserted the telling of life history stories by the interviewee allows her to re-possess the life events, therefore contributing to their self-esteem. Longer than traditional qualitative interviews, life history interviews should last about two hours, long enough to cover significant events in some depth but not too long to tire the interviewee (Kvale, 1996; Smith, Kliene, Prunty & Dweyer, 1986). The life history interviews took place at the end of the fall semester, in various locations of the participant's choosing ranging from her dorm room to a vacant classroom or office on the college's campus.

Focus Group Discussions

Focus group discussions are helpful for the researcher to ask questions to get feedback on particular aspects of the phenomenon that is being studied. Focus groups are small groups of participants sharing similar characteristics brought together to participate in a focused discussion on a specific topic (Hollander, 2004). This allows multiple perspectives to be gleaned quickly and simultaneously. This method acknowledges that responses will be affected by group responses as participants may draw upon the shared fund of experiences and elicit responses not often accessible during a one on one interview (Taylor, 2011). Focus group discussions have the power to challenge accepted knowledge claims about marginalized groups as people "speak in

both collective and individual voices-creating space for traditionally marginalized groups to articulate their particular experience while allowing people to argue and disagree" (Kamberelis & Dimitriadis, 2011, p. 552-553). Focus group discussions are an effective way to understand the multivocality of participants' attitudes, experiences and beliefs in a less formal way than individual interviews (Chapman, 2007).

One focus group discussion was held in late August before the start of the series of life history interviews to begin to engage participants in thinking about their lived science experiences, orient them to the Photovoice process as well as a general gathering to build comfort with the research process and camaraderie between myself and the participants. Another focus group discussion was held in late October to analyze the images captured by the participants through Photovoice. The participants were be able to share each image captured and explain the significance behind the image as it related to their lived science experiments as well as their developing science teaching identities.

PhotoVoice

PhotoVoice is a participatory research method engaging participants through the capture and narration of self-selected images. This method offers a new way to integrate the participant's voice in line with critical consciousness and feminist frameworks which undergird this research project. Wang and Burris (1997) developed this method that has been applied in many areas with growing application to educational research. Cook and Buck (2010) utilized Photovoice with middle school science students, Hark and Stallworth (2013) employed it in their study of four female students' math identity and Cook and Quigley (2013) used this method to study university students' connection with science.

Wang (1999) stated three goals of PhotoVoice: (1) document community strengths and weaknesses, (2) promote critical dialogue and knowledge about issues through group discussions of the photographs and (3) use photographs to reach policymakers.

During the first focus group session, I introduced the participants to PhotoVoice. We discussed the power of pictures on social media, the variety of pictures they have taken of themselves and their environment and the potential messages which could be conveyed through photographs. The procedure for PhotoVoice is as follows: I, as the researcher introduced Photovoice to participants during our first group discussion. I emailed all participants the same prompt with questions encouraging them to capture pictures on their cell phones of science in their lives, through the process of photo-elicitation. They were informed that there were no constraints to the photographs they submitted but they were expected to provide a short narrative explaining the purpose behind the selected photograph, as termed photo-elaboration. Multiple students asked if they could create a PowerPoint from which they could present their pictures and I agreed. During the second focus group discussion, we met in an empty classroom and the larger body of participants presented their PhotoVoice submissions.

Data Analysis

Brown & Gilliam (1992) proposed voice centered relation analysis as a way to pay particular attention to voices of women in research. They posited four questions to guide data analysis attending to female voice: (1) Whose voice? (2) In what body? (3) Telling what stories about relationships? (4) In what social and cultural frameworks? This specific attention to voice requires the researcher to actively listen for voice throughout the research process and continuously through analysis. Mauthner & Doucet (1998) extended voice centered analysis proposing a circular and hermeneutic process analysis, detailing four separate readings of the

data to hear the discord of voices more clearly. The first reading of data attends to the content and researchers. The researcher listens for what is being told by the respondent, the overall plot of the story, the main characters and even contradictions that arise in the telling. The second reading gives attention to how the respondents refer to themselves. The researchers listen to data, noting each time a respondent utters 'I' 'me' or 'we' then analyzes those events to understand what the respondent is saying about her experience. The third reading attends to social context and relationships that are present in the stories participants tell about themselves. Finally, a fourth reading attends to a multiplicity of voices, meaning the numerous and distinct ways people talk about themselves.

Voice Centered Analysis		
Reading 1	Reading for Plot and Researcher's Response	During the first reading, researcher listens to story participant has told
Reading 2	Reading for Voice	During the second reading, researcher listens for how participant situates self in telling of story
Reading 3	Reading for Relationships	During the third reading, researcher listens for how respondents spoke about relationships with teachers, family and classmates
Reading 4	Reading for Content	During the final reading, researcher listens for how participants are placed in cultural contexts, social structures

Figure 3.3- Four readings of Voice Centered Analysis

Lawrence- Lightfoot and Hoffman Davis (1997) explained the data analysis process of portraiture and stated that it is similar to the constant comparative methods of Glauser and Straus (1967). Analysis of portraiture data is conducted through synthesis and reflection characterized by deep insight and contemplation. Voice centered analysis would be the best mode of analysis for this project. Pertinent to the goals of this research project was readability by the students that I studied. I undertook this project in hopes that these students would see value in their science experiences, linking their positive or negative experiences to the type of science teacher they

hoped to be and realizing that educational research is relatable and doable. While a larger goal of the research was to inform teacher education programs for students of color, the main aspiration for this project was one of empowerment for these future teachers. Voice centered analysis allowed me to explicitly focus on the students' telling of their experiences, and value their voice in addition to the way they choose to tell their science life stories while presenting research findings in a comprehensible manner.

Trustworthiness and Credibility

Trustworthiness and credibility are integral to high quality qualitative research studies (Lincoln & Guba, 1986). Several strategies were employed throughout this research project to ensure trustworthiness and credibility of this study such as reflective journaling, developing thick rich descriptions of participants' lived science experiences and inviting the participants to engage in member checking of the data.

Schon (1987) emphasized effective reflexivity demonstrates the ability to treat oneself as the object of inquiry within the world. Since my experiences as a Black female graduate of the child development program were similar to the study's participants, it was beneficial to keep a reflective journal through this research process. While I did not include myself as a participant in this study, I do agree with Hertz (1997) that reflexivity during this study encouraged me to constantly uncover "what I know" and "how I know it", allowing me to confront the assumptions or expectations I had about the outcomes of my study.

Through this research study I kept a reflective journal, detailing my thoughts and experiences both before and after each interaction with participants. The reflective journal helped me write through my internal struggles with the dissertation process, was helpful in responding to participants' stories that were similar to my experiences, and enabled me to create lists of

questions that arose from the stories they shared about science in their lives.

Limitations

There were limitations that impacted this study. First, due to the modest size of the elementary certification program at Spelman College, the number of potential participants was limited. By only selecting participants from this school, the stories of Black female elementary teacher candidates at public historically Black universities and at predominantly White institutions were not included. With the rigorous application process, high academic expectations and expensive yearly tuition, this study does not include Black elementary teacher candidates who experienced serious academic struggles in their formal schooling or were from homes unable to cover the tuition bill. Additionally, the research methods employed throughout this study privileged the voice of the participants, without any measures to check the validity of the stories they told about lived science experiences across their lives. Finally, my previous interactions with the participants as a volunteer in their science methods course could impact the researcher-participant relationship.

Throughout the study I operated from a sister participant-observer status (Evans Winter, 2011). Through my connection to the students as an alum, their Spelman sister, and a previous student of this teacher preparation program, this status broke down walls that could have been present had I not been a Spelman graduate or had I conducted my research at a different institution. Some researchers may argue that my status added a level of "messiness' to my data collection process, I agree; however, this afforded me a level of trust with the participants that allowed them to share stories they may not have felt comfortable sharing with an outsider.

Summary

Utilizing life history interviews, PhotoVoice and focus group discussions as the methods of this research study yielded thick, rich descriptions of the participants' lived science experiences. The depth that was achieved through the construction of the lived science timelines during the life history interview as well as allowing the participants to recreate, capture and narrate significant science moments throughout their lives allowed for important multilayered accounts that are absent from the current literature. Finally, as the participants created timelines of science experiences in the life history interview, and captured and narrated various photographs of science, they were involved in the research process as checkers to respond to the validity of the data I recorded as I began to construct the portrait. Inviting the participants to member check the I-Poems and other data enhanced the credibility of the study, honored the shared stories of the participants lived science histories and demonstrated the importance of their histories as rich, compelling data.

This chapter began by detailing appropriate research methodologies for this research study and justified the selection of portraiture as the most appropriate methodology for the execution of this study. After describing the context of the study, the qualitative data collection methods were detailed followed by an explanation of voice-centered analysis. Finally, the chapter concluded by addressing issues of trustworthiness and limitations of the study.

The following I Poem is my own. I present it as a way to share my own lived science experiences in an effort to illuminate how I read data shared by participants in this study. The portraitist's identity and experiences shape the contours of the portrait as Lawrence-Lightfoot asserted "the identity, character and history of the researcher are obviously critical to the manner of listening, selecting, interpreting and composing the story…portraiture admits the central and

creative role of the *self* of the portraitist. (Lawrence-Lightfoot, 2001, p.13). As a Black woman who as a young Black girl wrestled with the construction and performance of my own science engagement, I welcomed the chance to revisit those memories as I considered how I became the elementary science educator and education researcher I am today.

Researcher's I-Poem

I remember being an inquisitive one.
I was a voracious reader, overjoyed with family trips to the public library.

My first science memory is a 2nd grade science fair project
I remember the white and muted green ribbon that was kept for many years after.
my science experiment showed the effects of smoking on the lungs/breath of a smoker.
One of my mother's co-workers was a smoker
we got her to breathe into coffee filters after smoking.
I saw the coffee filters yellow in comparison to the filters from the nonsmoker.

In elementary I read a book about dinosaurs
I questioned my parents about where the dinosaurs fit in the Creation Story.
Raised as devout Seventh Day Adventists, I learned the Earth was only 6,000 years old
I couldn't remember the Bible mentioning dinosaurs.
I'm not sure of the exact answer,
I think I was told the dinosaurs were the only animals lost in the flood…

My mother was a nurse
my female cousin who lived next door was in school to become a doctor
I told them I wanted to be a doctor.
I think initially I wanted to be a neurosurgeon,
I shifted to pediatrician
I remember marveling at the allure of the white coat and profound intelligence that a doctor must hold,
like my pediatrician, Dr. Sherrill.

I remembering Ms. Miller, a tall, thin Black woman who was the middle school science teacher
I remember our room being a science lab with long black science lab tables and cabinets lining the walls to contain science instruments.
I do not remember ever doing science.
Ms. Miller was authoritative woman with a warm personality;
I remember her being well liked by my classmates
I associate her teaching with lectures and bookwork, not conducting science experiments…

High school was a "science intensive" time for me
Freshman year I met Mrs. Kirk, a small, spunky White woman who commanded the attention of her students and made science engaging.
Biology freshman year was a combination of bookwork, lectures but also fun activities like creating an animal cell cake, learning about genetics and Pundit squares.
I excelled in Biology
I met chemistry and Mr. S my sophomore year
my love for science waned.
I remember he was like your typical chemistry teacher.

A tall, White, older male with a comb over who worn short sleeved button up shirts with a pocket protector under his white lab coat.
His lectures were painful, delivered by a monotonous voice.
My two prevailing thoughts about his course were being unable to memorize every detail of the periodic table (and my grade suffering from it…)
and my unnecessary fear of lighting a Bunsen burner (too many horror movies…).

Junior year I took Human Anatomy and Physiology with Mrs. Kirk again
I really enjoyed the passion with which she presented the information. .
I realized that I was the only Black body in this classroom.
I remember feeling out of place
I enrolled in another class with Mrs. Kirk, Advanced Placement (AP) Biology.
I liked the material,
I admit it was challenging,
I remember wanting to be successful.
I felt a rush when we talked about Frankenfood, learning about genetically modified organisms (GMOs) for the first time.
I felt important when we went to the local university to use high tech machinery to separate mixtures.
I felt confused when we did a lab with carbon dating
I went home and shared what we were learning to be told to "memorize the information for the test but know that's not what we believe".
I appreciated dissection more than surgery
I choose to abandon my medical school dreams and desire to become a doctor.

I decided to become a Child Development major seeking certification to teach elementary
I noticed a lack of science being taught in elementary schools in which I spent my time.
This observation prompted me to write my senior thesis around the science teaching self-efficacy of elementary teachers investigating the factors that lessen their desire/drive to teach science.

As an elementary teacher, I observed many of the same issues around science instruction
As a kindergarten teacher I created a weekly science club for the 3rd-5th
I partnered with the Atlanta Audubon Society and created incorporating hands on, relatable science experiments
I changed schools,
I created a science club at that school as well,
I looped up with my fourth grade students as the science teacher for the whole 5th grade.

I established Science Friday,
a day when all students came to the gym for an in school science field trip by grade level and had the opportunity to engage in hands on science learning.
I wore a hot pink wig and neon tie dyed lab coat,
I had the opportunity to lead students through science experiments and
I challenged them to ask "Why?" and "How?"

I was dismayed that many teachers approached me offering statements like “How do you know all that science? I’m not a science person… I don’t do science.”
These comments brought me back to what I had observed as an undergraduate;
Black female teachers who did not have a strong self-efficacy towards teaching science in elementary grades.
I was discomforted, knowing
I, for the most part, had the same amount of teacher preparation to deliver science at the elementary level, as did my colleagues.
This propelled me to apply for doctoral research programs to further investigate the science teaching abilities of elementary teachers.

I inquired about pursuing a PhD in Science Education and was notified
I did not have the required number of science college credits to focus on science ed
I applied and enrolled in the Educational Theory and Practice program,
The courses I took through the Science Education department reminded me of the experiences in AP Biology
I was the only Black female voice in the classroom.
I represent a double minority by being both Black, female and appearing much younger than my classmates, my area of focus was elementary, the only elementary voice in a room of most high school science teacher and a few middle school teachers
I sought to validate my presence in this space.
I remember dropping the first science education course in which I had enrolled
I was intimidated by them being more science-y than me.
I remember looks of amusement when I introduced my elementary teaching background during the first class.

I enrolled in another Science Education course whose syllabus stated science curriculum across kindergarten through twelfth grade would be covered
I did find it intriguing however, that one of the middle school teachers bemoaned the fact that their students lacked adequate science preparation once they entered middle school, making his job much more difficult.
I continued to fight to insert myself into class discussions, speaking even when my voice shook about issues around science instruction regarding race, gender and class
I continued to delve deeper into the theoretical framework of Black feminist thought to understand how intersecting oppressions kept quality science instruction for students in regard to their race/class/gender.

I was fortunate to connect with the Education Program at my undergraduate institution
I proposed to conduct my dissertation research with the elementary certification majors
I started visiting and assisting with the elementary science methods course
I had hoped to start conducting my research during this time,
I would supply relevant explanations from my teaching experience to help explain what those concepts or pedagogical methods should look like for elementary students.
During the middle of the semester, the students went to department chair as well as the provost to bring me on as co-instructor to finish the semester.
I didn’t want the participants to focus solely on the issues surrounding the class,

I wanted them to be far enough removed so they could speak across all of their lived science experiences in totality.

I started conducting research.
I spoke with 8 brilliant aspiring elementary teachers but four participants stood out.
The portraits that follow explain how race, gender and class at times limited and expanded these elementary teacher candidates' access to rich science experiences and how this access shaped their identities as future teachers of elementary science.
I will present the portraits of Shonnie, Tiffany, Jackie and Josie exploring their individual lived science histories and how they interpret those histories to position themselves as teachers of elementary science.

CHAPTER 4 – Research Findings

The purpose of this qualitative study was to investigate the conflation of race and gender on the development of elementary science teaching identities of Black female elementary teacher candidates. The study investigated how formal and informal science experiences encouraged participants to develop weak or robust science identities and how the experiences in their teacher preparation program further shaped those identities.

I employed qualitative research methods to conduct this study to answer the following research questions:

1) What are the lived science experiences of Black females in an elementary certification program at an HBCU?

2) How do the science experiences of Black female teacher candidates shape their identity as teachers of elementary science?
   a) How do the kindergarten through 12th grade science experiences of Black female pre-service teachers impact their science identity?
   b) How do college science experiences of Black female pre-service teachers impact their identity formation as teachers of elementary science?

The research methods employed in this study consisted of life history interviews a method which allowed participants to construct a timeline focused on their lived science experiences during elementary, middle and high school. It also drew on experiences in the participants' college prerequisites and throughout their teacher preparation program. There were two focus group interviews conducted that served as a "sister circle" for the participants to share their successes and frustrations regarding their developing science teaching practice. Finally, the participants responded to Photovoice prompts, a qualitative method that allows participants to reflect on a prompt, capture a photographic image (photoelicitation) and written narrative explanation to respond to the prompt (photoelaboration).

Using the data collected from these qualitative research methods, I employed the "Voice-Centered Relational Method" or "Listening Guide" (Gilligan et al., 2003; McLean Taylor et al., 1996; Mikel Brown and Gilligan, 1992) to listen to the data shared by each participant. The method of "Voice-Centered Relational Methods" involves four separate readings of each interview transcript to listen closely and lift the participant's voice from the interview, thus deepening the understanding of a particular aspect. In the first reading of each transcript I listened to the broad story that was being portrayed, looking for a broad synopsis of the participant's responses. The first reading answered the question 'who is telling what story?' (Byrne et al., 2009: 69). The second reading answered a question around what story the participant telling was about the aspect being researched. From the second reading I-Poems were constructed, lifting each statement that starts with *I, me, us,* or *we* to clearly depict participant responses to prompts in relation to themselves. The researcher listened for how the participant positioned herself in the retelling of her life history. In the third reading I listened for how the participant explained her relationships with others and how those relationships impacted the aspect being researched. Finally, in the fourth reading I looked for specific contexts and structures that nurtured or constrained the participant to develop her sense of self in relation to the research focus (Brown & Gilliam, 1992).

Presentation of the Data

In this chapter I present four portraits; a detailed description of the lived science experiences of each of the four participants and the ways those experiences have impacted the development of their elementary science teaching identities. Following the participant portraits, I present the overarching themes that arose across the portraits recurring through each participant's retelling of her science history. These are themes that emerged continuously in

similar points of each participant's story. These themes impacted the participants' ability to develop relationships with their science teachers and see themselves as successful do-ers of science. This ultimately informed their ability to confidently view themselves as competent teachers of elementary science. While the portraits are presented separately, presentation of the overarching themes combine data from all participants to show the salience of each theme.

Table 4.1: Participants' Profiles

Participant	Age	Race	Hometown	Family Status	Highest Science Experience in in High School
Shonnie	21	Black	Newark, New Jersey	Single Parent Home	Chemistry 2
Tiffany	20	Black	Nashville, TN	Two Parent Home	Accelerated Medical Track (Finished HS in 3 Years)
Jackie	21	Black	Orange, NJ	Two Parent Home	Advanced Placement Physics
Josie	22	Black	Atlanta, GA	Single Parent Home, then Two Parent Home	Honors Biology

Shonnie's Portrait

"*I don't think there is a message that Black people can't do science, I think it's just that Black people can't do anything and no one can do science.*"

In Shonnie's family, school success was always the expectation. She was raised in New Jersey primarily by her mother along with an older brother. Shonnie described her mother instilling the need to be better and attain more than she did for herself. While not consistently pushed towards the sciences, Shonnie spoke often of summer programs at Carnegie Mellon University that were advertised by flyers sent to her school to attract girls into STEM fields. Throughout the interviews, Shonnie described a connection with the "doing of science" expressing positive ways she felt from being successful at science and how moments of lecture or note taking shook her "science self". While she expressed nervousness about the future, she was clear about her desire to become a teacher and what she expected from herself and her future students. Shonnie shared,

I would definitely have a lot of experiments that will be fun but make sure they know why. Making them know why that experiment is relevant, but asking them too. That's one of the things I liked about middle school. I feel like in elementary school that's what you can do for your students too. Would this be more interesting or would that be more interesting? Paying attention to after the lesson, being reflective in that moment and afterwards.

Did my students get this or did they not? Did they like the video I showed them, do they like the songs we sing or do they like it better when we are creating something? Do they like it when something goes home or when something stays here? Just asking yourself those questions that no one considers.

During her participation in this research, Shonnie engaged critically, interrogating the ways race and gender impacted her access to science instruction. This portraiture is constructed from her words and chosen images and illustrates a tenuous relationship with science. Regardless of her prior experiences, she is dedicated to becoming a teacher who provides quality science instruction to her future students. First her portrait will highlight key experiences in the elementary years, then show the tensions that arose in science during middle, high and college years. Finally, the portrait depicts Shonnie during student teaching experience, where she synthesized her lived science experiences. She interweaves these experiences with her ideas of schooling needs of Black children as she continues to develop her elementary science teaching identity.

With an engaging and vocal personality enhanced by quick wit, Shonnie was often the leader of her cohort. She was serious about teaching. She often served as a liaison between instructors and other students to give a relevant teaching example. She had already signed a contract and secured a teaching position before starting her last year of college. This feat was indicative of her laser focus and passion for education. Her life history interview lasted the longest out of all the participants with me finally concluding it at two hours although we could have easily dialogued for much longer.

Science in Elementary School

When asked to reflect on science messages from home Shonnie paused, then shared that her home life had a large impact on her performance in school. Her mother expected her to perform well and encouraged her to think about pursuing a career in the sciences.

> I think my mom was pretty supportive of me
> She was a little disappointed because I didn't do something science related
> I got older and she tried to steer me back towards it but that made me not want to do it more

Elementary memories of science were fond ones, centering Shonnie as a "doer" of science rather than a passive learner. For her, elementary science was fun, engaging, exciting and strengthened the idea that science was important and a part of her everyday life. After focusing on science in her elementary years, she voluntarily stated that that stage was vastly different than science learning in other stages of her life.

> When I didn't understand stuff and then I did the experiment, I would understand it better
> I don't remember anything negative
> I think the message we got was like science is everywhere
> I liked that
> I can remember in second grade we were doing worms, we grew them and had to feed them
> I think as I got older things were different than in elementary school

Shonnie's most colorful description of science in her early life centered on a calendar project she was assigned for that school year. Her teacher would give the students a calendar with multiple options of projects to investigate at home related the current science content they were learning and then present their findings in class. Shonnie explained how choice, variety and the public aspect of doing science made her feel confident and connected to science. Her face broke out with a huge smile as she remembered the pride she felt carrying her science projects to class.

> I remember making one of our calendars
> I chose a date to do the experiment in front of the class
> I did whatever graph it was for that month
> I thought graphs were cool
> I remember this one time it was ice cream
> I called however many people I had to ask
> I had like fifteen people
> I colored each box for their data
> I think in elementary, every time I got up to do a presentation I felt like someone special
> Even if I was doing the same presentation that the three people before me did, I still felt like someone special
> I walked in with projects
> I feel like that added to the confidence that I had as a person

The photograph Shonnie submitted to explain her thoughts around science in elementary school shows her enjoyment of the major theme science in her elementary years. Her picture and explanation shows that quality science instruction was about choice, options and individuality.

"My shoe collection reminds me of science in elementary school, because it is reminiscent of the choices and options that we had. Each option would elevate knowledge and they were all similar, but the options were different and allowed for individuality."

Science in Shonnie's elementary years allowed her to begin to develop a strong science identity. Engaging teachers, choice in activities and the doing of science impacted her enjoyment and achievement in this subject.

Science in Middle and High School

Shonnie's science experiences in elementary school were vastly different than her science schooling experiences in middle school. The tone of the interview took a sharp turn and Shonnie's demeanor physically changed, shoulders slumped, and head lowered reflecting a sort of helplessness replacing the excited energy that had just filled the room. She described feeling disconnected and unaffected by her science courses. Gone were the feelings of pride and connectedness. At this point she remembers relationships with her teachers that impacted her science learning and how the dispositions of her teachers impacted her engagement with science content.

It wasn't the worst experience
I wasn't sad or angry but I wasn't happy anymore
I was just there
I don't remember 8th grade
I can't even tell you if I had science in 8th grade

Many obstacles outside of Shonnie's control impacted the science instruction she received. She recalled 7th grade when she had 5 teachers within that one year, an experience which obviously hugely impacted the quality and depth of instruction that could be delivered with such transience of teachers. Shonnie connected the transience of teachers to having to learn science through bookwork rather than hands-on activities.

I don't know what was going on with the teacher retention rate in 7th grade
I had 5 science teachers within one year
First day we got there we did an experiment
After that we kept doing bookwork

Science in middle school was not motivating for Shonnie. She reflected on the way her science teacher grouped students heterogeneously and used her to tutor other students who weren't as strong in science. Rather than selecting higher level assignments for Shonnie, her teacher used her to tutor students after she completed the basic class assignments.

I knew it then but he put all the kids who didn't know science in my group
I know he was doing it so I could help them but there was no one in the group to push me
I was just bored and teaching them
But now I don't like that; I feel like I could have learned so much more

Shonnie tried to interrogate why her teacher put her in the group with struggling learners, expecting her to tutor her classmates without providing any support to engage Shonnie on an academically gifted level. She realized her teacher was aware of the differentiated needs of learners and she was aware that she deserved to be challenged but Shonnie quickly moved to excusing the teacher's actions and labeling that experience as something that helped her develop her teaching/tutoring skills.

"The sink reminds me of science in middle school because science was most enjoyable when we needed to wash our hands afterwards."

When Shonnie described her high school science experiences, similar themes arose around the way her science learning was impacted by her interactions with teachers. Specifically noting teacher-centered teaching practices such as lecturing and bookwork or the lack of respect from another teacher, Shonnie shared important factors that impacted her engagement with science in high school.

> When I got to 9th grade, even though all of this stuff happened, I was still really excited about it.
> But biology ruined it.
> I didn't like biology at all
> My teacher lectured a lot
> I think that was part of my issue cause science is really like
> I don't get anything from lectures
> If it's in the book, I'm fine
> I can read it in the book and copy it
> When people talk to me, I don't understand it as well as when I see it.

Shonnie had the desire to do science, to learn science through inquiry and exploration and disconnected when her teacher relied on lectures to disseminate the science content. While Shonnie had thrived with teachers who provided opportunities for her to learn through hands on inquiry engagement, her achievement and engagement suffered with teachers who provided higher-level content through only lecture.

Additionally, Shonnie acknowledged that her engagement in science was impacted by her relationships with teachers. She recalled interactions with her 9th grade science teacher who didn't bother to learn the names of the Black female students in his class.

> The 9th grade teacher wasn't really respectful
> All the Black girls had the same name
> We were all Ra'chel to him

Shonnie described the feeling of disrespect she experienced from a teacher who refused to learn her name. She expressed frustration that her teacher knew the name of only one Black girl in the class, the student with the lightest skin, and referred to all the other Black girls by that name. Shonnie's experience aligns to research which explains the difficulty Black girls face in schools where teachers interact through stereotypic and deficit views (Brown, 2011; Francis, 2012; Morris, 2007; Nychae, 2016). Through the retelling of that experience, it was obvious that Shonnie desired a more respectful interaction with that teacher, closer to the personalized attention she received in previous grades which helped affirm her intelligence and engagement.

> He wasn't interested in me and I wasn't interested in his class
> There was no reason to sit and talk to him after class about what I wasn't understanding
> He wasn't interested in me and I wasn't interested in his class because he wasn't going to remember the conversation and if he does remember what we talked about he would think that it was Ra'chel who talked to him so why am I going to meet with him?
> I don't know but his persona all that was him, made me not care about biology and what we were learning was boring…

Shonnie described her relationship with science as fluid. Rather than being shut down by negative experiences in science classes in previous years, she was able to re-engage with the content at later times. She mentioned times where she interacted with science at extremes, really loving science sometimes and at other times experiencing frustration which led to feelings of stress and failure.

> I loved chemistry
> I liked it a lot

I memorized it on my own
My chemistry teacher was part of the reason I took Chem 2
Cause I loved it the first time and he was supposed to be teaching it the 2nd time
I don't think that there was anything that I really disliked about chemistry

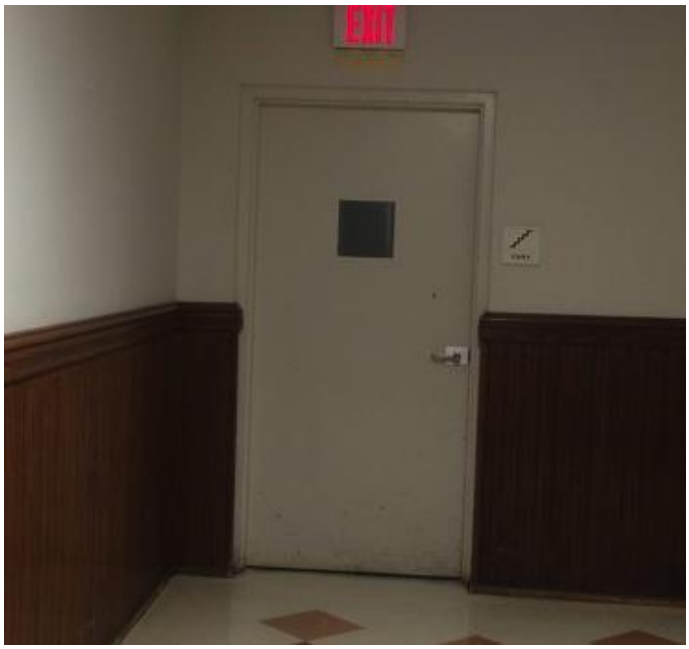
Even when presented with difficult science content, Shonnie's interest and engagement persisted when she felt acknowledged and supported by her teacher.

I liked the science teacher that taught it, he wanted me to take Physics 2
I should have just taken it with him; he made it make sense
If I got to school early, he would sit with me and talk to me
If I wanted to stay late, he would stay late and work with me
I liked that about him
I know he gave us a list of like 12 projects
I worked with a group, with like 3 other guys,
We made a rap
We performed a rap song in front of our class
It was so much fun
He recorded it and it was just a lot of fun.
I like that because experiments had always been fun

Moving into the next remembered science moment, once again Shonnie's science engagement took a sharp turn and her recollections linked this disengagement to the disposition of her teacher. (Lu, Chen, Hong & Yore, 2016) suggest the importance of positive relationships with science teachers and students and identify a correlation between positive teacher-student relationships and science achievement. Through the details Shonnie shared during her interview, it is evident her interactions with her science teachers impacted her science achievement. Although Shonnie remembered being excited about Chem 2, when the instructor changed and she no longer had her original chemistry teacher, her engagement in class was affected.

Then Chem 2, it was a disappointment
I was looking forward to Chem 2
It was probably the happiest I had been for a class in a really long time
I loved the concepts
I was disappointed when I found out the instructor was changed
I thought it would be my chemistry teacher but it wasn't
I didn't so much like him because he talked to us like we were frustrating him

I know that could be frustrating as a teacher, but that doesn't mean that you don't teach us…



"*The door and exit sign are artifacts that remind me of science in high school because I spent the majority of the time watching the clock wanting to leave the classroom."*

Shonnie's photograph and explanation of science in high school showed disengagement and frustration. At a level when the "doing" of science is usually highest in K-12 schooling with dedicated science class times and laboratory spaces, Shonnie seemed to have less science involvement. The "messiness" of science that she enjoyed in previous years seemed to be absent for the majority of her high school years.

Science during College

Similar to the varied interactions Shonnie remembered from kindergarten to twelfth grade, her college experiences followed the same themes of desiring to engage deeply with science but experiencing interactions hampered by professors due to teacher-centered teaching styles or lack of choice.

I didn't like science in college at all
I didn't like environmental science
I did not have a choice with what science I wanted to choose.

I guess they don't feel people learn environmental science in school and you need it for the GACE, so they make you take it
I don't like that
I didn't like that I didn't have a choice because environmental science wasn't something I would have chosen
One thing I appreciate about college is that you make your own schedule
I would have chosen a chemistry class
I love chemistry

Shonnie related her frustrations around her inability to choose a college science course back to her memories of choice in elementary school. Earlier in the portrait she expressed pride in being able to choose which science activities to complete and how this increased her engagement in the tasks. She experienced frustration with being required to take environmental science for the elementary certification course. She questioned how this one type of science helped prepare her to be a teacher of elementary science content. It is also notable that she reported that she would have chosen chemistry, acknowledging that was the course she preferred regardless of her negative memories of Chem 2 but did not connect her enjoyment of chemistry in regard to her elementary science teaching development.

When asked to think about the elementary science methods course she took once in the major Shonnie reported:

Then we started doing EDU330.
That class was horrible.
She didn't teach us on our level.
She didn't teach us on the level we would be teaching didn't prepare us for the grade levels we would be teaching.
She didn't see where we were in order to know what to teach ...even the stuff we were learning.
She didn't assess us before hand to see how much knowledge we have or had of what she was teaching before she started teaching something.
I don't know what they told her when they gave her the class because that was her first time teaching it too.
Especially with science, because science is one of those things that you don't get to in your placements
so it's like you miss that a lot if it's not in the methods class.

As Shonnie recalled the required Elementary Math and Science Methods course, her memories towards the first instructor reflected a sense of frustration at not receiving age appropriate or culturally relevant teaching strategies for teaching elementary science. However, when I took over instruction of the course towards the end of the semester, our in class activities activated pleasant memories from her elementary experience.

> I liked the idea of having something to show for your lesson, like something the students could take home or take home not like a worksheet.
> I got to touch them,
> I got to feel them,
> when I brought in my science projects,
> all that made me feel good about science, you know?

Persisting as a teacher of elementary science in spite of…

Shonnie expressed several times throughout our interactions that she did not feel adequately prepared to teach elementary science although expressing high confidence in becoming an elementary teacher. She questioned the organization of the certification program in regard to required courses to support her science teaching as well as frustration about the lack of science instruction she was able to observe during her field experience placements.

Specific to teacher education in both the elementary science course and field experience previously completed, Shonnie constantly received messages indicating that science is not prioritized at the schools were she was placed nor with the students those schools served. There were constant expressions of frustration especially around the field experience sites where she was not able to observe science teaching in action. While Shonnie did not interrogate the science methods instructor's lack of support, Shonnie continuously spoke of the lack of dedication to science instruction by the elementary teachers she observed. The photographs she submitted were critical of the current level of science instruction observed while acknowledging that much more could be done to support science learning of elementary students.

Shonnie shared this memory of observing science instruction;

> She gave them a piece of paper and a book.
> They copied the diagram and then there were supplemental worksheets where they wrote the lifecycle.
> That's it.
> They weren't doing anything fun.
> The one day she gave them construction paper and cut out the arrows for them to create the life cycle, which could have been cute, but she did it because her bulletin boards were due and she needed something to put on the boards.
> Not because they would have fun doing it.
> And some of them put it on incorrectly and she would just tear it up like you don't get to make one.
> She has 25 students; the board can only hold 9 or 10 so she doesn't need them all.
> They can just sit there and copy out of the book.
> But when you sit there and look at how happy they were that day, why wouldn't you want to do stuff like that all the time?
> That was like the only science lesson I saw.

Specific to her next placement, Shonnie raised questions around certification levels of elementary teachers and alternative scheduling to support science instruction:

> They are departmentalized which I don't particularly like
> the other two teachers don't know anything about science.
> So it works really well because they actually have someone who teaches science and knows about it.
> He's Biochem, he has a Masters, it may be in education but his Bachelors is in Biochem.
> We should start looking at the way that we, the way you get your certification.
> I think that that's something to look into because
> I think that's beneficial.
> He's not the best science teacher,
> he wants to do a lot of lecturing which is fine at some point students need to know how to take notes, listen to a lecture
> but that's not elementary school but he does that in every class.
> That wasn't the best thing but
> he just needs someone to tell him how to be a teacher.
> His Masters is in general education but not elementary education.
> He needs someone to teach him how to be an elementary school teacher but if they worked as a team, that would happen.

She acknowledged an appreciation for the science content knowledge the teacher held by having a earned advanced degree in science, but realized that his instructional strategies did not support elementary learning of science. Shonnie turned a critical eye toward the tenuous

relationship between acquiring developmentally appropriate teaching skills for young learners and obtaining a deep level of science knowledge that would support elementary science teaching and learning.

"Science teaching to me is a completed PowerPoint without anyone to share it with. The teacher has lessons prepared, usually lecture based, but never gets around to teaching the students before the day is out."

Shonnie saw the value in departmentalization as it made time for science instruction on a more consistent schedule rather than it being something that teachers rushed to fit in at the end of the day. Her critical photographs and explanations showed that science is often for display rather that a real invitation to the messiness and wonderment that could engage young learners of science.

"Often times science teaching is done only for the benefit of the bookshelf. The science materials sit on the shelf waiting to be utilized, but instead it just becomes a storage space for everything unwanted."

"The things that hamper my teaching of science are old, worn, and inadequate tools and supplies."

When questioned about what she would do to make science learning engaging for her students, Shonnie shared thoughts around student choice to guide the lesson and teacher reflection to evaluate the effectiveness of instructional strategies.

> I would definitely have a lot of experiments that will be fun but making sure they know why.
> Making them know why that experiment is relevant, but asking them too.
> I feel like in elementary school that's what you can do for your students too.
> Would this be more interesting or would that be more interesting?
> Paying attention to after the lesson, being reflective in that moment and afterwards. Did my students get this or did they not?
> Did they like the video I showed them, do they like the songs we sing or do they like it better when we are creating something?
> Do they like it when something goes home or when something stays here?
> Just asking yourself those questions that no one considers.

"A clock could help facilitate the teaching of science because if teachers are more conscious of time science won't be the "class we never get to." Also, we need to value the complete education of our students as much as we value our time."

Finally, when asked what advice she would give to the elementary teacher with whom she was currently placed for student teaching, she immediately gave four thoughtful responses around responsiveness, ingenuity and vulnerability as a teacher of elementary science.

> I would tell her to remember that even if you teach and no one walks away knowing something they didn't know when they walked into the room then you haven't taught anything.
> I would tell her that and suggest to her that she thinks of ways to be innovative so that they are walking away with new knowledge.
> I would suggest to her that it's not always bad to talk to your students.
> That like, it's ok to stand in front of the children.
> Think of ways to give them information without making it a college level course or a middle school course where it's a lecture but it's ok to talk in front of them.
> I would suggest to them,
> I would suggest that she remember that there are different types of learners that talking is not always going to work, letting them read is not always going to work.
> It's ok to reach the visual learners, the auditory learners,
> It's ok to just reach the kinesetic learners and all of them can learn.
> She needs to look at differentiation in a different way because three different worksheets isn't differentiation.

Taken all together, Shonnie's portrait depicts a pre-service elementary teacher dedicated to the holistic learning of her future students. She acknowledged that teaching elementary science is daunting but acknowledged a personal mission to expose her future students to all subjects in order to ensure their academic success.

Tiffany's Portrait

"I had great science experiences until here. I wish that's what they could see. I loved science all my life and it's not like I hate science but it's difficult me teaching because I don't know fully how to teach it."

My first interaction with Tiffany was an interesting one. When I entered the classroom, her table immediately began to whisper and she asked me who I was. I politely told her I would be introduced by the chair of the department when class started and she responded with a "Humph!" Once I was introduced as a graduate of the department, their Spelman sister and a current doctoral student, her face broke out into a huge smile as she said, "Alright Sister! Yasssss!" Tiffany was a joyful and sometimes loud student, another one of the leaders in the group and close to Shonnie. They both sat towards the front of the class with a quick tongue and sharp eye showing their excitement or disapproval of the professor.

Tiffany found herself as an elementary education major after trying on multiple majors. She was quick to explain her trajectory at Spelman and often seemed defensive of the change in her future aspirations. Although she had received a seemingly strong K-12 science foundation her portraiture depicts a student whose science confidence had been rocked to the core and negatively impacted her faith in her ability to teach science at the elementary level.

Science in Elementary Years

Tiffany was immersed in the doing of science far before entering elementary school. Her vivid memories of her relationship to science through family members and loved ones were recollected in a proud and matter of fact way, showing that it had always been thought of as natural progression for her to persist in science and eventually become a doctor.

> My momma works for Meharry Medical College as the medical program coordinator Sometimes I would learn a script and be a character for the students to come in and learn how to deal with visiting patients.
> My godmother was the Associate Dean of Medicine at Meharry,

She was also a physician
I really wanted to be like her
They all instilled in me to be as smart as you can
Once I got into school I really started excelling in math and science
With them knowing that I wanted to be doctor; there was a push for me to learn more science.

Tiffany recalled openness with science around her home and an almost constant engagement with science as a way of understanding the world. Interestingly, despite very positive early science memories, Tiffany did not recall many science memories in school during her elementary years.

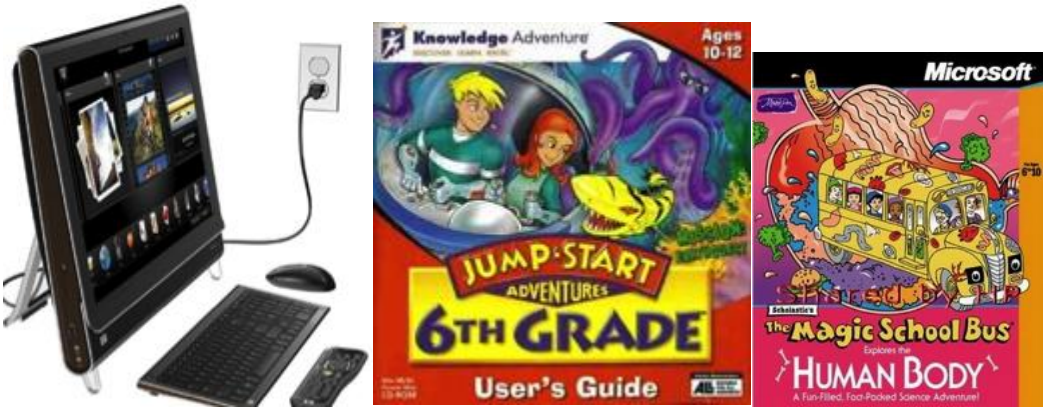
It is really hard thinking of science inside of school
I don't remember science
We didn't really do a lot of stuff for science, even in fifth grade when we were departmentalized
My fifth grade homeroom teacher was the science teacher
She was really sweet, but still wasn't hands on

I don't remember science
I thought that was interesting because science is a hands-on thing
The word I would use for science in elementary school is null and void
I barely remember it.
I really got most of my science experiences from outside of elementary school.

Tiffany's family's relationship to science isn't necessarily a normal thing for Black families. As Tiffany's mother and godmother were employed at Meharry Medical College, a historically Black medical college, here Tiffany saw Black students thriving in science. These images of successful Black future doctors laid a foundation for Tiffany's confidence to do well in science and aspire to become a doctor. Here, Tiffany was able to come in close contact with successful scientists that looked like her and due to her mother and god mother's occupations Tiffany was able to participate in this science community at an early age.

Another salient aspect of Tiffany's family life was the socio-economic status of her family. She was raised in a two-parent, two-income home and even though she remembered her

father's early work as a sanitation truck driver, she expressed her young memories of his job in scientific terms, remembering being fascinated by the gears of the truck, the large wheels and the various components of the trash compactor at the dump site.



What artifacts do you have at home that remind you of doing science before college?
When I was younger, I had a variety of academic games for the computer. The internet was also my main resource for finding more information on a related topic.

Due in large part to Tiffany's access to a community of Black scientists and the jobs of her mother and godmother, Tiffany's elementary years formed a very solid foundation for her science identity. While most children receive the bulk of their science experiences at school, this was not the case for Tiffany as this out of school science community connection cemented her interest in science in a way that was not most common for many elementary aged students. Transitioning to middle school and high school continued the formal science disconnect with Tiffany.

Science in Middle School

Tiffany had minimal memories of science in middle school. This was the shortest section we discussed during her life history interview. While her voice was previously upbeat describing her enjoyment of science albeit informally or out of school, her tone dropped in a matter of fact manner when trying to recall memories of science in middle school. I found it interesting that

while there is a block devoted to science instruction in middle school, most of her memories of science were somewhat nonexistent or at least not tied to general science content. Her memories were tied to out of the classroom experiences and field trips rather than discussing middle school science content or assignments.

> So in 6th through 8th there were more activities, actual science lab classes
> 8th grade we got a lot of busy work because she had a baby
> When she came back we had some experiments.
> I do remember field trips in the 6th grade
> We went to Rock City
> That helped me appreciate nature and we went to see Ruby Falls
> 7th and 8th grade we had vocational classes
> I chose teen living and we did a lot of food science

When I prompted her to focus on her science classes and science teachers she shared,

Science? she barely cared for me in the classroom
It would be Tiffany, stop talking

Tiffany spent a great deal of time discussing her relationship with the 8th grade science teacher, who was also her dance coach. She remembered run-ins with the teacher over her attitude and she expressed frustrations that the teacher let that impact her work with Tiffany in the class. Tiffany stated that she felt like the teacher chose not to teach her because of these issues around their relationship and her attitude. This memory reminded me of Shonnie's frustrations with some of her teachers and other bodies of research on Black girls in education.

> I would try to talk to the Black lady that was the teacher in the other part of the school
> She barely wanted to talk to me.
> I thought Black people stayed together, especially in a small area like Smyrna…

Tiffany's confidence in science should have been read as a positive attribute; instead, it became a marker that positioned her as somewhat combative, challenging the teacher's science knowledge and being loud, visible and disruptive.

> I was confident, I thought I knew a lot.
> I would be telling people, kids on the playground certain stuff they didn't know…

In middle school, they didn't engage me
My 7th grade teacher would say one thing, tell the wrong reason
I would tell the right one.
Maybe it's not that she told the wrong thing, but she wouldn't go in depth
So if I'm at a group table, I would say it a way for them to get it.
She would be mad that I'm talking but these four can now get it right on the test and give a really good explanation.

Tiffany's experiences with her science teachers are reminiscent of the literature on the construction of "those loud Black girls" who use their voices and their bodies as a way to engage in learning. However, because their participation in class may not look like traditionally acceptable gendered participation norms, their efforts are viewed as acts of defiance and disruption (Fordham, 1993; Kynard, 2010; Lei, 2003; Richardson, 2009).

In middle school I said self-initiated because she didn't really care for me
I had to learn all this stuff on my own.

Science in High School

Although Tiffany experienced some struggles in middle school with science she entered high school intent on going to college and medical school and eventually becoming a doctor. She spoke with authority about the classes she chose to keep her on that trajectory specifically describing the medical/health science track that was offered at her school. Tiffany's high school science memories were much more positive than elementary and middle, as she was able to deeply study an area of interest for her. Similar to the memories Shonnie shared, Tiffany did not enjoy science classes dominated by lectures but lit up when describing hands on lab activities.

My track was the medical track so I took health science the 2nd year
My last year of high school I did med fair/ clinicals where you were able to go into the local hospital
You leave school, go to the hospital
One week you may be with surgery, one week you may be with OB
Until you visit everything in the hospital.

It was engaging as far as science
Although the teachers were weird, they had wonderful activities, wonderful labs

The biology teacher wanted to go to medical school so he taught us from a bunch of lectures and slides; it was horrible.

What is science teaching? *Science teaching is actively engaging your students in the discovery of how living and nonliving things operate. Science teaching should be topic specific and grade level appropriate.*

In high school, school was exciting
I was excited about learning science on the medical track
It was life changing because
It helped me hone in on wanting to major in chemistry
when I got to college and continue to want to be a doctor.

During the interview, Tiffany described science during high school in such a detailed manner that I did not realize that she chose to finish high school a year early until later in the interview. Illustrating her drive and educational fortitude, Tiffany explained that she chose to take night classes at a local community college so she could finish school in three years and get started with college and her medical career.

Although Tiffany had a deep interest in science and several positive experiences engaging formally and informally with science, her transition to college and her pursuit of an undergraduate degree in science was not seamless.

Science in College

Tiffany enrolled in college with many more positive science experience than any of the other study participants. From her early experiences at a historically Black medical college, to the relationship with her mother and godmother and a health sciences focused high school track,

Tiffany seemed poised for success in college science. She enrolled in college as a Chemistry major and explained how difficult the first semester was for her.

> First year in college was general chemistry
> I came in a chemistry major.
> It was just horrible.
> I was just failing.
> I ended up withdrawing.
> I didn't end up withdrawing, I just got a D.
> I didn't continue on this track.
> I just got very discouraged
> I failed general chemistry
> I could have spent more time working on it and studying, things like that
> I didn't.
> The professor was going through a lot.
> She had a newborn baby and other young children,
> I think she was going through a divorce
> She never really was here but when she was, her teaching style was different.
> I didn't pass the tests in the class
> But then my godmother, the physician, passed away before Thanksgiving
> So that's another reason why wasn't focused because I was emotional about that.
> She's the person I looked up to for everything.
> She was the person I really wanted to be so I didn't have the drive behind me.

Listening to Tiffany's voice, you could hear multiple emotions. As she remembered her early college science courses, her voice was tinged with disappointment, embarrassment and frustration. She admitted that she should have studied harder or taken advantage of the tutorial resources available through the department. She explained that she was somewhat embarrassed that she had been so successful in science previously and now was unable to pass the first course of the major. The way she discussed the loss of her godmother showed that once that connection was lost, she felt unable to persist in a subject and future career that now seemed so daunting. After changing from a chemistry major to a biology major and an unsuccessful period as a psychology major, Tiffany applied to the education department as an early childhood education major. Surprisingly, even with an easier science course Tiffany still struggled in environmental science, the science requirement for the early childhood education major.

I was placed in fifth grade last fall it was excellent.
She was a science teacher.
Now she is the science lead, science lab instructor…
I was able to really do well in that fifth grade placement
She was like, what do you know how to do? What do you want to learn?
We had the type of relationship where I would just jump in or
We would just talk about it.
I was able to do fun activities for my observations.
The kids were really excited about science
She had a lot of cool experiments.
There was a boy in there
I took him under my wing.
On a whole the students were excited about the learning science.

These struggles persisted even into her student teaching practicum reified by her underdevelopment in the elementary science methods course and the lack of quality elementary science instruction observed during student teaching. Once again, listening to Tiffany's voice you hear multiple emotions: frustration at not being adequately prepared to deliver quality science instruction, mild disgust in the way her cooperating teacher delivered science instruction and a desire to teach better science to her students in student teaching.

For my student teaching, science is null and void.
I wasn't excited about the math and science methods class
There was that language barrier…
I expected to learn content and methods for math and science.
I have enough prior knowledge and experience with math
I can teach math all day long
Science, I didn't know like that
I still kinda don't…

What things facilitate your teaching of science? *Technology along with experiments/activities facilitate my teaching of science. I use various websites that have science videos and grade specific worksheets.*

My cooperating teacher doesn't help
This is probably something I should not take from her but she has them read aloud
I also would have wanted to have activities
I now try to incorporate activities
I feel like it's a lot of just writing
I don't know if they don't have funding as a school to get stuff for science.
I think that if they had more materials that could be seen that could be hands on activities, they would be excited

What things hamper your teaching of science? *I believe lack of funding and lesson diversity hamper me from teaching science. There are not many schools that have a budget specified for science experiment materials. Also, I believe having diverse lessons would also better my student teaching and will make the students more actively engaged.*

My class right now is active
I think if they had more materials that could be seen and used, they would be excited and want to do science.
It's just at that at student teaching,
it's bad science

Like Shonnie, Tiffany's interview ran close to the two-hour limit. She expressed appreciation to be able to think about science across her life and consider how those experiences shaped her as a teacher of science. Wrapping up the interview, Tiffany shared her thoughts on what it would take to become a better teacher of science by incorporating inquiry, technology and representations of scientists.

To be a better teacher of elementary science,
I want to have a lot of hands on activities
It could be the iPad, the computer, movies, maybe career chats
Like people in science coming to talk about it.

During the interview Tiffany alluded to race many times when talking about the students which she took classes with or the racial makeup of the schools in which she completed her field

experience and student teaching. I asked her directly about her thoughts about the specific needs of Black children learning science and she stated:

> I'm not going to say they are just made for Black children to fail but
> low SES and middle class type of Black children are not seeing science like I wish they would.
> I had great science experiences until here
> I wish that's what they could see

We ended the interview with a chilling statement from a teacher candidate who had previously been so deeply immersed in science. Tiffany's portrait ends totally different than it started; the lover of science and learning scared and unable to share her passion with others.

> I loved science all my life and
> it's not like I hate science
> but it's difficult me teaching because
> I don't know fully how to teach it.

Jackie's Portrait

"*All of my science teachers in high school looked like typical scientists. They were older White men, they all had white hair, Mr. B was actually bald, and they wore like button ups, typically short sleeved."*

Jackie, was quiet and had a pleasant, yet self-assured demeanor. She has warm eyes and a bright smile fitting for an elementary school teacher. She spoke calmly and intentionally, with an eagerness to share what she knew about teaching. Like Shonnie, she had secured a teaching position with a charter school during the summer of her junior year, so her experience with teaching and ease of instructional strategies was somewhat more advanced than her classmates. She was very engaged during the interview sharing her thoughts in a confident manner. With a strong family background, she spoke of her parents supporting her educational endeavors at an early age.

Science in the Elementary Years

When asked to remember science in her early years, Jackie quickly explained multiple conversations she and her parents had about science in their everyday lives.

> I don't think they ever were like "go into the field of science" or "make sure you study your science"
> I got older; science wasn't such a push as my dad was thinking about careers, what I wanted to do
> I actually did not want to be a doctor because
> I did not want to go
> I did not want to take all those science classes.
>
> I might notice that these clouds are black or they are much more fluffy today and then my dad would be like, yeah there are different types of clouds
> I do remember my parents taking me to Liberty Science Center when I was younger
> I had so much fun when I was younger
> I feel like I still would have a lot of fun if I went there today.

Jackie explained that her parents were married and financially, they lived a comfortable life. She spoke of her father working in wealth management, her mother and aunts previously

attending Spelman and other details about being raised in a Black middle class lifestyle. When asked about science around her home Jackie shared that her mother loved plants so she grew up watching her mother care for plants while Jackie tended to her pet beta fish.

Regarding formal science instruction, Jackie listed several science concepts she learned in elementary school but emphatically remarked that none of her teachers stood out as teaching science well.

> I remember a lot of times we talked about plants and the plant cycle
> I remember light experiments we used to do
> I just remember that
> I thought it was so cool
> I can think of the experiment and which class I was in when I did the experiment
> I don't remember any one for being amazing in the field of science

When asked to describe science in elementary school she labeled it:

> Generic.
> Nothing was too exciting,
> I feel like the experiments that we did were things that most people do.
> We didn't need lots of resources for them.
> They didn't go like above or beyond.
> One thing that I do remember
> we made the solar system in my 3rd grade class only
> we got to put on a play and we were the Solar System.

Jackie's memories of science instruction in elementary school were similar to Tiffany's as they both struggled to recount significant or memorable instances of science learning. Like Shonnie, they both attached memories of science to 'doing science' or inquiry science learning but like Tiffany, Jackie did not express excitement around the science she did in elementary school. The science instruction she remembered was generic, not able to spark her interest in the subject matter. Where Shonnie recalled memories of engaging elementary formal science learning and Tiffany recalled personal connections with science learning through informal, non-

school instruction, Jackie did not report engaging in science learning in either formal or informal science instruction.

What artifacts do you have at home that remind you of doing science before college? *This is a box of relaxer used on coarse hair to make it straight. I have been getting perms since the age of 9. I understood it then, as I understand it now – this olive oil root stimulator uses chemicals to permanently change the texture of hair. This is important to understand because science is all around. Using real life examples of science could make learning more relative and fun for students.*

Science in Middle and High School

With a puzzled look, Jackie explained that she remembered only two teachers from middle school, her 6th and 7th grade science teachers. She recalled that sixth grade was memorable because that was the first time she sat a lab table rather than a desk to do science. She remembered other details about the set up of the room such as the eye rinse station and microscopes on the lab tables. With a smile, she recollected that this was the first time she thought that doing science was fun.

I do remember two teachers
I don't remember everything that we did but I do remember those classes.
I remember 6th grade
I remember 7th grade.
I do not remember 8th grade
I can see the teachers' faces from 6th grade and 7th grade
I just smile thinking about it because the classes were fun
I want to say once a month or every so often we were cutting something or looking at something real
I remember a lot of hands on experiences in 7th grade
I had been in when we actually had lab tables
I guess that would be because this was the first science classroom that I was in
I was like science/chemistry/and experiments; that was fun.
I went to three different elementary schools

I think my 7th grade year was so much fun because she related with us more and made it engaging and fun
I feel like that was because she was younger and she felt like she could relate a little better
I was excited for science in middle school
I knew that we were actually going to do science and not just read about it
I knew we were coming to the class
I would be so excited and want to keep doing it
I just remember we walked into the classroom and she had the brains out in little pans at our tables and they smelled
I feel like we were, everyone was like, let's go to science class, we may be doing something awesome today.

When asked to summarize her science experiences during middle school Jackie said:

Invigorating, because
I was excited to do, like,
I was excited for science in middle school because
I knew that we were actually going to do science and not just read about it. So yeah, whenever I knew we were coming to the class I was like Oooo! What are we going to do today?
I would be so excited and want to keep doing it but we obviously moved on.

When prompted to share her high school science experiences, Jackie frowned and reported that was when science went bad although things had been good until then. She reported experiencing success in 9th grade honors Biology, 10th grade honors Chemistry, 11th honors Physics but having a great deal of difficulty with AP Physics.

I was in honors classes all through high school
I was in honors biology then sophomore year
I was in honors chemistry, Junior year
I was in honors physics and senior year
I took AP Physics.
I was getting As in Biology, chemistry and honors physics.

Jackie alluded to having to take advanced courses due to family expectations and the effortlessness at which school came to her. She recalled excelling in school so even though she was not interested in a career in science, it was not odd for her to take advanced science courses

in high school. As Jackie described her high school formal science experiences, she shed light on factors that may have impacted her success in her AP Physics class.

While remembering details about science in high school, Jackie stated, "all of my science teachers in high school looked like typical scientists". When I asked her what she meant by that she explained, "They were older White men, they all had white hair, Mr. B was actually bald, they wore like button ups, typically short sleeved." Her description of her science teachers reminded me of the research around images of stereotypic scientist (Buldu, 2006; Chambers, 1983; Finson, Beaver & Crumond, 1995; Mead & Metraux, 1957). She went on to describe details about each teacher,

They all had their high pants with their belts, Mr. C, the very stereotypical one, he wore big glasses, he kinda like walked around with a hunch but he walked really fast, he wore running shoes, like New Balance running shoes and he actually had pocket protectors, he always had a pen in his pocket. But yeah, they were all older White men, button ups.

Whether or not Jackie's recollection of the teachers was accurate, it is important to note that this image is what she associated scientists with, an image directly in opposition to her young, Black female self. However, although the representation of the scientists that Jackie encountered as her science teachers were opposite herself, she still was able to connect with some of her teachers who demonstrated interest in their science content as well as their individual students.

> I could tell both Mr. C and Doc,
> they enjoyed what they were teaching and
> they were really into everything.
> I actually like them as people.

However, when the science instruction was poorly delivered and did not include a hands-on and real world connection, Jackie felt disconnected from her science learning.

I feel like because those classes were boring,
I started to lose interest in science.
I still wasn't like really, really interested unless we were doing an experiment and could relate it to life.

After recalling how science instruction was delivered in high school, she then spent time thinking of the racial composition of her science classrooms and how being one of the only Black girls in the classroom made her feel isolated, different from her peers and ultimately question her engagement and enjoyment of her classes. Both Shonnie and Tiffany had spoken briefly about similar memories, but Jackie's retelling of how it felt not belonging seemed deeper and more poignant.

I was a junior and senior, there was one other Black girl in my honors physics class, there were no other Black people in my AP Physics class except for one who was an immigrant.

Similar to Shonnie's statement that Black people can't do anything, but no one can do science, Jackie recalled that she did remember Black students in her other AP courses, but none in her science courses potentially due to the perceived difficulty of the content. Another aspect that could have impacted the lack of other Black students in her science courses could be that Jackie lived in an upper middle class neighborhood that didn't have many other Black families, a factor that may have been related to the small number of Black students in her classes. She spoke of playing soccer and her and her sister being the few Black players in her league. Similar to the composition of her extra-curriculars, Jackie experienced the same isolation in her advanced classes.

I was still in honors and AP classes but there were still Black people in those AP classes but not the science ones
I just feel like subconsciously you notice that your friends are no longer in your classes so science was not fun anymore I guess
I didn't have any of my friends in my class

Interestingly, Jackie did not attribute her enrollment in AP Physics as a matter of ability, but more so just because it was the next step in her science course progression. Her tone dropped during the retelling of her experience in AP Physics possibly due to the failure she experienced.

> I was taking science because it was a requirement and I had taken the honors classes so this was the next step.
> I also wrote down a whole bunch of numbers and equations that are not real because physics, science just stopped making sense to me by my junior year and
> I did not like science those years.

During both Shonnie and Jackie's interviews high school somewhat cemented a divorce from science. Both participants attributed this divorce to relational aspects of having or not having teachers who connected with students and having or not having classmates from the same racial background to reaffirm their identities as capable do-ers of science. Tiffany did not experience science during her high school years in this same manner in part because she had people whom she looked up to who were deeply involved in science careers and continued to encourage her towards her dreams of a career in medicine.

Science in College

Jackie entered Spelman pretty focused. She spoke earlier in the interview about her mother and aunt who attended Spelman and the expectation that she would attend Spelman as well. She spoke very matter-of-factly, stating that she entered with one major in mind and stayed that course for the duration of her matriculation.

> I was an early childhood major when I came into Spelman.
> I knew that that was what I wanted to do.
> I know that environmental science is the one they told us they had to take.
> I wrote save the Earth,
> I put zzzz's also because that class was boring.
> I had already talked about this stuff with my parents.

Similar to the other participants Jackie did not see the relevance of the environmental science course as a part of her elementary education course of study. Because her parents had engaged her in informal experiences with science, she did not feel like any new information had been presented and did not experience anything that added to her skills as a teacher of elementary science. Interestingly, Jackie counted the environmental science course as her last science course without mentioning the elementary science methods course she had taken the prior semester.

> I never touched science again
> The word I chose for science now in college was unimportant because
> that's how I felt about my environmental science,
> I felt like it was not an important class,
> I was just doing it. EDU330
> I didn't consider it a science class.
> I was like, ok this class isn't really important either,
>
> I don't really consider it a science class in hindsight yeah, cause
> I feel like it was supposed to be a methods class but we weren't learning methods
> I drew this little squiggle, not connecting
> I felt like there was a disconnect with our professor culturally and with what we wanted to get out of class.

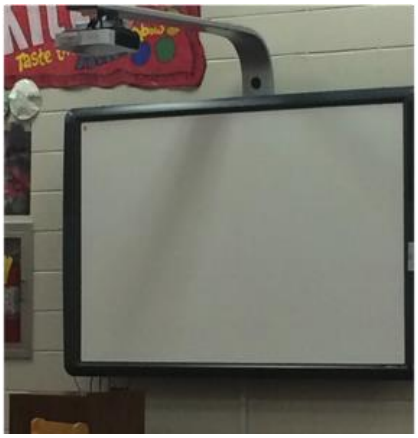
All three previous participants voiced their frustration of disconnect they experienced during the elementary science methods course. Individually, they all voiced the desire to gain the appropriate skills to teach science well in their future classrooms, but did not leave that class having those expectations met. Similarly, all three voiced higher expectations for science instruction during their field and student teaching experiences but were not able to learn from strong elementary teachers of science. Jackie described her elementary science teaching observations in somewhat of a dejected voice.

> I put “Science question mark… maybe tomorrow?
> I wrote Brainpop because they use a lot of Brainpop videos.
> I do remember a couple of color experiments in my field experience last semester
> I could tell that they were trying to make it so kids could go to the science all the time

I feel like she flips science and social studies
I feel like she notices that we don't do a lot of work with social studies and science

What is science? *This is a picture of two cubes of ice reacting to the wood and metal materials they lay on top of. This represents science to me because science has always been most fun and easiest to understand when I was able to explore through experiments. This was an experiment conducted in my third grade class at Heritage Academy to determine which material was a better conductor. Students were able to observe and conclude that metal is a conductor, while wood is not.*

Jackie, like the other participants, expected to see more science being taught through her elementary placements as a way to learn from a teacher how to deliver quality science instruction. Instead, the sciences taught in the placements were mostly driven by videos about science rather than engaging students in doing science.



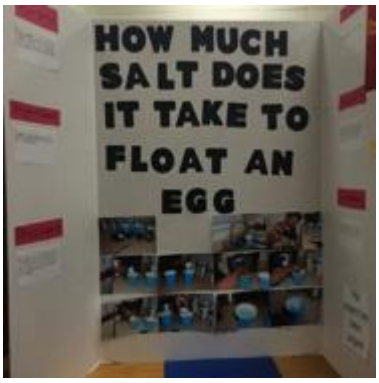
What things hamper your teaching of science? *This is a picture of a Promethean board. I chose this image because too often teachers become comfortable showing videos on BrainPop or YouTube to facilitate learning in science. In actuality, this hinders the mind and closes off so many creative opportunities to explore science and make connections with students through activities outside of technology.*

In addition to science videos driving instruction, Jackie addressed the de-prioritization of science and social studies as they were not subjects taught each day along with reading and math. In this case the phenomenon of the "disappearing curriculum" not only impacted the students who were not receiving a complete education, but it also impacted the teacher candidate who was observing instruction and learning how to teach. Although some elementary schools have created science lab spaces for students to visit once a week, Jackie noted that this also was not a viable solution to ensure high quality science instruction.

What is science teaching? *This is a picture of students learning science in a science lab. This would be ideal to have all the supplies and materials available for in depth exploration of concepts. I chose this picture, specifically, because the science teacher is a middle aged, white male, wearing a lab coat. In my opinion, he also looks a little "nerdy" due to his bald head, slight hunch and awkward smile. He is enthused to teach the students science, but they are not engaged by simply looking at the board. Science should be fun, but it has become stereotypically taught by white males.*

Through this project Jackie began to interrogate the way science was presented to the students at this majority Black school. She stated that her teacher rarely taught science and began to rely on the man running the science lab to deliver the more engaging science content. However, the picture and narrative she submitted still did not show students engaged in science during the one time specifically reserved for science exploration. Students were seated at empty tables, watching science knowledge being delivered by a bald White man in a lab coat, talking

about chemicals. While this may not have been representative of every visit to the science lab, this was a very poignant portrait of the instruction Black students received at that school and the experiences Jackie amassed during her elementary teaching placements.



What things facilitate your teaching of science? *I choose three pictures to symbolize what things facilitate my teaching of science. These are two examples of science fair projects and a sculpture of 2 students learning together. Science Fairs are excellent ways to get students to think outside the box and explore science in real life. The selection of these pictures reminds the teacher to always go back to the mind of the students'. Students are naturally inquisitive and love to explore. Use the students' minds to open up ideas and expand students' knowledge beyond the curriculum.*

After walking through the work Jackie had drawn out for her life history interview she sat back and stated,

> I actually like this activity because,
> Just kind of seeing how my experiences shapes how I feel about science.
> I don't remember anything that happened at an early age and it became interesting when I was able to connect with my teachers and do experiments
> But then my high school I wasn't really doing experiments,
> My teachers were monotone,
> it got harder so
> I got uninterested and by college it was a requirement.

Like the other participants, Jackie had the desire to engage in science; however unlike Shonnie and Tiffany at times, Jackie never felt engaged or welcomed into the space of "doing science". As she spoke of science across various points of her life, it almost seemed as if she longed for the invitation to engage deeply, especially once she entered her teacher preparation

program. Although she came from a family who engaged in talks about everyday science as a young child, her schooling did not continue to spark her interest in science and celebrate her as a "do-er" of science. Nevertheless, like Shonnie, Jackie understood the necessity of high quality, hands on science instruction. Regardless of the fact that Jackie felt that she had not been fully prepared to deliver elementary science instruction, she knew that she wanted her students to learn in a hands-on, collaborative space that encourages students' curiosity.

Josie's Portrait

"He was so into it he made me into science too. I guess to show your excitement and your enthusiasm for what you're learning, what the students are learning or what you're teaching is important because the students most of the time they are going to see it."

Josie was somewhat of an outlier in comparison to other student participants.. She kept to herself, sometimes falling asleep in class, but when called upon, she always had something thoughtful to add to the class discussion. She mentioned wanting to participate in the study to help other teacher candidates that came through the program, hoping to help them develop a love for teaching science that she wished she had had been able to develop. Josie's responses were always pretty matter of fact and I appreciated what she chose to share with me. Her steely determination reminded me of myself as her sleepiness was attributed to working to pay the expensive tuition of this private liberal arts college. Even though Josie experienced financial hardships, she was determined to become an elementary teacher.

Just as her interactions in class, her life interview was direct and to the point. Her responses were reflective but she didn't share the spark for science as was evident with Shonnie and Tiffany. Maybe most telling were her Photovoice explanations. They were a chance for her to compose and present her thoughts on her own terms. Science for Josie struck many of the same chords as the other participants as she found herself on the other side of the science dichotomy where most of her science teachers were older, White males.

Science During Elementary Years

When prompted to remember science in the elementary years, Josie's remembrances lacked some of the detail of the other participants. She didn't have the same experiences with science camps, exciting teachers or personal pets but did recognize science in the chemical changes from food preparation or hair styling.

The closest thing to science at home was cooking and hair
Both of my aunts did hair, and you know, perms can change your hair, chemical changes and all that.
And cooking, my mom always cooked,
My aunties always cooked, my grandma when she was well she used to cook.

While Josie didn't indicate if the classification of these occurrences as science happened as an adult or if they were scientific phenomena discussed in her home, she linked her science memories to culturally connected activities with her female relatives. (

Her school science memories from her elementary years were spotty, lacking the detail shared by the other three participants. Josie explained that due to family issues she started school in metropolitan Atlanta while living with her mother, but moved to rural Georgia to live with her father in her early elementary years. This movement could explain the gap in details as Josie spent more time talking about the move and new environment rather than details of the instruction she received.

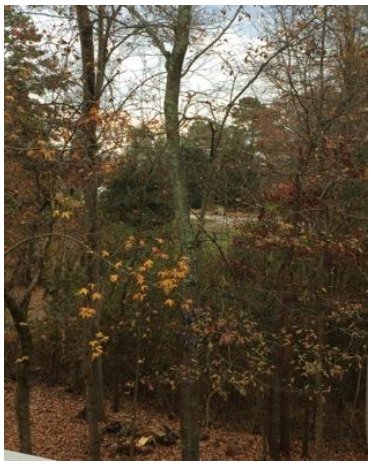
I don't remember nothing science in kindergarten or first grade
So up until 2nd grade I remember birds especially.
It was fun,
But I don't remember us doing experiments.
In fourth grade it was departmentalized
She had animals in the class but I for the most part think she cared more about the animals than the students

The way Josie recalled the class pets and the teacher's responses was interesting. Often and especially in an elementary setting, having animals in the classroom is used to help teach students social skills, caring for the pet or learning responsible handling and social attachments as well as to foster interest in life science. Interestingly, Josie first remembers the teacher's restrictive attitude about the pets rather than the positive things she could have learned by having animals in the classroom.

I remember there was a lot of bookwork, writing down all kinda stuff
We were able to, she would let us hold and touch the animals

And fifth grade, it was departmentalized too
I remember when she would introduce something
I would be so nervous to figure out how I was going to learn it and she made it easy.
I remember we made ice cream
We made volcanoes we erupted
We did dyeing the plant stems to show how water moves through the plant
We did other stuff for plants
That's when I started learning about chemical compounds and stuff, H20, what that means and all that

Josie began to recount in more detail the elementary science in grades where subjects were departmentalized. In elementary school, especially at younger grades elementary teachers are generalists, expected to teach all subjects within the school day. Maybe with having a period each day devoted to science instruction, similar to middle school and high school scheduling Josie experienced higher doses of science instruction allowing her to remember more science in her later elementary years. Her recollections were matter of fact, a bit more connected to the science activities she was retelling but once again, she did not exhibit enthusiasm about the different engagements. It is important to note that her science memories of "making ice cream, erupting volcanoes and dyeing plants" were more vivid as she recalled her lived experiences of doing science.



This is a nature shot taken outside of my mother's home. This picture for me represents the how the simplicity of nature and the earth can manifest itself into the complexity chemicals, reactions, and the like. This is what science means to me.

Science in Middle School

For Josie, science in middle school continued in the same vein as science previously. With science being departmentalized, Josie remembered attending class each day characterized mostly by bookwork, with the exception of one experiment with dry ice. She was not able to explain what the experiment involved, but like the other participants, she was able to recall it as a science memory as it was a time when she was physically manipulating items and "doing science".

> So in middle school
> I remember this one experiment where we had to work with dry ice 'cause it hurt…
> We did mostly environmental stuff and plants
> We did the food chain
> We did learn about chemical compounds, photosynthesis versus the other one
> We used to do a lot of bookwork for homework

As Josie began to talk about science in 8th grade, a smile spread across her face. She remembered her science teacher as a nice person, a teacher who made the content come alive and linked science phenomena to other real life concepts. Even though this teacher was a White male, Josie remembered aspects of his personality and teaching style that helped her connect on a deeper level to a subject in which she previously hadn't shown much interest.

> 8th grade, Mr. B, I still talk to him now, he's my favorite teacher ever
> We did a lot of experiments
> I remember he integrated; somehow we ended up talking about the stock market
> I don't know how he related it but it worked I remember that.
> We did a lot of projects, like the solar system model
> I remember that one
> We always had food and stuff
> I guess we had to take tests and stuff like that but it was the only time it was boring
> Other than that it was never boring in his class
> We would go outside,
> We used to create videos and music back then to learn
> I still talk to him now; I can still call him right now and ask a favor,
> He was cool.

Josie remembered student-centered instructional strategies that were performance-based rather than teacher-directed comprised of lectures and bookwork. She smiled remembering the projects of creating music and learning outside. Although she didn't recount the exact science concepts that were being taught through those activities, it is fair to say that those science-learning activities resonated positively with Josie in a way she had not previously described her learning of science.

> He was so into it he made me into science too
> I guess to show your excitement and your enthusiasm for what you're learning, what the students are learning or what you're teaching is important because the students most of the time they are going to see it.

Josie realized the importance of a teacher modeling his or her interest in a subject as a way to hook students. This was another example of the insightful comments she made linking her previous science experiences to her future career as an educator.

From what I can recall, the majority of what I as a student found most enjoyable were projects and creating models of different science themes. This picture is a ball that I won at the skating rink, but it is reminiscent of a model of an animal cell. I am not sure if it was the fact that this project involved manipulatives or the fact that I really enjoyed middle school science, but this project is one of the many things that I remember and enjoyed.

Science in High School

Similar to the previous participants, Josie's physical demeanor shifted as she began to recount her high school science experiences. She described learning with her 8th grade teacher and then the disconnection with her high school science teachers. While she could remember more details about various labs, it was evident that she wished for a relationship with her teachers but attributed her high school science disconnect to class being held after lunch, the age of the teacher and attitudes of the teachers, ending her explanation of science in high school with "I could take it or leave it."

> In 9th grade he was a nice White man but his class was right after lunch so I'd be tired
> We did a pig dissection at the end of the year
> We talked about Darwinism
> We did the food chain
> He made us take someone from our group had to take a piece of hair out of our head
> We had to observe it under the microscope
> I remember a lot of lectures
> We talked about the cell cycle, DNA, dominant traits, nutrition, anatomy and sex
> He was really nice.

Josie's explanation of 9th grade science seemed to have some of the hope and connection from the successes she experienced in 8th grade. She kept mentioning how hard it was to stay awake in the teacher's class although he was "nice" and "tried hard" but in the end, she explained, she just couldn't stay awake. From that point on, her memories of science in high school continued to devolve as she earned lower and lower grades each year.

> 10th grade year I had chemistry
> I remember the periodic table
> I remember she had us memorize parts over time so we would know half of it
> We did experiments but a lot of them I didn't get the point of
> We would go to lab tables and do stuff
> We did a lot of massing objects

> 11th grade we did a lot, but the way he explained, the way he went about teaching us; it was terrible.
> He was boring

It didn't relate to what we were learning
He never could get me to get it
I know I'm not stupid
When we raised our hands he would get really irritated
We did a toothpick tower, the circuit thing, different types of waves and static electricity
I think my highest grade on the test was like an 89
That's not good, I feel like...
Science before his class?
I could take it or leave it.
Like, I wouldn't mind doing it since I had to do to it.
9th I got an A
10th I got an A-
Then 11th I got a C
By the end of the semester I had a B- but I feel like he just gave me that so I wouldn't complain or get on his nerves.

Josie's memory of science in 11th grade depicted a somewhat common pedagogical dilemma in science classrooms. She remembered doing quite a few hands on science labs but reported that the teacher was visibly frustrated when students asked questions to clarify science phenomena they were studying. For Josie as well as Jackie and Shonnie, it was important to be able to engage the teacher, ask questions pertinent to the lesson and receive answers that acknowledged their engagement. Josie's memory of earning a C but receiving a B- 'just so I wouldn't complain or get on his nerves' could speak to the teacher's lack of investment into individual students like Josie.

Science during College

I had to bite the bullet and take science my sophomore year
So I only had, the first test I got an A on, and everything else after that I was struggling, trying to get an A
.Junior year is when we took the methods and content
That was confusing because of the language barrier
I guess she didn't know exactly what she should be teaching,
She just thought she could come in and teach science as if we were students
Opposed to teaching us how to be teachers to younger children.
your lessons at the end of the semester were fun
That was the best time we had in that class.
I felt like I was not prepared
It made me disconnect from the class

> That's why I guess I was so adamant about going to those GACE preps
> I felt like I wouldn't get what I needed for the GACE in that math and science methods class

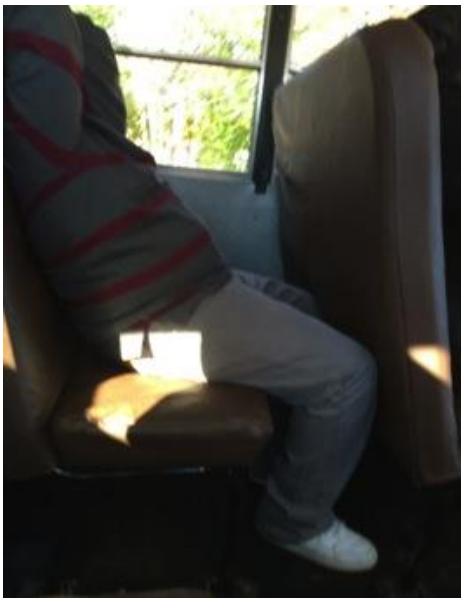
Josie was more vocal about her frustration with the lack of preparation in the science methods course than many of her classmates. She mentioned needing more support to understand and pass the GACE assessment and voiced her frustration with the course not adequately exposing her to the methods of teaching elementary science. Another important factor that impacted Josie's preparation was the amount of science she saw or did not see being taught in her field placements.

> I never really seen science in some of my field placements honestly
> Burgess, you know they have to go to, it's like an elective there.
> It's a 'special'; they went every blue moon.
> I used to always talk about constellations cause' that's all I knew about for teaching science in elementary.

This is a picture of my students actively engaged in an online Georgia Milestone test prep, Achieve 3000. My experiences have shaped my opinion in that to teach anything, especially complex concepts such as science, students need to be motivated and engaged from beginning to end. Of course this sense of motivation manifests itself through the organization and enthusiasm of the teacher. These factors assist in facilitating teaching science to elementary students.

During her year-long student teaching placement, Josie was placed with the 5th grade Social Studies teacher so while she accumulated her required hours for her teaching certificate, she mainly observed social studies instruction which further impacted her ability to develop a strong elementary science teaching identity. Nevertheless, Josie continued to share critical thoughts about ideal science instruction and relationships with teachers. She asserted the importance of relationships with teachers as a method to better communicate certain scientific phenomena to students through culturally responsive, real world examples.

> If you and your teacher don't have a relationship,
> It makes it hard
> Then they don't know you so they don't know how to teach you
> Because every child is different so when they are teaching us all the same across the board, even with you teaching us this one way,
> If no one gets it and you are still doing the same thing,
> its discouraging because that means that we don't matter,
> All you are worried about is getting through the day opposed to getting us, the students, through the day.
> I am old enough to know and understand what you are doing and where it's coming from.

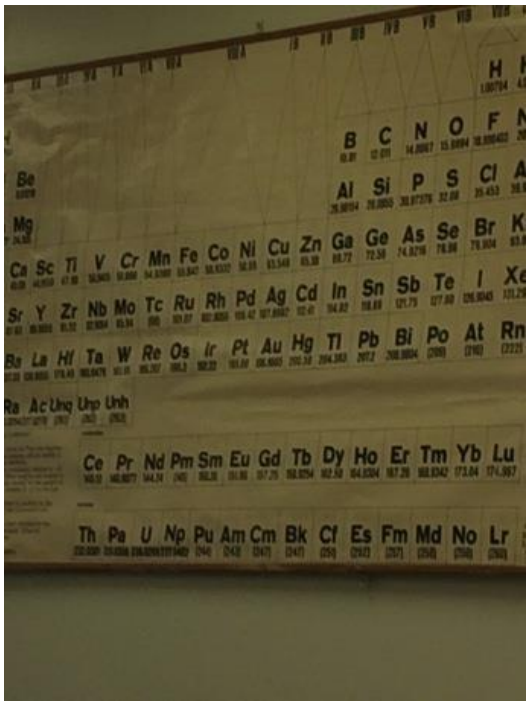


Just as student engagement facilitates in teaching science, a lack thereof can greatly hinder it. This picture is of a student asleep during a field trip. This is a representation of how easily students can become uninterested and disassociate themselves from science, especially when the students are not confident in their ability to grasp concepts of science.

> If I had had Black teachers I think the relationship part would have been a little different
> I probably would have been able to have gotten some of the concepts
> Of course these White instructors were explaining it in a way that related to their experiences, not so much my experiences

Josie's closing thoughts for the life history interview were sobering, but tinged with hope. It was evident that she desired to be a good teacher of elementary science, but felt that she did not leave her teacher preparation program with the skills to do so.

> I am not prepared for that
> I don't feel like I have learned enough and then all of the aspects with the other classes that we take, even now some of those things are fuzzy to me
> But when I go into the classroom and actually try to apply it, it's on command.
> So I guess its different when you are actually in the classroom then when you're just talking about it.



For me, teaching science is always difficult for me to get through. In all honesty, what I am most appreciative of with teaching 5th grade is that we are departmentalized and I rarely have to assist in creating and teaching science lessons. This picture represents my feelings for teaching science. My overall experiences with learning science greatly influence my reluctance to teach science. As this picture, my opinion of teaching science is bland and does not provide much room for creativity

Josie's elementary science teaching preparation concerned me the most. During her student teaching placement, she was unable to see science taught consistently since she was placed with the social studies teacher. This also means that she was unable to critically evaluate the science being taught to the students on her grade level, further constraining her opportunities to learn how to teach or how not to teach science. As she was a participant who never fully claimed a strong science identity, this aspect of her teacher preparation program further hindered her science teaching identity formation.

The Portraits Combined - Recurring Themes

These four portraits reveal the similarities and differences between participants' lived science experiences as Black female elementary teacher candidates and illustrate how those experiences impacted the construction of their elementary science teaching identities. While all the participants broadly identified as Black females, in listening to their life histories, details about the participants' family composition, parent occupations, hometowns, relationships with teachers and support systems influenced the development of their science identities as well as their elementary science teaching identities.

An interpretive analysis of the life history interview transcripts and PhotoVoice submissions revealed a deep interest in teaching science well but highlighted instances in their lives where their science identities were shaken and science-teaching identities were subsequently compromised. Recurring themes that appeared throughout the data were (1) the telling stories of doing science, (2) telling stories about relationships with teachers, (3) telling stories about significant struggles in science, (4) telling stories about expectations as teacher candidates, and (5) telling stories about dreams of teaching elementary science.

OVER-ARCHING THEMES
Telling Stories about "Doing Science" Participating in inquiry science was important to Black female students' interest/ability to see themselves as scientists
Telling Stories about Relationships with Teachers Relationships with teachers impacted Black female students' interest/ability to see themselves as scientists
Telling Stories about Significant Struggles in Science Significant academic struggles impacted how Black female students saw themselves as scientists
Telling Stories about Expectations as Teacher Candidates The participants in this study expected the science methods portion of their teacher education program to scaffold their elementary science teaching abilities regardless of previous experiences with science
Telling Stories about Dreams of Teaching Elementary Science Regardless of the impact of the participants' lived science experiences, each teacher candidate expressed a personal commitment to figure out how to teach science well to her future students

Figure 4.2: Themes that arose from the study

Telling Stories about "Doing Science"

Participating in inquiry science was an important aspect of the participant's interest in science and their ability to see themselves as "do-ers" of science. All of the participants spoke of the importance of learning through hands-on science activities at various parts of their schooling and expressed high levels of interest in the moments they were able to recall specific science inquiry activities. While not all participants remembered learning through inquiry science in elementary, Shonnie had the most compelling recollections of participating in science formally and Tiffany had the most compelling recollections of participating in science informally at this stage. Shonnie's visible excitement recounting conducting and reporting on science experiences underscores the indelible mark these experiences had on her personal connection with science. So when I didn't understand stuff and I did the experiment, then I would understand it better…I think the message we got was like science is everywhere so I liked that. I wrote relevant. It was really relevant. It was never a question of how does this relate to my life or how is this important. Our teachers always made a point to tell us that science could be fun.

Shonnie appreciated doing science experiments and participating in science inquiry through communicating her findings; both experiences supported the development of her young science identity. "I think in elementary, every time I got up to do a presentation I felt like someone special. No matter what, even if I was doing the same presentation that three people before me did, I still felt like someone special".

Tiffany developed a similar attachment to science during elementary years although these feelings were fostered through her relationships with her parents' and godmother's occupations. With her mother and grandmother inviting her into their work at this historic Black medical school, Tiffany's interest in science was sparked. Tiffany recounted many instances of informal

science learning and access to science information around the house.

When I was younger I had this big thing about pregnancy, I would always go get the 'P' encyclopedia and think I was reading about pregnancy. I had "Operation", I had computer games for science or 'The Magic School Bus'. My dad had this weird obsession with death so it was a very open topic about science and how like your body decomposes and all that stuff. We had lots of different science resources in the house.

Tiffany's experience was unlike the other participants, as her science identity was developed mostly through out of school experiences. Throughout her interview, the majority of positive inquiry science experiences were related to her time learning with the medical students at Meharry.

The other two participants, Jackie and Josie worked hard to remember learning science in their elementary years; however, during both of their interviews they expressed difficulty remembering robust science instruction. Jackie remembered growing plants, learning about ecosystems and looking through prisms but when asked to use one word to label her elementary science experiences she said, "Generic. Nothing was too exciting. I feel like the experiments that we did were things that most people do. They didn't go above or beyond." Josie described similar feelings of detachment in her elementary years until she described her fifth grade year where instruction was departmentalized.

It was fun, when we were doing experiments; we learned complex stuff. I remember when she would introduce something, I would be so nervous to figure out how I was going to learn it and she made it easy. I remember we made ice cream, we made volcanoes, we did dyeing the plant stems to show how water moves through the plant...she was fun. She was cool.

Through each participant's interview, their discuss of their interaction with science and

participation with inquiry science showed a desire to engage deeply and learn through doing science but as the grades progressed many of the participants recounted their science classes to be filled with lectures and note taking. These teaching styles seemed to impact Shonnie, Jackie and Josie more than Tiffany since they did not have the same family supports which helped support their individual science identities.

During middle school both Shonnie and Tiffany recounted difficulty in middle schools as science was characterized by more bookwork. Factors such as teacher attrition impacted Shonnie's ability to engage in inquiry science during her classes.

She remembered, 7th grade we did a lot of book work. I don't know what was going on with the teacher retention rate in 7th grade because we had 5 science teachers within one year. I was easier for teachers to pass out book work than do experiments. They also did a lot of lecturing…I don't like lecturing at all cause no one ever taught us how to take notes, the teacher just started lectures and we were like what should I write?

Tiffany, Jackie and Josie retold mixed memories of learning in science. During middle school all three experienced more formal science instruction because it had become departmentalized but some teachers lectured and some infused science experiments into instruction. Josie remembered the stark difference between her 7th and 8th grade science teachers.

We used to take tests all the time. We used to do a lot of bookwork for homework. Nothing fun. But 8th grade, he was very interactive. He was really cool. We did a lot of experiments; he integrated a lot of real world stuff into what we were learning.

Jackie also fondly remembered inquiry science in middle school.

That's why I think my 7th grade year was so much fun because she related with us more and

made it engaging and fun. We dissected like every other month if not every month and she was open to conversation. I was excited for science because I knew we were actually going to do it, not just read about it.

Science in high school continued to move away from inquiry science for Shonnie, Jackie and Josie. The amount of information being covered and the way it was being taught further complicated the participants' development of their science identities. Although Shonnie expressed a passion for chemistry, she retold how her biology teacher lectured each class without notes. "I think that was part of my issue cause science is really like, I don't get anything from lectures, at all. All he did was talk and it was really boring." Jackie remembered similar experiences even though she took the science honors track in high school.

Chemistry was boring. I put 'zzz's' because that man made me fall asleep in his class. The only fun days were labs which happened on Fridays. During the week he had a really monotone voice…those classes were boring. I started to lose interest in science…I wasn't like really, really interested unless we were doing an experiment and could relate it to life.

Similar to Shonnie and Jackie, Josie didn't remember many positive inquiry science experiences in high school. She briefly described pig dissection and other times the application of the lab concept was not explained.

In chemistry we did experiments but a lot of them I didn't get the point of it, she never really explained it. 11th grade, he tried to do a lot of things but the way he explained it, the way he went about teaching us, it was terrible. He never really, he was never really good explaining so when we raised our hands he would get very irritated because I guess he felt like he explained it good enough, but he didn't.

The only participant who continued to have a robust relationship with science was

Tiffany as she was on a fast track to graduate in three years and was enrolled in a medical track where she was able to spend a great deal of time in a local hospital completing rotations in different departments. She remembered,

My track was medical track so I took health science the 2nd year and my last year I did med fair/clinicals. That's where in the fall after learning everything you leave school, go to the hospital; kind of like a co-op. You leave school, go to the hospital, and one week you may be with surgery, one week you may be with OB, next week you may be with something else 'til you visit everything in the hospital.

All of the participants fondly remembered participating in science even if it was something messy like pig dissection. The participants expressed excitement remembering exploring scientific phenomena with various materials, the pride of representing what they had learned through presentations, videos or class discussions as well as the frustration when science was presented in a one-sided manner where they were the receptacles of the teacher's knowledge. If the participants had been engaged in more robust science instruction throughout their formal schooling, there is strong chance their science identities would have become healthier.

Telling Stories about Relationships with Science Teachers

Relationships with teachers impacted Black female students' interest in persevering in science and engaging deeply in science class. As the participants remembered science instruction in their middle and high school years they all reflected on the relationships they had with those teachers. All participants were able to remember both positive and negative relationships with their science teachers but with this group of participants, the negative relationships outweighed the number of positive ones. Each participant shared vivid memories of

difficult relationships with teachers and the way those relationships impacted their interest in class. Shonnie remembered her 9th grade biology teacher.

He wasn't very respectful person. All of the Black girls had the same name. We were all Ra'chel to him. He called us all Ra'chel. There was a girl named that and we were all her. He emailed my mom one time and he said Ra'chel in the email… it was any Black girl who was Brown or darker…our names were kind of ethnic…he didn't have an interest to learn my name, so that kind of turned me off. He wasn't interested in my and I wasn't interested in his class so there was no reason for me to sit and talk to him after class about what I wasn't understanding because he wouldn't remember the conversation…

Shonnie longed for connections with her teachers, and enjoyed telling me about her chemistry teacher. "I liked that he took initiative but he was also one of my mom's teachers and he always brought that up. I liked that too. He was a great guy. He was taught my mom Chem 2 and he kept telling me "you're going to take Chem 2. I going to teach you just like I had your mom before she dropped the IB program." Shonnie explained that she enjoyed his class in large part because he cared about her learning and connected with her individually to ensure she understood the content. She remembered him coming early or staying late to help her understand the information. "It was all about whatever we were willing to do, he was willing to do and I appreciated that." Sadly, that teacher was not Shonnie's Chem 2 teacher and her high school science career did not end as she'd hoped. She felt her Chem 2 teacher didn't think that she could pass the test to receive an IB diploma and didn't prepare the class for the test. For her to have been so excited to take a course, it was difficult hearing her describe her disappointment in the lack of support from her teacher.

Tiffany also recounted negative experiences with her teachers who she felt seemed

threatened by her confidence in science.

They didn't engage me and that's probably one of the reasons why she didn't like me. She would say one thing, tell the wrong reason and I would tell the right one. She wouldn't go in depth so if I'm at a group table and I would say a way for them to get it she would get made that I'm talking but these four would get it right on the test and could give a good explanation.

Tiffany remembered that she didn't have a great relationship with the science teacher the next year either and shared that she tried to work with the other science teacher who was a Black lady "but she barely wanted to talk to me. I thought Black people stayed together…". These experiences with science teachers in middle school caused Tiffany to label science during her middle school years as "self-initiated…because they didn't really help encourage me, not the teachers and not specifically in science." Had Tiffany not been surrounded by family members who encouraged, celebrated and nurtured her successes in science, these challenging relationships with her science teachers could have taken her off her track to pursue medical school.

Telling Stories about Significant Struggles in Science

Throughout each participant's life history interview, there was a significant event, grade or teacher that they identified as a moment of disconnection impacting their science identity. For the three participants that had not intended to pursue a career in science, their experiences with high school science unseated any previous confidence they had developed with science. Shonnie, Jackie and Josie remembered struggles in middle school but they found comfort in having a good teacher the next year or were generally optimistic about their ability to re-engage with science in the future. By the time Shonnie, Jackie and Josie neared the neared the end of their high school years and were enrolled in more difficult science courses, their experiences were retold with

stress and frustration. There were stories of isolation attributed to being the only Black student or Black female student in their classes or isolation from a teacher who didn't engage them with relevant science instruction. Shonnie remembered, "12th grade. Chem 2 was such a disappointment. I was really looking forward to Chem 2; it was probably the happiest I had been for a class in a really long time. In hindsight, he taught us Chem 2 like it was a lower level class. 75% of what was on the test he didn't teach… I just didn't like him because he talked to us like we were frustrating his life…I know that could be frustrating as a teacher but that doesn't mean that you don't teach us or the ones who actually wanted to be there."

Jackie also had frustrations regarding the instruction she didn't receive in her advanced science course. As a student taking AP Physics Jackie shared how her isolation compounded with the realization that she was not understanding the concepts caused her to mentally check out.

Senior year I had no friends in that AP class and it was a 2 hours class, so once I realized that I was lost in the first 30 minutes, that next hour and a half it was like, I don't want to be here…I obviously was not going to take the AP exam so he let me leave class early each day…I just feel like subconsciously you notice that your friends are no longer in your classes so science was not fun anymore I guess… It was the only class that I didn't have friends in the class….it was a requirement and I had taken the honors classes so this was the next step.

Jackie's statement about taking AP Physics because it was the natural progression leaves room to wonder, would she have engaged differently if she had been able to take a different science class with more engaging content or filled with more of her peers?

Josie's recollection of science in high school included only 9th, 10th and 11th grades. She didn't share anything about science in 12th grade but talked about 11th grade chemistry and explained her frustrations.

11th grade I got a C. So it was just, it was terrible. And by the end of the semester I had a B-, but I feel like he just gave that to me just so I wouldn't complain or get on his nerves.

When prompted to discuss her feelings about science in high school she emphatically stated, "I didn't like it. I didn't want to do it. It was too much. I didn't have any AP courses, I had one AP math class but I dropped that. This class, all my stuff was honors. I would never go higher to AP because my friends would be so stressed, pulling out their hair, talking about they couldn't, I know I used to go out a lot and they couldn't go nowhere. I didn't wanna be like that."

The retelling of the high school science experiences of Shonnie, Jackie and Josie were constrained by difficulty with instructors' teaching styles, lack of representation in courses and other unlabeled issues

Tiffany's struggle in science came later than the other participants as she entered college set on majoring in science and entering medical school. The strong science identity she had developed through informal science experiences, strong relationships with science professionals such as her mother and godmother and her steely determination to become a doctor was rocked by difficult coursework, new found freedom and the death of her one of her closest mentors. The experiences of these compounding factors shook Tiffany's science identity to the core. When she was asked to recount science in her college years, Tiffany laughed in a defensive way and told me it would be quick. She mentioned that she came in as a chemistry major but "it was just horrible." As I inquired further she explained, "I was just failing. I ended up withdrawing." Then

she remembered and corrected herself, “No I actually I didn’t end up withdrawing, I just got a D. So I didn’t continue on this track…I just got very discouraged because I failed general chemistry. I failed, it was a D but they didn’t give me the credit. I would have had to take it again.” As we talked about the factors that contributed to her earning the D she stated,

It was a bit of both me and the instructor. Me on the part that like going to college I never had a tutor in high school, I really just took time to study. I really didn’t adopt those things once I got here so I could have spent more time working on it and studying, things like that, but I didn’t. Also, she (the teacher) had a newborn baby and she had other little children so she was home, they were sick, something was always up and she was going through a divorce. So she really was never here but when she was her teaching style was different. I passed the labs, but couldn’t pass the tests.

Interestingly, Tiffany took responsibility for her lack of focus during her first year at college and the impact that it had on her academic performance. Equally interesting was the stark difference in her confidence levels as she got closer to her lifelong dream of becoming a medical doctor. As she described her performance on her tests, gone were the traces of the student who helped correct and extend her classmates’ understanding of science being taught. With desperation she remembered, “That really discouraged me; if I can’t even pass general chemistry how was I gonna pass the MCAT? How am I gonna pass organic chemistry so I honestly was just over it, like whatever…” When I pressed her about her support back home she started to explain how her new social life as a freshman caused her to lose focus and then her voice cracked and she said,

Then my godmother passed away before Thanksgiving. So that didn’t help

because now I was emotional about that, she's the person I looked up to for everything. She was the person that I really wanted to be, all that stuff so

I didn't really have a drive behind me...

Tiffany's voice trailed off.

After a somewhat successful attempt at her biology course, Tiffany explained that she bounced from major to major considering a career as an athletic trainer, then a lawyer then finally falling into the child development major.

Telling Stories about Expectations as Teacher Candidates

All the participants were part of the same cohort and faced the same program expectations to receive certification to teach elementary grades. Three science related aspects defined the expectations of this major:

1) enrollment in the environmental science course as the science prerequisite,

2) participation in the elementary science methods course and

3) exposure to science teaching during field and clinical experiences.

Each of the participants shared their disappointment in the way their expectations to elementary science teaching were not met during their teacher preparation program. None of the participants expressed interest or appreciation for the Environmental Science course they were expected to take to satisfy their science requirement as an education major. Jackie and Josie spoke about their lack of interest in the way the information was presented and the lack of applicable content between that course and the content they would be teaching their future students. Shonnie and Tiffany lamented their frustration with their inability to choose their own science course, having to be locked into a course that seemed less rigorous and less interesting than other content they had hoped to study.

As a part of the course of study, the participants enrolled in the science methods course during their 2nd semester of being enrolled in the early childhood certification program. This semester long course combined methods for teaching math and science, a common practice at liberal arts colleges that required multiple "core requirements" and limited time for longer courses. Since the participants had previously been enrolled in other methods courses, there was an expectation as to the type of instruction they would experience during this course. As the participants recounted their experiences in that course, they expressed common irritations with the structure of the course and cultural miscommunications between the students and instructor. In an exasperated voice Shonnie disclosed,

Then we started doing 330. That class was horrible. Dr. S was really passionate about science and I appreciate that about her, but we didn't make anything relevant; she didn't teach us on our level. She didn't teach us on the level we would be teaching…I'm not sure what they told her when they gave her the class because that was her first time teaching it too.. But in our other courses it was like we did or would do a lesson plan for K-5 which was really beneficial because then you understand how much you should be able to teacher in one lesson.

As Shonnie continued to voice her frustration, she explained why learning in the science methods class was so important to her. "Especially with science, because science is one of those things that you don't get to in your placements so it's like you miss that a lot. I didn't even know how to write a science lesson plan, like what is realistic, what we would be able to get through."

The participants in this study expected the science methods portion of their teacher education program to scaffold their elementary science teaching abilities regardless of previous

experiences with science. The final aspect of the participants' training in their elementary teacher preparation program was observation of practicing elementary teachers through field and clinical placements. The participants generally had homogenous placements as the college coordinated with the surrounding school district for assignments. The district on a whole had been mired in a national scandal in recent years; found complicit in a cheating scandal that impacted many elementary, middle and high schools in the district. Also impacting the climate of the district were national mandates linked to high-stakes testing which prioritized reading/language art and mathematics as focus subjects for most under performing schools. Each participant noted that science was not taught by their cooperating teachers as an equal part of the curriculum; instead, it had become an add-on to the daily instruction schedule although the placements were with elementary teachers who were generalists, excepted to deliver instruction in all content areas. Through the life history interviews it was evident that none of the participants were able to observe consecutive teachers who provided quality science instruction.

During Shonnie's interview she reported that she didn't see much science instruction in her placements, visibly frustrated with her cooperating teacher for not providing in depth instruction for engaging concepts such as the life cycle of the butterfly.

> So the placement I had this year, they were doing life cycles and they didn't do anything fun with life cycles!...She gave them the book. She gave them pieces of paper and the copied the diagram from the book. That's it. They weren't doing anything fun. The one day she gave them construction paper to cut out arrows for the life cycle was because she needed to re-do her bulletin board, not because they would have fun doing it…that was like the only science lesson I saw. When she was absent they were copying out of

the book. Now in this placement they are departmentalized which I don't like but it works cuz the other teachers don't know anything about science.

Tiffany recalled her first field placement as a positive one with her cooperating teacher functioning as the lead science instructor. In that particular placement the school had created a lab space dedicated to science instruction and Tiffany expressed excitement from being placed in that classroom. When I asked how she felt about science in that placement she reported, "Good. She had a lot of cool experiments. We made a lava lamp, or like a lava bottle because there was no electricity. But it was really cool." Sadly, Tiffany was not that lucky in her next placement as she had basically the opposite experience with her next cooperating teacher. She explained why she felt she wasn't prepared to teach science emphasizing how often it was delivered through bookwork.

I feel like it's a lot of just writing. And my cooperating teacher doesn't help and I probably learn from her which is probably something that I should not take form her but then she has them read it aloud and that doesn't really help. They don't have, I don't know if they have funding as a school to get stuff for science…

Through Tiffany's recollection of the science she observed during her placements, she touched on multiple factors that could have impacted the quality of science instruction being delivered. She mentioned the teacher centered instructional strategies, lack of funding to purchase supplies for science investigations and the challenges of a general education elementary teacher devoting time, skills and resources to teach science.

Jackie's experience mirrored that of the other participants. When she explained that portion of her life history diagram she stated,

I put ‘science?... maybe tomorrow’ because the way they structure science in schools now it’s like ok, we are definitely having math, we are definitely having an hour of reading and science and social studies we will split up.

So some teachers have done it where we will do an hour of science today and do an hour of social studies tomorrow or one this week and one next week or even thirty minutes of each but either way it just sends across the message that science is less important.

Similar to Jackie’s questions about the frequency of science instruction, when Josie remembered science in her field placements it was also ‘hit or miss’. The first placement she spoke of took place in a departmentalized setting where she was placed with the social studies teacher, but had observed her homeroom students in science a couple of times. She noted that the science teacher did have a good command of the class and provided high quality instruction although she was not able to recount an example of him leading students through inquiry science. She celebrated the fact that she hadn’t seen him teach lecture style but was able to provide differentiation and good classroom management.

I’ve never seen him stand in front of the classroom and teach anything.

He gets them into groups, they respect him, they listen to him; he is real organized. He’s very together when it comes to his lessons and stuff. They were doing learned behaviors of animals, instincts and their environment.

So they had three groups, the below level students got on the computer and they did Study Island and went through the test for that. They came up with facts and then presented it, and then had to come up with four more facts. I asked them questions and they were responsive to what I was saying.

The only other incidence of science instruction that Josie recalled was at a previous placement where science was mainly taught by visiting a lab sporadically. “I never really seen science there honestly you know, they have to go to, and it’s like an elective there. It’s a special; they went every blue moon.” When I asked her if the classroom teachers taught science she reported that they did not but she did see engaging science instruction in the science lab. From here she began to critique the effect on students of only seeing science as an elective and offered some salient points about this intermittent instruction.

I guess if they see it as an elective, they probably won’t see it as important as it should be. Science, that’s how we grow, how we advance as a society.

My opinion, but um, if they only see it as art class, they may not take it as seriously or they may not find, they are not going to be motivated, they won’t make it an interest of theirs

When thinking about these students having to attend science daily once they enter middle school she asserted, “It will be a difficult transition and they’re going to have ill feelings towards it.”

Telling Stories about Resolve as a Teacher of Elementary Science

Regardless of the impact of the participants' lived science experiences, each teacher candidate expressed a personal commitment to figure out how to teach science well to her future students. Throughout their interviews, the participants expressed their expectations for themselves as future teachers of elementary science. They were able to explain what they perceived to be the most difficult challenge regarding teaching science to elementary students and were able to give pointed advice when prompted to supply three suggestions for their current cooperating teacher. From their critique of their previous field experience placements and memories of their own positive science schooling experiences they all wanted to provide engaging, inquiry based science instruction, develop close relationships while pushing students to excel and ensure that they were providing student-centered instruction.

In Shonnie's three pieces of advice for her cooperating teacher she: 1) challenged the teacher to truly assess the students' knowledge after a lesson to ensure understanding, 2) suggested that the teacher embrace innovation to encourage students to engage with the new content and 3) finally, understand the various learning styles in her classroom and the need to present information in various ways beyond lecture or worksheets. Shonnie stated that she wanted to be a teacher who would utilize all available resources to teach her students, bringing in technology and empowering students to explore. She reported that she would like to be a teacher that "gets messy" with science to show students how fun it can be. Lastly, she hoped to provide opportunities for students to share their scientific knowledge as she was able to in her own elementary years.

Tiffany's advice to her cooperating teacher echoed the sentiments of Shonnie's advice: 1) the teacher should have a large amount of hands on activities with materials covered in the

school budget, 2) bring in adults with jobs in the various sciences to explain their work and link to content being studied and finally 3) have the personal commitment to provide supplies even if the school is unable to purchase them. Tiffany's advice prioritized the students' ability to do science. As her interview wound to an end, she continued explaining the importance of inquiry science, "People need to know what Black children gravitate to and how they learn. They learn from hands on activities. They learn from having discussions. More hands on learning, more opportunities, and more things that they have makes it engaging and exciting."

Jackie's advice to her cooperating teacher suggested that she wanted to push past typical teacher-centered ways of presenting science to take students beyond her own comfort zone. She suggested that the teacher 1) stop relying on videos to teach science content; instead recommended using them as a starting point to introduce the concept and 2) provide more opportunities for students to engage with hands-on experiments. To those two pieces of advice, Jackie added that 3) her teacher should teach science everyday even if it is incorporating science into a reading or math lesson. One of Jackie's closing statements showed the type of teacher of science she hoped to be for her students; critiquing her experiences and identifying the types of science teachers she would have enjoyed. "Just looking at this whole experiment, and talking about all my experiences, I feel like it teacher were able to make it fun, I probably would still like science. I don't feel like science is important because of the lack of emphasis and creativity in my experiences growing up."

Although Josie was not in a placement where her cooperating teacher taught science, she was able to suggest three instructional strategies that would create a supportive science learning environment. She suggested the teacher should 1) know and teach to students' abilities and interests, 2) stay organized in order to cover all the material students would be assessed on in

order to help students develop confidence in a high stress testing environment, and 3) "just even if you are not enthusiastic about it, get into it for the sake of your children cause ultimately it's not about you, it's about the children."

I probed deeper as she admitted the totality of her experiences in her teacher preparation program left her feeling ill prepared to teach science to elementary students. Regardless of her feelings of unpreparedness, she asserted that she would be able to improvise to provide the instruction her students needed.

> I am able to adapt so I will able to teach science if I plan and prepare as much as I can on my own. Academically, no, I don't feel prepared for it because I don't think I know enough and some of those concepts are fuzzy but when I go into the classroom and actually try to apply it, it will be on command.

Altogether, the participants held high expectations about the need for them to provide high quality science instruction each day. They all mentioned the responsibility of shaping students' interest in science for years to come through the experiences the teachers scaffolded in their classrooms. Parts of this study served as a way for the participants to "talk back" against the science experiences provided by their previous teachers, standing up against the unproductive instructional moves they experienced in their own science schooling and observations during their field experiences; ultimately striving to develop a schema of how they would become competent teachers of elementary science in their own classrooms.

Summary of Analysis through Voice Centered Analysis

An analysis of participant's I Poems and life history interviews uncovered five themes that illuminated significant events which constrained and supported the development of these

elementary preservice teachers' science teaching identities. The five themes were: (a) the importance of 'doing' science; (b) relationships with teachers; (c) significant events of struggle in science; (d) expectations as teacher candidates; and (e) resolve as a teacher of elementary science. Chapter 5 presents a discussion of the impact of these themes on the development of the elementary science teaching identities of Black female elementary teacher candidates.

Conclusion

Chapter 4 opened with a brief review of the statement of the problem, theoretical framework, methodology and research questions. The chapter unfolded with four portraits constructed from the thematic analysis of I- Poems constructed from voice-centered listening from life history interviews. The chapter concluded with a summary of the five themes. Chapter 5 provides the discussion, implications and recommendations for future research and teacher preparation. Finally, Chapter 5 concludes with a discussion of the significance of this study and closing thoughts.

CHAPTER 5 - Discussion, Implications and Recommendations

"Their path to advancement might look less like a straight line and more like some of the pressure distributions and orbits they plotted, but they were determined to take a seat at the table…Their dark skin, their gender, their economic status--none of those were acceptable excuses for not giving the fullest rein to their imaginations and ambitions."
— Margot Lee Shetterly, Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race

This quote is from a book which inspired the latest blockbuster movie; currently the highest grossing movie of the last two weekends. This movie is somewhat of a game changer for Hollywood, like previously told stories of outer space exploration but different, celebrating a new cast of heroines. This movie brought the stories of young Black female mathematicians who helped calculate equations that launched our first astronauts into space to the forefront in a field that was historically dominated by White male mathematicians, scientists and engineers. The response to the movie and its story line has been deafening. On opening weekend, large throngs of movie go-ers flocked to the theaters to bear witness to this story. Across social networks scores of event invitations were generated by Black female mentoring groups across the country who heralded this movie's release as a celebration of #blackgirlmagic; a celebration of the intellectual and social prowess of a traditionally underrepresented, nay, intentionally ignored group of intellectuals. No longer could we ignore the contributions Black women have made nor continue to be confined to historically pernicious stereotypes of Jezebel, Mammy or welfare queen.

This study was conducted to investigate the lived science experiences of Black female elementary teacher candidates to understand the development of their science teaching identities. The spark for this research project was born out of multiple experiences with former Black

female elementary teacher colleagues who were vulnerable enough (or brazen enough) to lament their inability to provide adequate elementary science instruction. The flames of this study were fanned by the Black students in my former schools who yearned to engage deeply with the messiness of science, delving into the wonderment of scientific phenomena and posing questions to answer their insatiable desire to understand "why". I wonder how different the data would have read if the participants had been able to view this movie and be confronted with images that contradict stereotypical images of scientists and other members of the STEM community before they participated in my study. Would they have further interrogated their lived science experiences? Would they have felt even more dedicated to providing equitable science experiences for their future elementary students?

In chapter one I introduced the significance of this research study and discussed the conflation of the history of science instruction, teacher preparation and the perception of Black girlhood in science learning spaces. Chapter one also explained the importance of preparing all elementary teacher candidates to provide high quality science instruction. Chapter two presented literature of Endarkened Feminism epistemology and the theoretical frameworks of Critical Race Feminism and Black Feminist Thought to understand the impact of race and gender on this study's participants. Also, research across the fields of science education, science teacher education as well as identity construction were reviewed to present current understanding of race and gender in science education.

Next, chapter three grounded the research questions in the context of this study. It used the literature presented in the previous chapter to show the importance of this study's design as an emancipatory experience, privileging the participants' voices through portraiture as research methodology. The researcher acknowledged her inability to silence her lived experiences and

welcomed the blending of participants' voices with hers to conduct this study, a stance which is supported by portraiture methodology.

Chapter four presented four intricate portraits constructed from life history interviews and PhotoVoice pictures and narrations. These four portraits created a mosaic of science learning opportunities and struggles faced by Black female elementary preservice teachers and illustrated the impact of those experiences on elementary science teaching identity construction. Through the development of these portraits, five main themes arose: (1) the value of engaging in inquiry science, (2) the impact of relationships with teachers, (3) impact of struggles in science class on science identity development, (4) expectations as teacher candidates, and (5) participants' personal commitment to provide quality elementary science instruction regardless of lived science experiences.

In chapter 5, I will put forth answers to the research questions which framed this study and provide a discussion of implications of the study followed by recommendations for practice and research. I will conclude with final thoughts regarding this study and its participants.

Answering the Research Questions

Endarkened Feminist Epistemology (Dillard, 2006, 2012) provided an epistemological framework to approach this research project putting forth these helpful assumptions about the creation and validation of knowledge:

1. Self-definition forms one's participation and responsibility to one's community.
2. Research is both an intellectual and a spiritual pursuit, a pursuit of purpose.
3. Only within the context of community does the individual appear, and, through dialogue, continue to become
4. Concrete experience with everyday life form the criterion of meaning, the "matrix of meaning making"
5. Knowing and research are both historical and outward to the world. To approach them otherwise is to diminish their cultural and empirical meaningfulness
6. Power relations, manifest as racism, sexism, homophobia, and so on structure gender, race, and other identity relations within research. (p.18-26)

While there has been critique of this epistemology, the scholars who have offered up these critiques may underscore the importance of a new theory of knowledge in the study of Black women. Dillard (2006, 2012), a Black woman, proposed this theory of knowledge to helped explain the legitimacy of lived experiences of other Black women. Her contribution of EFE was questioned by a Black man, Handel Wright (2003) who suggested Dillard's conceptualization of Endarkened Feminist Epistemology had somewhat of a limited use as there were other conceptions available to use for research on Black women. Wright asserted, "Rather I am interested in how sociocultural difference may operate within an endarkened feminist epistemology; in how the concept, discourse, and project would work in relation to existing, presumably allied discourses and projects such as (racially unmarked but remarkably white) feminist epistemologies; as well as in what effect it will have in the larger context of educational research" (p. 201). Wright, a researcher who conducts research utilizing a postmodernist epistemology employed the work of Britzman, Rorty, Spivak and other leading postmodern theorists to assert Endarkened Feminist Epistemology is too limiting, centering the differences of the Black female experience in a way that perpetuated her alienation. Wright instead proposed what he termed to be a parallel articulation which questions "what difference difference makes" in an effort to address the multiplicities of Black female lives that he felt EFE did not adequately include.

Another postmodernist researcher, Patty Lather, considered the usefulness of EFE also bringing Wright's rebuttal into critique as way to reconsider the messiness of identity. Like Wright, Lather (2008) considered what was lost by an epistemology which prioritizes one 'othered-ness' over another. Lather, a White woman, suggested decentering one's experience in an effort to better understand the experiences of others. While there are many useful aspects of

postmodern thought and the work of these two researchers, for the fact that they embody spaces (Black male and White woman) that are outside of the experiences EFE seeks to validate, I wonder how worthwhile these critiques are for achieving the goal of developing an epistemology that celebrates and substantiate the unique experiences of Black women. I, along with other Black female researchers, assert the importance and necessity to use EFE to explain, corroborate and legitimize the experiences of Black women and girls.

Black feminist researchers have successfully employed this epistemological framework to investigate the schooling experiences of Black girls and women through a substantial volume of work covering elementary school experiences to the pursuit of terminal degrees (Evans-Winters and Love, 2015). The works in this volume illustrate the necessity of valuing the knowledge production and personhood of Black girls and women in ways unsubstantiated by other epistemological stances. For this study, I found assumptions 1, 4, 5, and 6 helpful to first, validate participants' responses and second, link their responses to implications for other Black girls and women.

Critical Race Feminism in education (Evans-Winters & Esposito, 2010) is an important theoretical framework for understanding the needs of Black girls and operates from these important premises:

1. Critical Race Feminism as a theoretical lens and movement purports that women of color's experiences, thus perspectives, are different from the experiences of men of color and those of White women
2. Critical Race Feminism focuses on the lives of women of color who face multiple forms of discrimination, due to the intersections of race, class and gender within a system of White male patriarchy and racist oppression
3. Critical Race Feminism asserts the multiple identities and consciousness of women of color
4. Critical Race Feminism is multidisciplinary in scope and breadth
5. Critical Race Feminism calls for theories and practices that simultaneously study and combat gender and racial oppression. (p.20)

All six of these premises were helpful in analyzing data from this study. By tightly focusing on the participants' retelling of their science identities and lived experiences, I came to understand how and why their science schooling and teacher preparation needs differ from that of Black males, White males, White females and students of other racial backgrounds. As I considered the science education and science teacher preparation of these Black female elementary preservice teachers, I teased apart the ways social and historical constructions of race and gender in science supported or constrained their participation in science spaces. From the inception of this research proposal, I and my dissertation committee discussed the messiness of this research project. Mentioned in previous chapters, my insider status afforded and sometimes constrained my gaze offering trust and connection with my participants but also highlighting a perceived need to protect my alma mater from critique. My status as a graduate from the college and program I chose to study, my status as a doctoral student working with undergraduate students as well as the particular sisterhood relationship Spelman graduates have with one another at times caused me not to pull at a hanging thread that could have unfurled a ball of additional messiness and confusion. The constant interplay of this study's messiness and portraiture's commitment to a search for goodness created a state of tension throughout the inception and completion of this project. Many questions arose that invited me to examine the culprits in the histories of the participants' lives, causing me to play a double-dutch game of sorts, considering positive aspects of the participants' lives then highlighting the subsequent events that limited the development of a robust science identity across multiple points of their lives. Upon the encouragement of my committee to lean into this messiness, I present an analysis of this study's finding and the implications specific to these participants, who have existed as outsiders within their lived science spaces.

Research Question #1:

What are the lived science experiences of Black females in an elementary certification program at an HBCU?

All four participants presented similar stories of their formal lived science experiences. They shared stories of limited inquiry experiences in science classes, teacher centered instruction, strained relationships with their science teachers, and feelings of isolation in advanced science courses. The terrain of their lived science experiences were not wholly negative, evidenced by the joy with which they recalled engaging in inquiry science, feeling supported by teachers and moments of science success. Their stories of alienation in traditional science learning environments resonated with othe Black women and girls who sought to be recognized as doers of science. One participant, Shonnie, passionately shared positive science experiences during her elementary years where she conducted inquiry science, was invited to present her findings to her classmates and subsequently developed a strong sense of pride in and appreciation of science. These instructional strategies facilitated the participant's membership in this elementary science community of practice as a legitimate participant through conducting and communicating science research. Shonnie's teacher presented science engagement in a culturally relevant manner (Ladson-Billings, 1995; Johnson, 2011; Wallace and Brand, 2012), providing students opportunities to conduct hands on explorations and foster pride and discussion through presentations to the rest of the class.

Another, participant, Tiffany, remembered the development of a strong science identity through legitimate peripheral participation in informal science experiences and support from family members who were accepted members of their immediate science community of practice as a doctor and medical school educator. Given the opportunity to engage in science through a

community with which she identified and who reinforced her participation in science, Tiffany could develop a strong science identity at a young age (Rosa & Moore, 2016, Simpson, & Parsons, 2009; Varelas, Martin & Kane, 2012). Black feminist scholars (hooks, 2000; Lindsey, 2013; Morgan, 2000) have maintained the importance of positive representation in areas where Black girls are marginalized to promote perseverance, tenacity and confidence while debunking stereotypes and empowering about them. While science instruction during elementary school years was not remembered as robust by all participants, on a whole, elementary school was not a detrimental period for the participants' science identity. These data mirror research that explains students in general and Black girls specifically are identified as less scientific during their advancement from elementary to middle school (Carlone, Scott & Lowder, 2014) due to factors such as teacher directed changes in opportunities for science engagement, expectations of traditional science performance and teacher expectations of appropriate gender and racial student performances.

Regarding science during their middle school years, participants expressed excitement for the opportunity to study science each day through departmentalization, wowed by lab tables and access to science tools, but were confronted by tenuous relationships with science teachers and teacher-centered instruction. Here participants' responses shed light on raced and gendered interactions with teachers. Memories of science during these years foregrounded interactions with teachers rather than science instruction. Strong budding science identities were weakened as the study's participants strived to gain entry into new communities of practice each year they received a new science teacher. The science teachers mediated the participant's acceptance in the community of practice by the learning opportunities made available in their classrooms. This finding is in line with Brickhouse, Lowery and Schultz's 2000 study of the identity work of four

Black girls from 7th to 8th grade where teachers held limited views of school science and science engagement that did not always celebrate the science work of these young Black girls. Like this study's participants, those students were more interested in science learning that involved lab activities and participation in science discourse. At times these science learning opportunities were constrained by budget restrictions, limited pedagogical content knowledge and negative controlling images of Black girls in schools (Brown, 2009; Evans-Winters, 2005, 2011; Love, 2011).

Additionally, these participants were forced to navigate expectations placed on them from the teachers who may not have always been understanding of their ways of participating in class. In the majority of science experiences the participants recounted, science was presented from an more Eurocentric manner, which did not make space for the ways they enjoyed learning. Like so many other Black girls in schools, their efforts to participate in science class were often read as loud, disrespectful, combative and trying to 'one-up' the teacher. They preferred to science learn in ways which incorporated aspects of Black Cultural Ethos such as orality, affect, expressive individualism, communalism, and rhythmic movement and expressiveness. Participants lit up when recalling group projects, hands on investigations, creating music videos to display learned science content and opportunities to present scientific findings to the whole class. Their brows furrowed as they expressed frustration with monotone, lecture based science instruction and science lessons that involved completing science worksheets individually. Parson (2008) addressed the academic and social benefit of reconstructing science classrooms to incorporate aspects of Black Cultural Ethos which could lead to more culturally congruent science instruction. asserting the possibilities and promise for additional research on this topic. The findings from this study support that assertion.

While none of the participants reported overt instances of racism or sexism from teachers, participants shared instances of microagressions "subtle, automatic or unconscious racial insults" (Dixon & Rousseau, 2005, p.13) such as an unwillingness of a teacher to learn the participant's name, one participant's dismissal from a class because the teacher gave 'permission to fail' , the construction of students as 'good Black students' in opposition to the other students in the class or school and overpolicing and hyperdisciplining of perceived disruptive behavior which were actually the participants' bids for participation in these science communities. One salient theme of Critical Race Theory, is applicable when considering the microaggressions participants faced: Delgado (1990) argued for a critical examination of the myths and stories powerful groups use to justify racial subordination. While these participants were allowed access to science classes and even persisted by choosing to take Honors or Advanced Placement classes, through the more covert or unconscious raced acts of their teachers these participants were rarely able to be seen as complete doers of science. The stories that were told about celebrated scientists, the racial backgrounds of the participants' teachers, the curriculum included in their science textbooks which rarely highlighted scientific contributions of nonwhite, nonmale scientist and the stark realization that they were one of the few or the only Black female student in their advanced science classes perpetuated ideas of racial subordination in science. Codrington (2014) raised several important questions to consider to reshape culturally responsive science teaching imploring science researchers not to stop at including culturally congruent teaching strategies but to push past that goal into an active and aggressive reshaping of the narrative of successful scientists which work to alienate students outside of that traditionally accepted image of the scientist.

For three of the four participants, science in high school presented the greatest struggle as the advanced courses in which the participants were enrolled were characterized by teacher-centric instructional strategies, perceptions of unsupportive teachers and racial isolation as participants realized they were the only Black student or Black female student in their advanced science classes. These realizations mirror findings from Kynard's 2010 study of Black female students where "Black female students felt ignored or marginalized at the same times their bodies were highly marked and super-visible" (p.42). The participants' bodies existed at the opposite spectrum of traditionally recognized scientists. Through the persistence of the stereotypical image of the scientist in media and traditional school science, and the hyper-policing and indoctrination of western science practices in high school science classes this study's participants were not able to benefit from systematic and material allocation of status and privilege thusly, they were unable to consistently develop celebrated science identities (Brickhouse, Lowery & Schultz, 2000; Carlone, 2014; Delgado, 2001). Participants shared memories of receiving low grades in science and identified particular moments of frustration during these years. Again, while participants did not point out specific racist or sexist science events, they were able to recount microagressions that caused them to question their own science abilities. The experiences shared by these high performing students reflect marginalization and exclusion in science education. However, one can wonder, what would been the experiences of Black female students who were not marked as high achievers? I submit that an examination of the lived science experiences of low achieving Black female students would reflect a very real crisis in the science schooling of Black girls and young women.

Michael Dumas (2010) utilized Critical Race Theory to offer a very helpful construct with which to analyze these participants' lived science experiences. Spurred by the concept of loss in

Octavia Butler's *Kindred*, Dumas considered what Black children and teachers lose when they are educated in American schools which have a history of celebrating white middle class ways of schooling Through the concept of schooling as a site of Black suffering, Dumas explored the social suffering parents and their children experienced through school integration describing how Black students are impacted by *school malaise,* where marginalized students suffer from the drudgery and futility of school as well as loss of hope for oneself and one's group due to the incongruence of the totality of the school experience. He also applied the concept of *racial melancholia* , a collective experience of social suffering due to struggles with the permanence of racism.

This is a powerful and productive lens with which to consider the lived science experiences of these participants. As Black girls in science classes they experienced *school science malaise,* suffering from the drudgery of their science classes while wrestling with the permanence of racism perpetuated by the constrains of traditional school science which did not make space for their young, Black, female bodies. Being young, Black and female, they belonged to many groups which were incongruent with celebrated scientists and the way their experienced science often cast them as outsiders. Returning to the concept of schooling as a site of loss and trauma, I assert science schooling was particularly a site of loss for these participants. Across their life history interviews they expressed many instances of loss; losing relationships from being the one of the few or only Black girl in their science classes, losing opportunities to engage deeply in science learning, the loss of future opportunities to pursue science as a college major and career and possibly losing the opportunity to enjoy and engage in everyday science. These participants lost large amounts of time; time that could have been spent learning about scientists which looked like them, celebrating achievements and sparking inspiration for their own potential

achievements. Jackie lost actual time as she was enrolled in her AP Physics class and her teacher let her leave class daily because he did not feel compelled to support her success in that class. The time she lost in that class, she could have been enrolled in a different class, continuing to satiate her desire to learn. Much more research should be done to explore schooling and science schooling particularly as a site of Black loss. Dumas implored researchers, "More than this, we must attend to how prolonged, targeted cultural devaluation of black children and blatant maldistribution of educational resources along racial (and class) lines affect how black subjects make meaning of schooling, their racialized bodies in relation to schooling, and the role of education and educational institutions in assuring the collective linked fate (p. 22-23). Through this framework researchers might be able to propose restorative practices for science education in hopes of righting the wrongs of traditional K-12 science schooling.

Once the participants matriculated to college, their experiences with science continued to deteriorate although participants did not identity raced or gendered learning experiences due to their enrollment in this historically Black women's college. This college functioned as a 'safe, cultural space" (Collins, 1991) sheltering these students from the raced and gendered experiences commonplace in their previous schooling. Although this college was functioned as a sanctuary for the participants, there were ways in which these participants' science identity development was not fully supported. They viewed the science course that was a requirement for the elementary certification major as a waste of time, not in line with their interests and presented in a haphazard manner as the instructors for the lab and lecture were not the same. For the participants who had taken accelerated science courses in high school, the environmental science course did not connect to or expound on their previous science instruction. Additionally, participants labeled the science instruction they received during the required math and science

methods course as disconnected, inapplicable and frustrating. Participants reported that cultural and linguistic barriers between the teacher candidates and their instructor impeded their ability to learn how to teach elementary science effectively. Finally, as another impediment, participants described their inability to observe high quality science instruction consistently being taught during their field experiences and student teaching in elementary school classrooms. In this space of higher education for Black women, participants did not report sexist or racist events, but began to critique the raced and gendered ways science was delivered in their field and student teaching sites.

Returning to Dumas (2010) concept of schooling as a site of loss, it is productive to consider what was lost through the participants' experiences in their teacher preparation programs. There were many levels of loss in these participants'' lives. Tiffany lost many things in regard to her science schooling at Spelman. I wonder how much of the weight of *racial melancholia*, the collective experience of social suffering, impacted her inability to persist in science after the death of her godmother. How did the impact of losing her role model effect the perceived weight of persisting in science, a traditionally White male space even though she was being educated in the most celebrated space to teach Black young women science? How much time was lost as Tiffany unsuccessfully took Chemistry, successfully passed the Biology course and still had to take the Environmental Science course? What was lost as Shonnie was forced to take Environmental Science when she had dreams to take Chemistry as her science prerequisite course?

Considering the science methods course, there are obvious parallels to loss. Participants bemoaned the loss of time to learn appropriate science teaching methods, loss of interest in science as the class rarely made connections to their future careers as elementary teachers, loss of

joy and loss of pride in their prior science successes. Even at a site which is nationally heralded for nurturing Black females in science, these participants were unable to reap the benefits of those resources, resulting in the inability to develop a robust science identity that was supported for students in other parts of the college campus.

Research Question #2

How do the science experiences of Black female teacher candidates impact their identity formation as teachers of elementary science?

a) How do the kindergarten through 12^{th} grade science experiences of Black female pre-service teachers impact their identity as teachers of elementary science?

b) How do college science experiences of Black female pre-service teachers impact their identity formation as teachers of elementary science?

Education researchers have employed the concept of identity as an important factor to understanding the learning process. Lave and Wegner (1991) explicate the notion of identity by considering the way one learns to become a member and identify with a certain community through legitimate peripheral participation in a community of practice. Additionally, Gee (1998) introduced a helpful framework from which to understand factors which support and constrain identity development asserting that identity is socially constructed through socially agreed upon norms that span discourse, embodied practices, style of dress and other visual markers. The utilization of these concepts of structures that support particular identity development aided me in analyzing the ways this study's participants' identities were shaped. By considering the conflation of race/class/gender on opportunities to participate in a community of practice we can uncover constraints and suggest possibilities for support.

Sfard and Prusak (2005) offered a definition of identity as "stories about persons", further stating one's first person identity is understood through "identifying stories told by the person herself". This is a helpful definition to utilize in the approach of this research study. Considering the stories participants told about themselves and others helped to provide an understanding of the participants and how they identifed themselves as a certain "kind of science person" (Gee, 1998) they have become and can be. The data gathered from the participants' representation of science across their lives painted a preliminary picture of the type of science person they regard themselves as in light of the many other competing identities that were thrust upon them as young Black girls.

The mosaic of primary and secondary science schooling experiences of these Black female elementary teacher candidates often times did not align with traditional stereotypic images of a scientist. Candidates reported struggles with teachers to fully engage as members of the science community as an impediment in the development of robust science identities. Longstanding and traditionally accepted images of a science person depict an older White male character engaged in chemical science wearing glasses, a lab coat and crazy hair (Mead and Metraux, 1957; Chambers, 1983; Finson, 1995; Farland-Smith, 2001).

Researchers have questioned the validity of DAST as a instrument to investigate students' perceptions of the image of a scientist. Los, Wilke & Pop (2008) asserted the insufficiency of traditional DAST tests which only prompted children to draw a scientist. Through their study, students were prompted to draw a variety of occupations to further uncover gendered perceptions of professions as a whole. Results from their study showed that students did still overwhelmingly draw scientists as male, although many drawings completed by male students were undistinguishable in regard to the drawings gender. Hillman, et.al., (2014) also

questioned the validity of DAST by pairing the DAST with additional questions to uncover students' thoughts about scientists. Results from the first administration of the DAST showed similar results as other research in the stereotypic image of a scientist, however, the survey questions asking students to describe the clothes, tools, actions, age and workplace of a scientist helped to provide additional context for their drawings. This study paired STEM Mentors with classes as science experts and found that drawings from the second administration of the DAST yielded more drawings where the scientist was depicted as a White male, representative of the STEM mentor's background.

Notwithstanding the critique of this instrument, several researchers have found it to be a productive measure of perceptions of scientists with both children and pre-service teachers (McCarthy, 2015; McKinnon & Perara, 2015; Subramaniam, Esprivao Hanell & Wojnowski, 2013). McKinnon and Perara (2015) found the DAST instrument to be a productive indicator of perceptions of the scientist with more stereotypic images drawn by elementary preservice teachers than secondary science preservice teachers. McCarthy (2015) found that stereotypic perceptions were still evident during a preservice teachers' matriculation through teacher preparation programs but were lessened after exposure to different types of science, various representations of scientists and the PSTs' own consideration of their lived science histories. In line with the majority demographic of elementary preservice teachers, an overwhelming amount of the participants in this study were White females. Further research should be conducted to evaluate the efficacy of this instrument with Black female elementary PSTs in an effort to uncover the impact of their perceptions of a scientist on their ability to develop a robust science teaching identity.

Participants in this study repeatedly called memories of the way this stereotypic image of a scientist prohibited their full involvement in their science classes by inhabiting bodies which were young, Black and female, the direct opposite of the traditional older, white male image. .If this image is taken as the norm for a celebrated participant in the science community, then the participants in the present study occupied marginalized spaces due to constructions of race, gender and age (hooks, 1990). Ong (2005) confirmed this finding through research of women of color who persisted in science careers. The study's participants reported receiving messages that suggested that not having the standard identity of a scientist negated their intellectual competence as scientist regardless of science abilities and scores.

Although none of the participants specifically reported instances where their science teachers asserted they were incapable of doing science, messages about them not being seen as the typical science student seeped in through perceived microagressions. During her life history interview, when asked about messages Shonnie received throughout her schooling she responded, "No one can do science and Black people can't do anything". This statement underscored the barriers she perceived to successful science participation. By recounting messages that science is hard for everyone and Black people did not have the skills to do much of anything, Shonnie revealed that these messages ultimately illustrated a double barrier to science: it being difficult for all and Black people being incapable of most academic pursuits. Also, regarding the stereotypic image of the scientist, through the photonarration of one of Jackie's PhotoVoice submissions, she presented an image of an older, White man in a lab coat as the teacher who ran the science lab at her elemtentary student teaching site. Through her photonarration she problematized the messages her students received through the presence of this

man who was presented as having the most science knowledge in the school, more than the general education teachers who at that school site were mostly Black females.

Another type of imagery constrained participants' abilities to participate in their science communities. At times this study's participants were impacted by the controlling images often thrust on Black girls in schools such as combativeness and laziness (Love, 2011; Morris, 2016; Muhummad & Dixon, 2008; Pratt-Clarke, 2010; Richardson, 2000; Wing, 1997) which hampered participation in their science communities of practice due to their marginalized (hooks, 1990) or outsider (Collins, 1986) status in the science classroom. Participants told stories of 'bids' (Gee, 1998) or attempts to participate in science classrooms that were blocked by teachers as the immediate gatekeepers to participation in science classrooms; teachers who questioned participants' ability and interest to successfully function as members of a science community. Their frustrations were palpable as they described wanting to be acknowledged and celebrated as a part of their school science communities.

Each of the participants thrived with teachers who supported their individual science development and also demonstrated resilience in the face of teachers who did not see them as full members of the science community, whose behaviors at times impeded the participants' development of strong science identities. During their high school years, all participants chose to take higher level science courses, enrolling in an honors or Advanced Placement level science course during their senior year. The decision to enroll in a higher level science course can be taken as an indicator that the participant felt competent in science and able to perform well in the advanced course which could earn them college credit upon successful completion of the AP exam. Tan et.al, (2013) acknowledged the tenuous terrain young girls of color must navigate regarding school. The participants' recollection of teachers who did not engage them, teachers

who allowed them to disengage from the course or teachers who chose to focus on other students who seemed more likely to be successful on the AP test caused feelings of frustration and invisibility as participants reflected on the feeble science identities they were able to construct during their k-12 schooling. Previous research on the dialogic relationships between girls and the power structures of their science worlds (Carlone, 2004, 2014) reifies the need for continued research and supports to help young Black girls navigate school science spaces.

Research Question 2b) asked: How do college science experiences of Black female pre-service teachers impact their identity formation as teachers of elementary science?

There is a long history of the importance and success of Black educators, and Black female educators specifically in the history of the United States. Siddle-Walker (2000) recounted the approach of Black teachers working during segregation as:

consistently remembered for their high expectations for student success, for their dedication, and for their demanding teaching style, these [Black] teachers appear to have worked with the assumption that their job was to be certain that children learned the material presented. (pp. 265–266)

Black teachers were much more than dispensers of knowledge, they were concerned about multiple facets of their students' lives. Irvine and Fraser (1998) considered the idea of Black teachers as "warm demanders" who held high expectations of their Black students to achieve regardless of perceived obstacles, pairing their high expectations with the unwavering dedication to help students reach their highest potential. Collins (1991) asserted that Black teachers operated as a second mother to their students, interacting with care, compassion and concern for their Black students' academic and nonacademic well-being through other mothering.

The preparation of new cadres of Black female teachers hope to supply Black students with strong teachers that embody these characteristics of high expectations, personal responsibility and commitment to their craft as teachers. Participants in this study identified their commitment to teaching and identified hopes to replicate the successes of Black female educators they learned from and learned about during their teacher preparation program. While they were able to describe how their college experiences allowed them to develop strong identities as Black women, academically sound college students and appropriately skilled novice teachers, they were unable articulate a strong elementary science teaching identity.

Participants grappled with the development of many different identities during their college years; college student, young woman, Black woman, teacher candidate, teacher of elementary math, teacher of elementary reading, teacher of elementary social studies, teacher of elementary science, and many other identities that emerged during this time of transition, in relation to religion, gender, sexuality, identities linked to geographic locations, and the like. Applying Lave and Wegner's (1991) concept of communities of practice and legitimate peripheral participation to the structure of teacher development is a helpful framework to evaluate the opportunities for science teaching identity formation of this study's participants.

As participants discussed their expectations of the science requirements for the elementary teacher certification program, another community of practice, none of the participants expressed feelings of doubt towards their ability to be successful with the prerequisite science course. Two participants expressed frustration for not being able to enroll in or receive credit for a more difficult science course such as chemistry and biology rather than environmental science and the other two participants mentioned not feeling challenged by the material covered in the required course. All participants argued that the required course had

limited pertinence to the elementary science curriculum that they were expected to teach in their future classrooms. During their reflection on the required Environmental Science course, participants attributed difficulties with the professors as factors which impeded their enjoyment of the course. Factors specific to post-secondary schooling such as a different teacher for the lab and lecture seemed to be significant in unsettling the participants. Language barriers and the college instructors' reported inability to connect in personal ways with the students caused participants to feel disconnected from the course. Although participants reported earning an A or B in that course, my position as a researcher causes me to question: Why were these candidates forced to take Environmental Science? Why couldn't Shonnie take Chemistry or Tiffany's passing grade in Biology be considered sufficient for the science requirement? It is evident that there was little to no collaboration between the elementary science methods instructor and the Environmental Science instructors to ensure key concepts were covered in a fluid manner. There has been no national or state level guidance as to which science should be offered as the science prerequisite for elementary preservice teachers and the students' responses demonstrate an opportunity for the education program to consider selecting or creating a more applicable science course.

Legitimate peripheral participant is an initial form of membership characteristic of such a community. Acceptance by and interaction with acknowledged adept practitioners make learning legitimate and of value from the point of view of the apprentice…A deeper sense of the value of participation to the community and the learner lies in *becoming* part of the community (p110-111, Lave and Wegner, 1991).

This study's participants expressed frustrations as the outcomes of the elementary science methods course did not meet their expectations. Considering the science methods course as a

smaller community of practice within the larger teacher preparation program, participants were not able to participate in elementary science teaching opportunities through legitimate peripheral participation. During other methods courses, the participants reported opportunities to develop 'identities-in-practice' engaging in course requirements that mirrored practices of the teaching community, where participants practiced talking, knowing, doing and being as a teacher of elementary content and learning how to teach certain subjects through the participation in those communities of practice. Sutherland, Howard, & Markauskaite (2010) contended that preservice teachers need to acquire knowledge and skills of pedagogical practice and so doing, have opportunities to create and recreate identities as members of the professional teaching community.

Participants adamantly recounted their frustration with the elementary science methods course instructor's materials, instructional strategies and content coverage and contrasted that with how and what they learned in their other methods courses which helped them learn to teach that content. They expressed that the science methods course did not prepare them in the same way, leaving them with the unfulfilled desire to know how to plan science units, how to present challenging science content and other aspects of successful science teaching. From the participants' reports, it is clear the participants felt the science methods course was supposed to provide them with significant experiences that would help develop their ability to teach science, but that the course did not afford them those opportunities. From the participants' accounts, the science methods course did not operate as a community of practice, impeding the participants' ability to learn to teach elementary science, participate in the community, become full members and develop a robust science teaching identity. Program officials should have ensured the instructor hired was capable of teaching the course, providing any needed support and materials

to deepen science teaching methods for the students. Participants' recounted how the semester dragged on and the growing fear of the approaching GACE test, feeling unsure of their abilities to pass. Even after the successful passing of the GACE test to prove they held the appropriate level of content knowledge, participants still lamented the fears of teaching science and their lack of confidence to adequately plan engaging science lessons.

As a part of teacher preparation, field experience and student teaching opportunities function as another community of practice where preservice teachers should have opportunities to engage in legitimate peripheral participation with the support of a seasoned in-service teacher. Participants identified their field experience and student teaching sites as spaces in which quality science teaching was rarely if ever observed or modeled. In addition to the lack of opportunities to practice successful science teaching in the science methods course, the participants reported observing limited science instruction during their experiences observing elementary teachers and their classes, which conveyed messages that ranged from science being unimportant or less important than reading and mathematics, science being best taught by someone who majored in science in college and science being taught as a weekly addition to the schedule, all of which impedes daily science instruction.

While the participants entered the elementary teacher certification program with relatively strong science identities, the experiences during their teacher preparation program had dangerous effects on their science teaching identities, eroding some of the strong identities they formed during their primary and secondary years. I believe that the poorly taught science methods course and the limited science observed during field experience and student teaching were both factors that had equally damaging impressions on the participants' ability to develop robust science teaching identities. If the science methods course had been stronger, or if there

were there more opportunities to observe quality science instruction during the elementary field experience and student teaching, the participants would have been better able to develop a more robust elementary science teaching identity. There were many missed opportunities to adequately prepare these preservice teachers to teach elementary science. Biology is the largest major at the college with robust programs in chemistry, physics, as well as computer science. The college boasts the nation's only Black women's robotics team, the Spelbots, who have traveled internationally demonstrating the intellectual prowess of students on the team. The college also has an office of K-12 STEM Outreach that operates out of the main STEM departments, without any engagement with the education program. It would seem to be an easy win for the college to share these resources to train teachers going into these classrooms, but this was a missed opportunity to support these students.

Spelman College has cultivated deep relationships with leaders across STEM industry, providing internships and training to deserving students. What might the impact be of some type of internship or apprenticeship that allowed the elementary preservice teacher to see the viability of science as an option for their future students? Additionally, being situated in Atlanta, there were many informal science learning opportunities available such as the Georgia Aquarium, the Botanical Gardens, Zoo Atlanta and the Fernbank Museum of Natural History. Given the college's status, partnerships with these science organizations could have been forged that could help scaffold these participants' science identities.

In agreement with Lave and Wenger (1991) who argued, "Moving toward full participation in practice involves not just a greater commitment of time, intensified effort, more and broader responsibilities within the community, and more difficult and risky tasks, but more significantly, an increasing sense of identity as a master practitioner," (p.111). These participants

were not afforded adequate opportunities expected of teacher preparation programs. Teacher preparation programs present opportunities for preservice teachers to forge new identities in practice against the backdrop of their science histories-in-person and the raced and gendered science histories preservice teachers have experienced. Avraamidou (2014) argued teacher preparation programs must provide preservice teachers with experiences that cause "identity shifts" (p.154) while Markus and Nurius (1986) asserted that preservice teachers must have the opportunity to narrate who they want to be as teachers of elementary science through well planned teacher preparation that allows them to construct positive "possible selves". Considering the concept of identity fluidity and Gee's (2001) question "Who am I at this moment?" we are able to ponder the emancipatory aspect of the ever evolving nature of identity work.

Portraiture as method tasks the researcher to "search for goodness" (Lawrence Lightfoot, 1986). In her seminal portraiture, *The Good High School*, Lawrence-Lightfoot wrote,

The search for good schools is elusive and disappointing if by goodness we mean something close to perfection. These portraits of good schools reveal imperfections, uncertainties, and vulnerabilities in each of them. In fact, one could argue that a consciousness of imperfections, and the willingness to admit them and search for their origins and solutions is one of the important ingredients of goodness in schools. (p.309)

In line with Lawrence-Lightfoot's search for goodness, I offer this important note about the participants' teaching identity development through the imperfections, uncertainties and vulnerabilities of this teacher preparation program. While participants were not afforded a great deal of opportunities to observe and participate in science learning, the preparation in other areas of their teacher development equipped them to 'talk back' to and critique their elementary

science preparation. Through the program's emphasis on culturally responsive teaching, advocacy, and pedagogical content knowledge, each participant was able to 'talk back' against the science they observed being taught in their field placements and 'talk back' against the activities that comprised the science methods course. When the participants discussed the science methods course, they enacted agency by naming inadequacies of the course but also spoke with compassion as they asserted the professor hadn't been set up for successful instruction of that course. Participants discussed how their teaching cohort at large and their participation in this research project helped them develop a deeper sense of community to collectively 'talk back' against their lived science experiences. While participants felt like outsiders during their K-12 schooling, the teacher preparation program afforded them the opportunity to commune with other Black young women who identified with their struggles as young Black girls who were at times prohibited from participating in communities of science. These future educators employed aspects of Black feminist thought, naming their experiences as vowing to provide a different experience for their future students. They expressed their motivation to teach and readiness to serve Black students in urban classrooms as a way to 'talk back' to their own experiences of not having Black teachers in their lives, hoping to bridge the gap they felt as students.

Taken as a whole, the participants seemed to have developed strong teaching identities although their reported science teaching identities were not as robust. Participants expressed confidence in their ability to connect with students, plan engaging lessons, understand content standards and practice other important teacher actions. These stronger teaching identities were viewed as assets as the participants asserted they could tap into those experiences to help them be better teachers of science. It is also helpful to note that the teacher preparation program provided many opportunities for teacher candidates to read, participate and enact aspects of culturally

responsive pedagogy and advocacy for students. These experiences helped participants develop a critical lens to interrogate the limited science instruction provided in their field placement sites. I argue that since these participants were able to develop aspects of a strong teaching identity, strong professional development support once they become classroom teachers could have the ability to strengthen their science teaching identities.

Implications of Research

1. Inquiry science taught through student centered instruction is imperative for Black girls to develop strong science identities. While national science teaching organizations explain the importance of inquiry for all students, the learning needs of Black girls in science classes hands on science learning is essential to development of their science identities. Research on Black girls ways of being, the embodied practices of learning and pivotal information on the benefit of incorporating tenets of Black Cultural Ethos in science classrooms will help teachers reshape their understanding of behaviors demonstrated in their classroom; being able to accept those bids for acceptance and creating more learning opportunities which will support participation in science learning. As Black girls are less encumbered by obligations to perform scientifically through celebrated practices of Whiteness and maleness, Black girls are able to engage with science in a manner congruent with other aspects of their lived experiences, developing stronger science identities through participation and acceptance as doers of science.
2. Teacher beliefs, attitudes and behaviors constrain or support the participation of Black girls in science communities of practice. Deeply held beliefs about who can do science influence instructional practices by teachers. When teachers believe that Black girls are not likely to be successful in science, they impede opportunities for them to engage

deeply to learn science in a meaningful way. Participants expressed frustration with constantly challenging negative teacher perceptions about Black girls while wrestling to gain fuller participation in their science classes, recalling the loss of hope for success in that science space. Conversely, participants were able to recall science teachers who welcomed their efforts to participate fully in their science classes. The continual divide between the racial background of teachers and that of their students along with the detrimental celebrated characteristics of a scientist underscores the importance of positive science teacher beliefs, attitudes and behaviors to allow access and support participation of Black girls in science.

3. Teacher preparation programs must intentionally develop science methods courses to interrogate previous raced/gendered/classed lived science experiences and scaffold science teaching identities for marginalized preservice teachers. Black female preservice teachers have lived through a great deal of trauma on many levels of schooling. Due to the particular images and constructions of science knowledge in science classes across the United States, Black female elementary preservice teachers deserve the opportunity to interrogate and name their lived science experiences in an effort to begin to develop their science teaching identities. Without the opportunity to address these experiences, these preservice teachers have the potential to reinscribe their personal views and limiting beliefs of race and gender in science onto their future students.
4. Field experiences and student teaching sites must be chosen with intentionality to pair preservice teachers with strong teachers of science. By pairing preservice teachers with teachers who themselves displayed underdeveloped science teaching identities, participants' development was stunted through this lack of preparation. The teacher

preparation program worked to identify strong Black teachers as cooperating teachers for these field experiences asserting the importance of needing teachers who modeled culturally responsive teaching, high expectations of students and at least 3 years of experience as a teacher. These characteristics helped identify a good science teacher, but did not identify a strong teacher of elementary science. It would be most helpful if teacher preparation programs serving Black preservice teachers worked closely and intentionally with partner schools to identity strong Black teachers of science for field experience and student teaching. These models of exemplary science teaching are imperative to the development of strong science teaching identities by Black young women who have been impacted by many years of deleterious science learning.

5. School districts should design science professional development which invites in-service teachers to interrogate their limiting beliefs about marginalized students. Participants were directly impacted by the beliefs of their teachers about which students could do science. These limiting beliefs about girls and Black students doubly affected participants' ability to permeate different levels of participation in their science classes. As many of these behaviors of teachers are unconscious, teachers and their students would benefit from invitations to cross examine these beliefs and explicate the effects of these beliefs on his or her teaching practice.

Recommendations for Future Research

This study engaged Black female preservice teachers in their final year of college, asking them to reflect on 20 plus years of formal and informal science experiences. There is a lack of research focused on the science identity formation of Black elementary teacher candidates, specifically, Black female elementary teacher candidates. While some research has looked at

science teaching identity construction of elementary teacher candidates, so far there has been limited consideration of science teaching identities of non-White elementary teacher candidates. Currently 7.1% of elementary teachers are Black (National Center for Education Statistics, 2008), and most often teach in metropolitan areas and/or low performing schools therefore, it is imperative to study the aspects of identity formation for this demographic as a way to uncover the necessary supports to strengthen science teaching confidence to better engage all students in science learning.

Nationally, teacher preparation programs are changing in response to current research and recommendations to strengthen content knowledge of elementary teacher candidates. Some schools have implemented five year bachelors programs to deepen content knowledge, while others have mandated elementary teacher candidates graduate with a content focus or double major. Many liberal arts colleges have not responded to these calls and still offer a combined math and science class allowing minimal exposure to elementary science instruction. More research should be done to evaluate the effectiveness of these science courses and other ways to strengthen pedagogical and content knowledge through these abbreviated formats.

Through the successful use of life history interviews in this study, it is reasonable to assume that the broader application of life history methods in teacher preparation programs would be beneficial to confront raced/classed/gendered experiences in content areas for traditionally marginalized preservice teachers. To this point, future research should include other emancipatory research methods such as PhotoVoice, in order to understand and reshape undeveloped science identities held by black female elementary teacher candidates.

Significance of Study

My study extended the current research on the development of science teaching identities of elementary teacher candidates and the importance of scaffolding science identities of nonwhite, non-male k-12 students and teacher candidates. This study extended the current research on the development of science teaching identities by employing both a fresh epistemological lens, Endarkened Feminist Epistemology, Critical Race Feminism and Portraiture, a methodology motivated by 'a search for goodness'. The study illustrated a model for other researchers seeking to employ emancipatory research methods which emphasize the voice and spirit of their participants. Themes regarding the successful development of science identities included the importance of participating in inquiry science, the development of positive student/teacher relationships which honor students' Black-ness and female-ness and the necessity of reaffirming relationships which support developing science identities. Strong science identities do not automatically lead to strong science teaching identities. This study also found that a science methods course which creates opportunities for teacher candidates to critique their lived science experiences, engage in conversations interrogating traditional science instruction and intentionally selects field placements to ensure teacher candidates can observe quality science instruction could have helped participants develop a more robust science teaching identity. Additionally, this study found that using emancipatory methods such as Life History Interviews and PhotoVoice, gave participants a welcome opportunity to "talk back" to their science experiences across their lives as well as to share aspirations for their future classrooms.

This process created a safe, shared space for participants to share their frustrations with the science teaching preparation of their teaching certification program and articulate hopes and expectations for their future elementary classrooms. On this search for goodness, participants

were able to identify 1) their resilience, 2) their ability to transfer teaching skills developed in other content areas and 3) their commitment to provide exceptional instruction for the minority students of their future classrooms. This study provides information on the value of portraiture in science education research and is an example of emancipatory research methods rooted in the need to amplify voices of nonwhite, non-male students and teachers who participate in science learning. In addition, the possibility to better prepare elementary teacher candidates to provide exceptional science instruction to underserved students justifies the need to reconstitute the practice of and research on science teaching preparation for elementary teacher candidates.

This study is significant as it empowered these teacher candidates to critique instructional activities in their math and science methods course and problematize science instruction available to students in their field placement sites. Participants actively engaged in the process of sharing raced and gendered stories of science learning, and chose to be vulnerable through their retelling of painful feelings of isolation and academic struggle related to their science learning.

Finally, this study is significant in its hope to spark a new line of research that focuses tightly on a demographic often absent from literature on elementary teacher education. Through an unapologetic prioritization of the lived science experiences of Black female elementary teacher candidates, this study demonstrates possibilities and responsibilities in future research.

Limitations

This study was impacted by various limitations that were evident during the creation of this research project and that arose during data collection. Due to the small number of students enrolled in this college's elementary certification program, I had a limited number of participants from which to select. Additionally, by selecting participants from a college that has high

expectations for students seeking enrollment, the college's application process selected students who have been academically strong during their K-12 years. Additionally, the application process for the Education Department may have also weeded out academically weaker students so the participant pool was comprised of academically strong Black female preservice teachers. If this study had been conducted with participants from a public college or university, the experiences of those participants may not have included advance science courses in high school.

By selecting only female born participants, the data are not wholly representative of the experiences of Black female elementary PSTs. To that point, there was one male born elementary PST (who was enrolled in the neighboring male private historically Black college) in the cohort from which the participants were selected. He expressed interest in participating in the study and when I stated that I wanted to focus on the needs of Black female elementary PSTs, he said something like, "Well, what do you think I am?" Although it was a light-hearted comment, future research could include additional aspects of gender identity and science identity development. I'm sure that this student could have added valuable insights into this topic, but my most immediate fear upon his request to participate was my limited understanding of his community and any personal unaddressed biases from being raised in a strict, religious and patriarchal home.

Finally, due to the qualitative nature of this study and the utilization of portraiture, the participant size of this study was quite narrow. While a larger participant pool could have yielded data from a larger number of Black females, I feel that my approach did not negate or mute/silence/quiet the richness of data from these participants' stories.

There were additional limitations that arose during my study. PhotoVoice as a method is often used to impact policy through a presentation of photographs to policy makers. In this case a

potential policy audience could have been faculty of the Education department, the Chair of the department, the college Provost or the college President. There were many changes across the campus during the time periods of this study, with a change in the college's President, and Provost as well as in the Education department including a change in the Chair of the department and me being hired as an instructor. When I asked the participants if they wanted to share their PhotoVoice responses with a larger audience, they agreed that they only wanted to share within the group of participants. While I think their photo responses were rich, valid and highly valuable to the strengthening of this degree, I did not push them to present their PhotoVoice submissions to the other faculty members.

This study's data collection methods involved self-report and did not involve triangulation through observation or interviews with participants' former science teachers, college instructors or cooperating teachers in field experience or student teaching. As is always the case, these remembrances were incomplete or unverifiable, but Endarkened Feminist Epistemology and Black Feminist Thought validates the retelling of these participants' memories as full, complete and enough. Through conversations about my research project during data collection I wondered if including data from the Science Teaching Efficacy Beliefs Instrument (STEBI-B) would be a good tool to further understand (or validate through a verified instrument) participants' science teaching identities. I had the participants complete the STEBI-B once after they presented their PhotoVoice responses. While this instrument has been utilized in other studies to investigate beliefs and efficacy of preservice elementary teachers, since the focus of this study was not efficacy beliefs, and this study did not measure changes over time, I did not include the data from this survey in the present study. I may return to those data in a future study.

Also, participants asked to add work sessions or science teaching tutorials to the research project as they realized that they all felt ill prepared to teach science well. I was aware of this possibility before I started to conduct this research study and was unable to add this aspect of support due to the scope of this research project. Nevertheless, the data collected from their responses help imagine the possibilities for how to support other Black female elementary PSTs to strengthen their science teaching identities.

Final Thoughts

By employing an Endarkened Feminist Epistemology and emancipatory research methods, this portraiture portrayed the lived science experiences of Black female elementary teacher candidates and the effect of those experiences on the development of their science teaching identities. Four participants' portraits were constructed using data from Life History Interviews, PhotoVoice, and focus group discussions. Through utilization of voice-centered analysis with the collected data, five themes were identified: (1) the importance of 'doing science', (2) tenuous relationships with science teachers, (3) significant struggles in science, (4) expectations of teacher preparation and (5) resolve to provide high quality science instruction to future students.

Although there was not a great deal of data across all four portraits to label this a recurring theme, I want to return to Tiffany' portrait to highlight the importance of representation in her ability to become a part of a science community and sustain her interest in pursuing a career in science. Her relationship with her mother and godmother who held significant roles in a science community bolstered her interest in science and reified her belief in her own ability to do science as she was able to see examples of successful Black women in science. Rather than just reading about successful Black women in science, Tiffany had first-hand knowledge of these

women who consistently supported her own development in science. Regardless of less than positive interactions with science in her formal schooling, Tiffany persisted in science during her primary and secondary schooling. Once she reached college however, her godmother's death took away one of Tiffany's most impactful science relationships and she reported feeling lost and unmotivated to persist in science.

Tiffany's portrait continues to disquiet my spirit as she was the one participant who had developed the strongest science identity in her primary and secondary schooling but expressed the weakest science teaching identity as she considered her future as an elementary teacher. While she could call on at least 12 years of positive science experiences, the science Tiffany experienced during her college years was so negative (the death of her godmother, learning to be successful in college, needing a science tutor, failing chemistry, abandoning her science major and hopes to become a doctor) or so unstimulating (environmental science prerequisite, elementary science methods course, field experiences) that Tiffany was unable to connect with those k-12 science experiences to create a strong elementary science teaching identity.

Tiffany's experiences with science in her college years illuminates the importance of crafting elementary science teaching training with intentionality. Had Tiffany's experiences in the teacher preparation helped her reconnect with the aspects of science she enjoyed while providing the pedagogical supports to translate her positive science experiences to plan lessons for her future students, she may have been able to establish a positive science teaching identity that mirrored the strong science identity she developed as a child.

This research study was a labor of love for my sisters. At many points I wondered about providing additional support for the participants and who they would become once they entered their own elementary classrooms and became teachers of science. As these participants are my

Spelman sisters, I longed to celebrate their first years in the classroom but I have not engaged with them since the end of data collection and member checking. Now that this research project is complete, I hope to re-engage them as a sister-friend, to inquire about their teaching lives, lives in general and share with them the work that has come out of their participation in this study. Future research could provide a look into the development of their science teaching identities as full time classroom teachers and investigate how those identities have been strengthened or weakened through the opportunities and constraints in their schools. This study demonstrated Black female elementary teacher candidates are able to 'talk back' against unsupportive science learning experiences, problematize poor elementary science methods course, visualize optimal elementary science instruction and vocalize their commitment to provide instruction in the "whole curriculum" to their future students. Through their courageous participation, this search for goodness found these women were able to demonstrate resilience, resolve and commitment in a field that has historically alienated them.

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APPENDICES

Screening Survey for Participation

Please complete the following questions:

Identification Number:

1. Name _____
2. Gender _____
3. Majoring in Early Childhood Education-Certification Track? Yes No
4. Age _____
5. Race _____
6. Are you willing to participate in this study, which will take approximately 7 hours of time over the next two-three months? Yes No
7. Contact Information
   Email _____

   Phone Number _____

Seeking Black Female Elementary Teacher Candidates to Participate in an Individual Interview and Focus Group for research on Science Educational Opportunities.

Must be
Black, Female & Spelman College Seniors in Early Childhood Education Seeking Elementary Certification

Time commitment of up to seven hours

Contact Marsha Francis
mef2011@uga.edu
or
(404) 602-2628

Primary Investigator – Dr. Cory Buxton
UGA | cbuxton@uga.edu

Participants will be compensated $40 for their participation.

Recruitment Letter

October 1, 2014

Dear Invited Participant:

I am a graduate student under the direction of Dr. Cory Buxton in the Department of Educational Theory and Practice at The University of Georgia. I invite you to participate in a research study entitled "A Portraiture of Lived Science Experiences of Black Female Elementary Teacher Candidates" that is being conducted to investigate if/how race and gender impacts the lived science experiences of Black female elementary teacher candidates.

Your participation will involve one life history interview, three focus group discussions and the creation of about 6 photographs and should take a total of about 7 hours over the course of the semester. Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled. If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return or destroy the information.

If you agree to participate in this study, your data will be stored electronically and password protected, with the physical devices containing the data stored in a locked file cabinet in the researchers home to ensure confidentiality. Only the primary investigator, Dr. Cory Buxton and myself will see this data. The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only.

The findings from this project may provide information on the raced and gendered experiences of Black girls and women with science to better prepare teacher educators to scaffold the science teaching identities of Black female elementary teacher candidates. There are no known risks or discomforts associated with this research. Your participation in this study will be compensated with a $40 Visa gift card.

If you have any questions about this research project, please feel free to call me at (404) 602-2628 or send an e-mail to mef2011@uga.edu. Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 609 Boyd GSRC, Athens, Georgia 30602; telephone (706) 542-3199; email address irb@uga.edu.Thank you for your consideration! Please keep this letter for your records.

Sincerely,

Marsha Francis

Focus Group Protocol
First Focus Group Interview Protocol

Thank you for coming here today to participate in this focus group. My name is Marsha Francis and I am a doctoral student in the University of Georgia Department of Educational Theory and Practice. The purpose of this group is to help me gain a better understanding about the lived science experiences of Black female elementary teacher candidates.

I recognize that each of you have had unique and different science learning experiences. All points of view, both positive and negative are important. There are no wrong answers to the questions I will ask but rather different points of view. Please feel free to share your point of view even if it differs for what others have said. What you discuss here will be very helpful for my individual research project and after today's session, you are welcome to ask me questions about the research and about our discussion.

I decided to talk to you in a group rather than individually so that you can hear each others' thoughts about these questions. You might agree or disagree with your classmates as you share and I'm sure we will have a lively discussion. If you do not want to participate, you do not have to. You can sit quietly and listen, you can answer these questions or you can choose to leave at any point you choose to do so. I will record what we say because I don't want to forget the important things you may tell me, but I am the only one who will listen to our recorded conversation.

Does anyone have any questions?

Okay, so, I am going to give everyone a form now, which states that your participation in this group is entirely voluntary and that you may decline to participate, or to answer any particular question, or to leave the study at any time. Please read this sheet carefully before signing it. It discusses potential risks to you as members of this group as well as the use of audio recording during this session. I'd like to give everyone the opportunity to ask any questions they may have before we begin the group.

Opening Question

At this time, we would like for each of you to say your initials and why you are interested in participating in this study.

General Questions

1. When you think about science education, what comes to mind?
2. How would you describe the role of science in your life?
3. Tell me about a time that stands out to you when you had a positive experience with science learning.
4. Tell me about a time that stands out to you when you had a negative experience with science learning.
5. Do you think your race impacted your access to science educational opportunities? Why or why not?
6. Do you think your gender impacted your access to science educational opportunities? Why

or why not?

Closing Questions
Was there anything we missed that you think should be discussed about science education, and how science intersected with your lives as Black girls and now Black women?

Thank you for your responses. I think we had covered a lot of ground in tonight's discussion. The next phase of the research process will involve individual life history interviews where we will think deeply about science at major points in your life to construct a robust picture of your interaction with science formally and informally. Also before we meet for our next focus group discussion, I would like to assign you a little homework. We will incorporate a different data collection method, called Photo Voice, to give you an opportunity to create images to represent science in your lives in your elementary years, your middle school years, your high school years, your college years including your teacher education program, science during your student teaching and possibly construct a picture to forecast your teaching of science in your elementary classroom. You can take these pictures on your smart phone or other mobile device and email them to me at mef2011@uga.edu. When you send this picture, I would like you to write one or two sentences to explain the image you are submitting and how it pertains to science at that particular point in your life. We will meet again for another focus group discussion in about a month where I will share your pictures with the group and explain each representation. Please feel free to contact me if you have any questions about the Photo voice process.

Life History Interview Protocol

Good evening, thanks for meeting with me tonight. How was your day? Ok, this session will be a little less formal. It will be recorded like the previous focus group discussion for my records, but the same confidentiality measures apply for this interview. Are you comfortable with proceeding?

I have a few prompts to get us thinking about science across your life but you really will be directing this conversation as you share your science memories with me. We will be using this chart paper and marker to actually draw a time line to chart important memories involving science in school and out of school to show how your science identity has evolved over time.

- What can you remember about science before or during your elementary school years? What memories do you have of science in school? What memories do you have of experiencing science outside of school?
- What can you remember about science in your middle school years? What memories do you have of science in school? What memories do you have of experiencing science outside of school?
- What can you remember about science in your high school years? What memories do you have of science in school? What memories do you have of experiencing science outside of school?
- What can you remember about science during your time here at Spelman College? What memories do you have of science in school? What memories do you have of science outside of school?
- What can you remember about science during your teacher education program? What memories do you have of science in those classes? What memories do you have of science during that time outside of those courses?
- What are some science experiences you have had so far in your student teaching?
- Are there any other science related memories that stick out in your mind that we haven't covered yet?
- What factors do you think impacted your feelings towards/experiences with science in school? What factors do you think impacted your feelings towards/experiences with science out of school (informally)? (Prompt for participants- Race/gender/SES/extracurricular activities/family member/role models)

I really appreciate you sharing your science memories with me. Thank you for talking with me and being so thoughtful in your responses.

Second Focus Group Discussion Protocol

This focus group discussion is less structured than the first focus group and will be shaped by the information shared by participants during their life history interviews and the images submitted from the PhotoVoice project. This focus group discussion will open with participants sharing their PhotoVoice images. Participants' images will be organized alphabetically and by each age level so all participants will have shared their elementary-aged images before starting on the middle school images and so on. Participants will take turns sharing and explaining their images while I write down on chart paper for the participants to see key words used during their explanations. There will be time allotted for participants to dialogue with each other about the images presented. After all participants have shared all images, I will recap the words I recorded to ensure I have captured important aspects of the images shared. The focus group discussion will conclude by me asking if there are any other science related experiences that we have not covered so far that participants would like to share or discuss.

Third Focus Group Discussion Protocol

Using the images and the life history interviews that were shared and discussed in the second focus group interview, I will look for themes across the interviews and images. From the life history interviews I will compose an "I-poem" for each participant selecting I-statements from the transcriptions of the interviews. I will also analyze the life history interviews for themes across each age level (elementary, middle, high, college, teacher preparation and student teaching) and organize these themes to share during the third focus group discussion. Participants will receive copies of their "I-poems" constructed from their life history interviews during the focus group and have time to read them over as a validity check to ensure I have captured what they shared about science in their lives. If any participant wants to share their "I-poem" with the group, they will be able to do so as this could also initiate another level of conversation appropriate for the data collection process. This third focus group discussion will conclude with participants member checking themes of this study regarding lived science experiences of this group of Black female elementary teacher candidates

Shonnie's I Poem

I think my mom was pretty supportive of me
She was a little disappointed because I didn't do something science
I got older she tried to steer my back towards it but that made me not want to do it more

I remember there was some instrument we were playing that had different sounds at different levels
I know that we were talking about pitch in hindsight
I remember making one of our calendars
I chose a date to do the experiment in front of the class
I did whatever graph it was for that month
I thought graphs were cool
I remember this one time it was ice cream
I called however many people I had to ask
I had like fifteen people
I colored each box for their data
When I didn't understand stuff and I did the experiment, I would understand it better
I did it in class but didn't realize that it was related
I don't remember anything negative
I think the message we got was like science is everywhere
I liked that
I can remember in second grade we were doing worms, we grew them and had to feed them
I think as I got older things were different than in elementary school

It wasn't the worst experience
I wasn't sad or angry but I wasn't happy anymore
I was just there
I don't remember 8th grade
I can't even tell you if I had science in 8th grade
I had a different science teacher
I didn't like that.
I know that's obviously how its works
I'm not open to change
I don't like it at all
I'm freaking out and the teachers weren't really that great.
It was like why am I here

I could tell that my teacher thought about what we wanted
I liked in 6th grade how we had groups and everyone had a role
I thought it was something positive because it made me take responsibility

I don't know what was going on with the teacher retention rate in 7th grade

I had 5 science teachers within one year
First day we got there we did an experiment
After that we kept doing bookwork
If I'm going to take notes
I would rather take them from a book than from a person lecturing
I guess that's just how I learn
I didn't like lecturing at all cause no one ever taught us how to take notes

I still had A's yeah
I might have gotten a B
I got a B because there was a point where I was like "Wow, get it together".
I don't remember if that was 6th or 7th grade
It probably wasn't 7th grade because I would have been too frustrated to have done anything
I probably got a B in there too
I didn't care
I had to have a B because I didn't want to be in the class anymore

I knew it then but he put all the kids who didn't know science in my group
I know he was doing it so I could help them but there was no one in the group to push me
I was just bored and teaching them
I was so excited about having group roles and being in a leadership position
I was in charge so it the moment, I didn't really get it
But now I don't like that I feel like I could have learned so much more
Overall I loved 6th grade science
6th grade was so amazing that it doesn't matter that I don't remember 8th grade and 7th grade sucked.
I dreaded the class in 7th grade
I was like, "No, I don't want to go".
I was irritated.

I think in elementary, every time I got up to do a presentation I felt like someone special
Even if I was doing the same presentation that the three people before me did, I still felt like someone special
I walked in with projects
I feel like that added to the confidence that I had as a person
I got to be as fun as the teacher was
I raised my hand and told him that he was wrong
I got to tell him why he was wrong on the board
I don't know if he did it intentionally, but he was like, "Hey, you are smarter than me".
That made me feel good.
Even though I didn't like working in groups with other people,
I don't think that I would be able to be a good teacher without that experience so that probably helped me

I loved chemistry
When I was happy, I was really, really happy.

When I had my low moments, they were really, really low.
I was really, really sad about the C in physics
I sat with him and we talked about it
He was like you can let this defeat you or you can make it better
I just accepted that C
I was like ok, we if a C is my A in physics; in my mind I have an A
After that, I never got another C
I had loved science forever
When I got to 9th grade, even though all of this stuff happened, I was still really excited about it.
But biology ruined it.
I could have (done something science)
I considered applying to CMU, Carnegie Mellon University
Something about that place really made me happy.

I didn't like biology at all
My teacher lectured a lot
I think that was part of my issue cause science is really like
I don't get anything from lectures
If it's in the book, I'm fine
I can read it in the book and copy it
When people talk to me, I don't understand it as well as when I see it

The 9th grade teacher wasn't really respectful
All the Black girls had the same name
We were all Ra'chel to him
I couldn't…
He wasn't interested in my and I wasn't interested in his class
There was no reason to sit and talk to him after class about what I wasn't understanding
I don't know but his persona all that was him, made me not care about biology and what were learning was boring

I remember pundit squares
I will never forget them
I learned a lot
I will always remember it from that lesson but we taught it to ourselves
I probably understood it more than my partner
I did the squares and there was no conversation after it
I don't really remember other experiments
I just remember there was a lever that we used for the shower and that we pulled it all the time
I really just didn't like biology

I loved chemistry
I liked it a lot
I loved chemistry
Even when I lost science in 9th grade I still had math, and everything related to math was going to be my best friend.

I really liked that about chemistry
I knew it all
I liked that we didn't have to memorize the periodic table
I think it's the first twelve, he told us a little think to memorize it
I memorized it on my own
But I like that he took initiative
He was part of the reason I took Chem 2
I took Chem 2 partially for him
Cause I loved it the first time and he was supposed to be teaching it the 2nd time
I don't think that there was anything that I really disliked about chemistry

11th grade I had physics
I loved my physics teacher
The 2nd quarter, that's when physics got difficult and I got a C
It was really confusing and I didn't get it
I wasn't understanding
I wanted to do the math problems and it was like "Lashon, this isn't just math"
I didn't get that stuff
I don't know. It was confusing
I liked the science teacher that taught it, he wanted me to take Physics 2
I should have just taken it with him; he made it make sense
If I got to school early, he would sit with me and talk to me
If I wanted to stay late, he would stay late and work with me
I liked that about him
I know he gave us a list of like 12 projects
I worked with a group, with like 3 other guys,
We made a rap
We performed a rap song in font of our class
It was so much fun
He recorded it and it was just a lot of fun.
I like that because experiments had always been fun

Then Chem 2, it was a disappointment
I was looking forward to Chem 2
It was probably the happiest I had been fore a class in a really long time
I loved the concepts
I loved what we had learned
It took all the stuff we had learned and made it harder even though I understood it
I was like, "It's not challenging because I'm so great at it"
I didn't so much like him because he talked to us like we were frustrating him
I know that could be frustrating as a teacher, but that doesn't mean that you don't teach us
I don't know
I wondered what score he told them to give me for IB
I didn't like that

I will go in depth up I didn't like science in college at all

I didn't like environmental science
I didn't like 330 (math and science methods for ECE)
Then I got this placement and they actually have an amazing science teacher
That made me really happy!
This is me when I start teaching science
I'm going to be really, really happy!
I will make a bunch of really happy science people!

But, I did not have a choice with what science I wanted to choose.
I guess they don't feel people learn environmental science in school and you need it for the GACE, so they make you take it
I don't like that
I can define environmental science for elementary students but there are standards that tell me what to teach them
I didn't like that I didn't have a choice because environmental science wasn't something I would have chosen
I wouldn't say that it wasn't difficult because it was challenging
But I think part of the challenge was that it wasn't interesting
I didn't want to learn about it
I didn't like the lecture/lab model in college just because your lecture teacher and your lab teacher aren't the same teachers
I think the same person who is teaching me lecture should be teaching me lab
I did actually like the labs we did though
But I wouldn't get the lab back until after the test
I didn't understand the lecture until after the test
One thing I appreciate about college is that you make your own schedule
I would have chosen a chemistry class
I love chemistry

I'm pretty sure they didn't tell Dr. Sung what they needed to or required for her
I didn't even know how to write a science lesson plan
When you came, I liked the idea of having something got show for your lesson
It reminded me of when I think about elementary school
I got to touch them
I got to feel them
When I brought in my science projects that made me feel good
Last year and the first placement I had this year, there was no student engagement with science
The summer I taught life cycles and we bought butterflies
I showed them the butterflies every morning
I showed them the cocoons
I let them put paper clips on them
It opened and sprayed out while I'm talking
I'm trying not to break because there are 30 first graders looking at me
I'm like, there's blood in my mouth
It was ok, all for the children
I'm pretty sure they could tell you about the four stages of a butterfly

That was like the only science lesson I saw
They departmentalize which I don't particularly like but it works for them because the other two teachers don't know anything about science
I think that's something to look into because I think that's beneficial
He's not the best science teacher
He wants to do a lot of lecturing
But I don't think that's appropriate for elementary school but he does that in every class
He needs someone to tell him how to be a teacher

I think that if we were Black we were going to be kept out of anything
Science is something that a lot of people think of as daunting, a lot of people are afraid of.
For some people it's like, "I'm Black but I'm going to do it anyway" and they have already had to fight so hard to get an education, they are not going to fight so hard to do science.
If someone is telling you you can't do anything, you are like, "I'm going to do it."
But then if they tell you that you can't do anything and you can't do science, it's like ok, I'm going to do something but it won't be science because then you are fighting two fights whereas anyone who is not Black who goes into science is only fighting one.
I don't think that there is a message that Black people can't do science
But I think its just that Black people can't do anything and no one can do science.

Tiffany's I-Poem

I grew up in Smyrna, Tennessee
I was raised with my momma and my daddy, one sibling, my sister, the sister right above me.

My momma works for Meharry Medical College as the medical program coordinator
Sometimes I would learn a script and be a character for the students to come in and learn how to deal with visiting patients.
My dad works as a day program manager at a day care for adults with special needs

My godmother was the Associate Dean of Medicine at Meharry,
She was also a physician
I really wanted to be like her
They all instilled in me to be as smart as you can
Once I got into school I really started excelling in math and science
With them knowing that I wanted to be doctor; there was a push for me to learn more science.

When I was younger
I had this big thing about pregnancy
I would always go, and get the P encyclopedia
And think that I was reading about it
It was my favorite encyclopedia to look at
My favorite movie was "Nine Months" about the pregnant lady
I would have "Operation"
I would have computer games for science or the Magic School Bus
So at home science was technology or a movie or just talking about it
It was a very open topic about science
Just different things around the house, resources in the house

Growing up until about seven years ago, my dad worked for BFI now Allied Waste
I'm a Montessori child
That's why I'm so smart
I remember he would pick me up, he drove an actual trash truck
I thought it was the coolest thing
He was pulling up in front of preschool and I would get in and put my seatbelt on.
I thought it was really cool how trucks could make it up a hill, they had to get weighed,
He was there for forever so I just learned stuff about trash composition, wheels, gears, various things about that.
I guess that's science, wheels and gears, mechanics and all that
That's something I started first learning

I was accident prone, still am to this day
I was really young
I got a cut

I was crawling
There was a wooden chair and I scraped it.
My godmother came in to the rescue and took me to get stitched up

At Montessori I was doing something I learned in gymnastics
I was on a tunnel and flipped
I had to get that sown up

Then at a place like Best Buy I was looking at a director action stick,
My mom told me to put it up
I cut my face on the edge of the thing it stood on
I just had a butterfly Band-Aid on it
I would have to be getting sewed up
But that takes into account that and the other doctor's offices
I would always have to be getting sewed up.
Fell in the skating rink, sprained my ankle really bad
That continued to add to my love of medicine even though I was the patient

During career days at school I really wouldn't pay attention when we had somebody unless it was like a doctor
I didn't really pay attention to a science teacher either

I would sit in on Meharry summer programs
That's why I really thought that I wanted to do organic chemistry
I thought I would love that class
But like I said, I failed chemistry

Bill Nye, The Magic School Bus, I always watched that in school
I saw an activity on like Nick Jr. sometimes I would do it with my mom
Whenever I was supposed to be out of school she would help me make something.

It is really hard thinking of science inside of school
Honestly, in elementary school, I don't remember science
We didn't really do a lot of stuff for science, even in fifth grade when we were departmentalized
My fifth grade homeroom teacher was the science teacher
She was really sweet, but still wasn't hands on
I do remember an activity we did
We went to the science lab and made paper out of Kleenex

I don't remember science at all
For one, we were always in the classroom
I feel like it was a bunch of videos K-4
Fifth grade we started getting hands on…
We planted 4th grade, but that was it

I think it was paper that you turned back into paper
I would want to do it.
I would do some with my mom because she was a stay at home mom
I was supposed to be out of school she would help me make something.
I don't remember science

I thought that was interesting because science is a hands-on thing

So in 6th through 8th there were more activities, actual science lab classes
My 7th grade teacher was really rude
She was my dance coach and the science teacher,
She felt like she could talk to us any kind of way
She liked me as a dancer but she would be in a mood in the classroom.
She did drop some good amount of knowledge,
She did have a lot of good activities and experiments

8th grade we got a lot of busy work because she had a baby
When she came back we had some experiments.

I do remember field trips in the 6th grade
We went to Rock City
That helped me appreciate nature and we went to see Ruby Falls

7th and 8th grade we had vocational classes
I chose teen living and we did a lot of food science

Science she barely cared for me in the classroom
It would be Tiffany, stop talking
I would try to talk to the Black lady that was the teacher in the other part of the school
She barely wanted to talk to me.
I thought Black people stayed together, especially in a small area like Smyrna…

The word I would use for science in elementary school is null and void
I barely remember it.
I really got most of my science experiences from outside of elementary school.
In middle school I said self-initiated because she didn't really care form me
I had to learn all this stuff on my own.

I was confident, I thought I knew a lot.
I would be telling people, kids on the playground certain stuff they didn't know…
In middle school, they didn't engage me
My 7th grade teacher would say one thing, tell the wrong reason
I would tell the right one.
Maybe it's not that she told the wrong thing, but she wouldn't go in depth
So if I'm at a group table, I would say it a way for them to get it.
She would be mad that I'm talking but these four can now get it right on the test and give a really good explanation.

For high school, those were really like lab classes
Freshman year I took physical science
Sophomore/junior year I took biology
Senior year I took chemistry.
I graduated in three years from high school
I took night classes because I was over high school from freshman year.
I really wanted to go to college

My track was the medical track so I took health science the 2nd year
My last year of high school I did med fair/clinicals where you were able to go into the local hospital
You leave school, go to the hospital
One week you may be with surgery, one week you may be with OB
Until you visit everything in the hospital.

I took Advanced Honors classes.
We didn't have International Baccalaureate
I don't like standardized testing so I wasn't trying to take the AP class
I wanted to be able to leave school and I wanted to be a doctor.
This plan outweighed all that.

I ranked towards the middle to top of my class in high school
It was engaging as far as science
Although the teachers were weird, they had wonderful activities, wonderful labs
The biology teacher wanted to go to medical school so he taught us from a bunch of lectures and slides; it was horrible.

In high school, school was exciting because I was excited about learning science on the medical track
It was life changing because it helped me hone in on wanting to major in chemistry when I got to college and continue to want to be a doctor.

My guidance counselor didn't want me to graduate early
I went to her with a full plan.
I'm going to graduate early, I'm going to an HBCU, I'm going to major in science.
I don't remember exactly what she said but it was like
You shouldn't do that in four years, you need to look at other schools, maybe not science
But she knew that I was on the medical track since she did my schedule
There was a junior college in our town that she was trying to put me, tell me to go there.
It didn't make sense because my high school pushed for four year colleges.
But they didn't know about Spelman, that it was the top HCBU and she didn't care.
I think she knew I knew people at Meharry,
I could like go to college and then go to medical college.
She wanted me to go to Monlow
I'm not trying to be a nurse not that I'm dogging nurses.

First year in college was general chemistry
I came in a chemistry major.
It was just horrible.
I was just failing.
I ended up withdrawing.
I didn't end up withdrawing, I just got a D.
I didn't continue on this track.
I just got very discouraged
I failed general chemistry
I would have had to take it again
I never had a tutor in high school,

I never really just took time to study.
I really didn't adopt those things once I got here
I could have spent more time working on it and studying, things like that
But I didn't.
The professor was going through a lot.
She had a newborn baby and other young children, I think she was going through a divorce
She never really was here but when she was, her teaching style was different.
I did actually pass the lab.
Somehow I passed the chemistry lab.

I didn't pass the tests in the class
I failed the first test because of the test, the material and my study habits.
I ended up doing a little better than one and two but it wasn't enough to help me pass the class
I can't even pass general chemistry how was I gonna pass the MCAT, how am I gonna pass organic chemistry
I honestly was just over it like whatever.
In the fall of freshman year my mother was like,
Go get a tutor, put your pride behind you, get a tutor, but I wasn't trying to do that.
I had a very active social life freshman year
But then my godmother, the physician, passed away before Thanksgiving
So that's another reason why wasn't focused because I was emotional about that.
She's the person I looked up to for everything.
She was the person I really wanted to be so I didn't have the drive behind me.

I switched to biology track and the teacher was weird
But I learned my lesson because here I wanted to be a physician
I wanted to be an athletic trainer/lawyer because that's when
I also went this whole psych major thing
But something happened in Biology because I didn't like it.
It was manageable but I didn't like it
I don't remember.
Then environmental science, which we had to take for this major
It was boring. I don't care about leaves,
Even though I passed Biology, I still had to take environmental science for the early childhood education major
I passed all my tests, all my labs and stuff
I got an A.

Then we go into this math and science course
I put time wasted because until you came along, we didn't know anything, we didn't do anything

Field experience, when I was placed in fifth grade last fall it was excellent.
She was a science teacher. Now she is the science lead, science lab instructor…
I was able to really do well in that fifth grade placement
She was like, what do you know how to do? What do you want to learn?
We had the type of relationship where I would just jump in or we would just talk about it.
I was able to do fun activities for my observations.
The kids were really excited about science; they really liked her.

She had a lot of cool experiments.
There was a boy in there and I took him under my wing.
On a whole the students were excited about the learning science.

For my student teaching, science is null and void.
I taught that bad lesson in science.
I don't know
I wasn't excited about the math and science methods class
I thought it was supposed to be based off of our other classes that were like that.
There was that language barrier…
I expected to learn content and methods for math and science.
I have enough prior knowledge and experience with math
I can teach math all day long
Science, I didn't know like that and I still kinda don't…
I'm not going to say that's why I had a bad time when you came and observed me

But yeah, I don't know how to fully teach it
I don't know how to fully teach it besides looking at the standard
Cultivating a lesson around the standard and then trying to throw in videos and activities.
I know when I was in elementary school, videos did help but I also would have wanted to have activities
That's why I know try to incorporate activities.
Videos are kind of clutch when it comes to science because they don't have a good science book.
It doesn't really have a lot of stuff that they need to know.

My cooperating teacher doesn't help
This is probably something I should not take from her but she has them read aloud
It doesn't really help.
I know when I was in elementary school, videos did help
I also would have wanted to have activities
I now try to incorporate activities
I feel like it's a lot of just writing
I probably learn this from her, which is probably something I should not take from her
I don't know if they don't have funding as a school to get stuff for science.
I think that if they had more materials that could be seen that could be hands on activities, they would be excited
They don't have any science materials.
When they were talking about light they were supposed to have concave and convex lenses but they didn't unless they used it when I wasn't there.

My class right now is active and I think if they had more materials that could be seen and used, they would be excited and want to do science.
Like when I taught there was a supplemental activity but they didn't get to see it until later on in the day after the lesson.
They like hands on activities
It's just at that student teaching, its bad science
It's a lot of bookwork
I didn't learn by book because up here I think we had science books but they were videos mostly

And sometimes we had activities that came with them.
I don't really remember a book down here.

To be a better teacher of elementary science, I want to have a lot of hands on activities
It would be better if the school had the stuff rather than buying things for 30 students…
I'm like this is student teaching and I'm breaking the bank.
I would want more activities, more technology inclusion
It could be the iPad, the computer, movies, maybe career chats
Like people in science coming to talk about it.

Right now, with my cooperating teacher
I do feel like she uses what she has but she isn't trying to go buy nothing.
I bought the candy for the math activity.
I was just using that with like what she told me she used to do and it wasn't really my lesson
I feel like she makes due with what she has
I just feel like she can get materials but she's not dedicated so I don't see her really going out and getting anything.

I'm not going to say they are just made for Black children to fail but low SES and middle class type of Black children are not seeing science like I wish they would

I had great science experiences until here
I wish that's what they could see

I loved science all my life and it's not like
I hate science but it's difficult me teaching because
I don't know fully how to teach it and
I didn't really do so well in math but
I still love medicine and science so
I just feel like they need, people need to know what Black children gravitate to and how they learn.

Jackie’s I Poem

I decided to come to Spelman because I was just in love with the school
I have had aunts and cousins that go here as
I don't think they ever were like "go into the field of science" or "make sure you study your science"
I might notice that these clouds are black or they are much more fluffy today and then my dad would be like, yeah there are different types of clouds
I do remember my parents taking me to Liberty Science Center when I was younger
I had so much fun when I was younger and I feel like I still would have a lot of fun if I went there.
I got older, science wasn't such a push as my dad was thinking about careers, what I wanted to do
I actually did not want to be a doctor because I did not want to go, I did not want to take all those science classes.
I know that's part of science
I had fish
I wondered why the sides got green
I was never, they never tried to push me away from science, just encouraged me in whatever I was successful in

Most of the things I remember are things we did experiments with
I remember a lot of times we talked about plants and the plant cycle
I remember light experiments we used to do
I just remember that because I thought it was so cool
I can think of the experiment and which class I was in when I did the experiment but
I don't remember any one teacher for being amazing in the field of science
I feel like the experiments that we did were things that most people do
I do remember
We made the solar system in my 3rd grade class only because we got to put on a play
We were the Solar System
I feel like she took the time to get to know me
I know she knew me as more than just my grades in the classroom
I feel like we had an understanding

I do remember two teachers,
I don't remember everything that we did but I do remember those classes.
I remember 6th grade
I remember 7th grade.
I do not remember 8th grade
I can see the teachers' faces from 6th grade and 7th grade
I just smile thinking about it because the classes were fun
I want to say once a month or every so often we were cutting something or looking at something real

I remember a lot of hands on experiences in 7th grade
I had been in when we actually had lab tables
I guess that would be because this was the first science classroom that I was in
In 6th grade I was like science/chemistry/and experiments; that was fun.
I went to three different elementary schools

I started to have some Black teachers in middle school..

My science teachers were White women, 6th grade was older, 7th grade she was younger, like 25, 26
I think my 7th grade year was so much fun because she related with us more and made it engaging and fun
I feel like that was because she was younger and she felt like she could relate a little better
I was excited to do
I was excited for science in middle school
I knew that we were actually going to do science and not just read about it
I knew we were coming to the class
I was like oooh! What are we going to do today?
I would be so excited and want to keep doing it
I just remember we walked into the classroom and she had the brains out in little pans at our tables and they smelled
I feel like we were, everyone was like, let's go to science class, we may be doing something awesome today.

I was in honors classes all through high school
I was in honors biology 9th grade
Then sophomore year I was in honors chemistry
Junior year I was in honors physics
Senior year I took AP Physics.
I was getting As in Biology, chemistry and honors physics.
I was failing every single test
I went on like our portal thing where we could see our grades
He put in my test scores 75 over 100 so I would have a passing grade, otherwise it was terrible
I remember that class it was first period of the day, the lights were usually off because he was doing something on the board, so that's really all I remember
I put zzz's cause that man, Mr. Brant made me fall asleep in his class
I loved him as a person,
I just hated the class.

I could tell both Mr. C and Doc it was because they enjoyed what they were teaching and they were really into everything.
I actually like them as people.

I feel like because those classes were boring,
I started to lose interest in science.
I still was getting good grades in Honors Physics so

I was like maybe I should do AP Physics, but
I still wasn't like really, really interested unless we were doing an experiment and could relate it to life.

I actually had some Black kids in my class, but after
I was a junior and senior,
There was one other Black girl in my honors physics class,
There were no other Black people in my AP Physics class except for one who was in immigrant.

I also wrote down a whole bunch of numbers and equations that are not real because physics,
science just stopped making sense to me by my junior year and
I just drew a big question mark because
I was lost.
I was just lost.

I wasn't so much disengaged, but
I will say that there were more distractions in class in high school than there were when I was in high school, so
like I said,
I started out with some Black people in those classes so
I had other people to talk to I guess, other friends.
I'm not sure if its because it got more challenging, um,
I'm going to say Mr. Brant lost me sophomore year.

I had no friends in that AP class and it was a 2-hour class.
I realized that I was lost in the first 30 minutes, that next hour and a half it was like,
I don't want to be in here.
I obviously was not going to take the AP exam, he would let me leave class early because it was two hours
I would stay for like the first period and like go into his office for the second period when
I would do work or go to my friends' lunches but
I was disengaged totally
I liked my teachers junior and senior year
I just did not like science those years.

I just feel like subconsciously you notice that your friends are no longer in your classes so science was not fun anymore I guess
I didn't have any of my friends in my class
I was still in honors and AP classes but there were still Black people in those AP classes
I was taking science because it was a requirement
I had taken the honors classes so this was the next step.

I didn't have to take science freshman year, sophomore year
I had to take environmental science for my major requirement
I was an early childhood major when I came into Spelman.
I knew that that was what I wanted to do.

I had the course sequence and environmental science is the science on there for me
I know that environmental science is the one they told us they had to take.
I wrote save the Earth,
I put zzzz's also because that class was boring.
I had already talked about this stuff with my parents.
I do talk to my parents about things that are science related in terms of global warming in terms of living in society and keeping our Earth clean but that's just my parents.
I thought it was boring because it was like I'm going to look at the PowerPoint or try to understand what she is saying but
I can't do both.
I feel like I was mostly looking at the PowerPoints.
I completely forgot about the lab.
I never touched science again
I don't really consider it a science class in hindsight yeah, cause
I feel like it was supposed to be a methods class but we weren't learning methods
I drew this little squiggle, not connecting
I felt like there was a disconnect with our professor culturally and with what we wanted to get out of class.

I put science question mark dot dot dot maybe tomorrow?
I wrote Brainpop because they use a lot of Brainpop videos.
I do remember a couple of color experiments in my field experience last semester
I could tell that they were trying to make it so kids could go there all the time (science lab)
I feel like she flips science and social studies
I feel like she notices that we don't do a lot of work with social studies and science
I chose for science now in college was unimportant because that's how I felt about my environmental science,
I felt like it was not an important class,
I was just doing it.
EDU330 I didn't consider it a science class.
I was like; ok this class isn't really important either,

I actually like this activity because, just kind of seeing how my experiences shapes how I feel about science.
I don't remember anything that happened at an early age and it became interesting when I was able to connect with my teachers and do experiments but then my high school I wasn't really doing experiments, my teachers were monotone, it got harder so I got uninterested and by college it was a requirement

I don't think that there was any situation where someone tried to deter me from science or where other students were favorited or anything like that
I'm going to say maybe race can play a role in identifying with science because like I said by the time I was in my junior and senior year there were really no Blacks
I was uninterested in the material and
I was uninterested in being in the room in general because

I didn't feel like anybody in there was like me.
I think everyone is different which is why
I guess mentally it played a role
I didn't realize it until now, so yeah, not having any other Black students in my class,
Ok well this isn't for it, it's fine that I don't get it,
I can't do this this is clearly for *them* kinda thing.

So yes, I will say that race plays a role but
I wasn't negatively affected by my teachers for being the only Black kid in my class.
I said, by the time
I got to high school; all my science teachers were male
That was when it was more serious and they were focused.
I had two geniuses in my class senior year

I was still doing well so there was no difference in me and any of the other girls
I hung out with both because
I played soccer so
I was friends with these people but other than that by high school
I would not have interacted with them at all but in my AP Physics class, Amy both of us were lost

I'm just thinking now,
It was interesting
It was me and another person that struggled
It was a guy
He was the only guy in the class who I felt like struggled
Everyone else got it
I will say that in AP Physics the guys did better than the girls overall in that class not to say that they weren't still passing but the guys got higher scores than the girls.

I don't know if my race had anything to do with it... but in AP Physics like I said, you know, you're supposed to keep working with the student until they get it but at some point my professor just kind of didn't want to teach me and was like you can go in the other room if you don't want to be in here.
I don't know if that had to do with race, because my friend, she didn't get that same type of treatment.
So maybe race had something to do with it…

I would probably feel more comfortable taking instruction from a Black instructor
I would definitely think that if I had an African American teacher that it might make class a little bit more relatable

I do feel prepared to succeed in teaching
I feel like most of the things that are standards are things that we need to teach students, I know
If I don't know them, I know enough about it

I know things that I may not remember but as soon as I start doing it I know how to do it
I know how to teach it

Specific to science, not necessarily.
I know a little bit about them
I will be able to learn enough to teach a lesson
But off the top of my head right now, I don't know.
I feel like I could teach science from experience, like if I remember doing fun things in science
But content wise, I know some stuff
But I would have to probe my mind to get to other things

I feel like the purpose of learning science is to be knowledgeable in life because everything we deal with is science.
I feel like everything we deal with is science so kids need to understand science because its around them all the time.
I feel like I would introduce science in a mind-blowing way like science is all around you and you don't even know it!
Point out all these things so they are like "Wow!"
So they can have "Ah-ha!" moments!
And I can be like, "Yeah! Now they want to know more!"

I feel like, just talking about my experiences righ now with you
I feel like, if teachers were able to make it fun, elementary through high school,
I probably would still like science.
It was only fun for like a couple of years, in the middle,
Then it became challenging and then boring
Now I feel like I don't need it at all other than to teach my students because I'm not a science major where I actually need scientific knowledge

Yeah, I don't feel like science is important
I feel like that's because of the lack of emphasis and creativity with science in my experiences growing up.

Josie's I Poem

Why Spelman?
I wanted a place where I would be the majority
So I would be able to know my teachers and have an actual relationship with them
First I lived with my mom and then I had to go stay with my daddy in Nashville, Georgia
I stayed with him for like a year in 2nd grade
I came back afterwards
My mom got married and we moved to Gwinnett

Nashville was small, like everybody knew everybody
It was the culture of the school
We were all close
I knew everybody
I went to church with my teachers
My parents just told me to make sure I did good and do what I had to do to get an A.

The closest thing to science at home was cooking and hair
Both of my aunts did hair, and you know, perms can change your hair, chemical changes and all that.
And cooking, my mom always cooked,
My aunties always cooked,
My grandma when she was well she used to cook.

I don't remember nothing science in kindergarten or first grade
So up until 2nd grade I don't remember actually working on science
She modeled it for us
We were able to do it in groups and then by ourselves
She was a Black woman, my 2nd grade teacher
My 3rd grade teacher was also a Black woman
This was the most fun activity that I can remember doing.
I remember birds especially.
It was fun,
But I don't remember us doing experiments.

In fourth grade it was departmentalized
She had animals in the class but I for the most part think she cared more about the animals than the students
I remember we had a praying mantis and she let us hold it
A boy got stung or bitten by it and he may have dropped it
She picked up the praying mantis and wasn't worried about the boy
I remember there was a lot of bookwork, writing down all kinda stuff
We were able to, she would let us hold and touch the animals

And fifth grade, it was departmentalized too
I remember when she would introduce something
I would be so nervous to figure out how I was going to learn it and she made it easy.
I remember we made ice cream
We made volcanoes we erupted
We did dyeing the plant stems to show how water moves through the plant
We did other stuff for plants
That's when I started learning about chemical compounds and stuff, H20, what that means and all that

I felt she was more worried about those animals than us,
I remember she used to always yell.
I remember looking in the book a lot.
I just liked the hands-on part of science.
I only remember most of the hands on stuff or the fun stuff
Even though I had to do what I had to do and I know we have to sit still and do work and focus, I just hated it.
When we were able to get up, talk to our friends, bounce ideas off one another, it was fun.

I guess cause she just reminded me so much of my mom
That's why I liked her so much.
I wouldn't say it was negative,
I would say it was just something I didn't want to do.
So that caused me to build up a reluctancy I guess…

I guess you could say it motivated me to do better in her class because of how relatable she was
She was fun and I liked her
She was able to talk to me in a way where I could understand where she was coming from

So in middle school I moved to a whole 'nother place so I didn't, as far as social life, I wasn't…
I remember this one experiment where we had to work with dry ice cause it hurt.
I remember that's how I met one of the girls I hang with
We were doing an experience in a group and I knew all that stuff
Honestly, when I moved, I thought I would be behind, but they were behind
A lot of the stuff that I learned, they were learning
That's when I started being less shy I guess because I knew a lot of the answers to the questions he would ask.
I don't know how to describe him, but he was, you know sometimes I liked him, sometimes I didn't

In 7th grade she used to yell a lot, she was an old lady
We did mostly environmental stuff and plants
We did the food chain
We did learn about chemical compounds, photosynthesis versus the other one
We used to do a lot of bookwork for homework

Nothing fun.

8th grade, Mr. B, I still talk to him now, he's my favorite teacher ever
We did a lot of experiments
I remember he integrated; somehow we ended up talking about the stock market
I don't know how he related it but it worked
I remember that.
We did a lot of projects, like the solar system model
I remember that one
We always had food and stuff
I guess we had to take tests and stuff like that but it was the only time it was boring
Other than that it was never boring in his class
We would go outside,
We used to create videos and music back then to learn
I still talk to him now; I can still call him right now and ask a favor,
He was cool.

He was so into it he made me into science too
I guess to show your excitement and your enthusiasm for what you're learning, what the students are learning or what you're teaching is important because the students most of the time they are going to see it.

Out of school science?
I used to recycle,
I mean most of it was in school, nothing really out of school

In 9th grade he was a nice White man but his class was right after lunch so I'd be tired
We did a pig dissection at the end of the year
We talked about Darwinism
We did the food chain
He made us take someone from our group had to take a piece of hair out of our head
We had to observe it under the microscope
I remember a lot of lectures
We talked about the cell cycle, DNA, dominant traits, nutrition, anatomy and sex
He was really nice.

10th grade year I had chemistry
I remember the periodic table
I remember she had us memorize parts over time so we would know half of it
We did experiments but a lot of them I didn't get the point of
We would go to lab tables and do stuff
We did a lot of massing objects

11th grade we did a lot but the way he explained, the way he went about teaching us, it was terrible.
He was boring

He always talked about his family
It didn't relate to what we were learning
He never could get me to get it
I know I'm not stupid
If you can't get me to get it, I know I'm not the only one sitting in here looking crazy.
When we raised our hands he would get really irritated
We did a toothpick tower, the circuit thing, different types of waves and static electricity
I think my highest grade on the test was like an 89
That's not good, I feel like...
Science before his class?
I could take it or leave it.
Like, I wouldn't mind doing it since I had to do to it.

9th I got an A
10th I got an A-
Then 11th I got a C
By the end of the semester I had a B- but I feel like he just gave me that so I wouldn't complain or get on his nerves.
I just remember Cs until the very end.
I didn't like it
I didn't want to do it
It was too much
I would never go higher than honors to AP because they would be stressed, pulling their hair out, talking about what they couldn't do
I didn't wanna be like that

I had to bite the bullet and take science my sophomore year here.
Oh, then I had you too
So I only had, the first test I got an A on, and everything else after that I was struggling, trying to get an A.
I had to work
I didn't come home until like 4 or 5 in the morning
I used to miss most of the classes
It was always confusing because there were two teachers
I promise you
Nobody ever used to say anything,
We would just sit there
The first test I got an A on and everything after that I was struggling, trying to get an A
I failed something, I don't remember what but
I straight failed.
I got a B- out of the class

Junior year is when we took the methods and content
That was confusing because of the language barrier
I guess she didn't know exactly what she should be teaching,
She just thought she could come in and teach science as if we were students

Opposed to teaching us how to be teachers to younger children.
It got better when we got you
But we were always still frustrated
We felt like we were ready for the GACE
But your lessons at the end of the semester were fun
That was the best time we had in that class.

I never really seen science in some of my field placements honestly
Burgess, you know they have to go to,
Its like an elective there.
It's a special.
They went every blue moon.
I used to always talk about constellations
That's all I knew about for teaching science in elementary.

I guess if they see it as an elective they probably won't see it as important as it should be.

I feel with departmentalization they only see it,
say if you are coming from it being a special to it being a main class
That's going to make it be a difficult transition
You're gonna have ill feelings towards it and you're going to associate ill feelings with science from now on.

I feel like sophomore year,
The professors were two Black people,
They were accomplished, that was one way to look at it
But when you feel like that same person who you thought you could look up to is the same person who is being so cold to you,
It kinda like frustrates you.

I felt like I was not prepared
It made me disconnect from the class
That's why I guess I was so adamant about going to those GACE preps
I felt like I wouldn't get what I needed for the GACE in that math and science methods class
Strangely, I got all As and one B my junior year.
Those were the best grades that I got
The cohort, we were able to help each other,
communicate,
help each other out,
keep each other on point.

I feel like my race plays a role in my education as a whole anyway
I know how to do what I need to do to get an A
I didn't have any interests,
I wasn't excited in the morning to wake up and go to school.

I mean having a relationship with peers is cool, needed and necessary
But when it is about your grades,
If you and your teacher don't have a relationship,
It makes it hard
Then they don't know you so they don't know how to teach you
Because every child is different so when they are teaching us all the same across the board, even with you teaching us this one way,
If no one gets it and you are still doing the same thing,
its discouraging because that means that we don't matter,
All you are worried about is getting through the day opposed to getting us, the students, through the day.

I think it's not just me being a woman,
But me being a Black woman,
The stereotypes and stigmas that are associated with, like I said,
I felt they had their guard up with me
They assumed that I would react or respond in a certain way,
They would either tip toe around it or
They would avoid me altogether sometimes
I am old enough, even in middle school,
I am old enough to know and understand what you are doing and where it's coming from.

I guess she would expect me to respond a certain way
So she would have to fire back first.
She would have to get me before I got her.
So when my frustration came out, I guess she took it for anger,
But no, it's just frustration because I am serious about my academics
So when I don't get it and you're not trying to help me get it,
Of course I will respond and it may not be the best…

I mean I'm trying to word it right,
he would let his frustration over take the goal, which was us learning what he was trying to teach, get it, understand it and be able to apply it when we had to go home and do homework.

If I had had Black teachers I think the relationship part would have been a little different
I probably would have been able to have gotten some of the concepts
Of course these White instructors were explaining it in a way that related to their experiences, not so much my experiences

I am not prepared for that
I don't feel like I have learned enough and then all of the aspects with the other classes that we take,
even now some of those things are fuzzy to me
But when I go into the classroom and actually try to apply it, it's on command.
So I guess its different when you are actually in the classroom then when you're just talking about it.

I guess planning and making sure that I am with the curriculum because I guess, it's easy like with anything I think it's easy to teach what you want to teach as opposed to what's supposed to be taught or on the curriculum and what they need to pass those tests.