Experiences of Black Women in College Science Learning Spaces: A Critical Race Theory Perspective

Melissa P. Schoene
Georgia State University

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

_________________________________________  ______________________________________
Renee’ Schwartz, Ph.D.  Suazette Reid Mooring, Ph.D.
Committee Chair  Committee Member

_________________________________________  ______________________________________
Christine Thomas, Ph.D.  Natalie S. King, Ph.D.
Committee Member  Committee Member

Date

_________________________________________
Gertrude Tinker Sachs, Ph.D.
Chairperson, Department of Middle and Secondary Education

_________________________________________
Paul Alberto, Ph.D.
Dean, College of Education and Human Development
AUTHOR’S STATEMENT

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Melissa P. Schoene
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All dissertations deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of this dissertation is:

Melissa P. Schoene
GSU-Perimeter College, Physical Sciences
555 N. Indian Creek Drive
Clarkston, GA 30021

The director of this dissertation is:

Dr. Renee’ Schwartz
Department of Middle and Secondary Education
College of Education and Human Development
Georgia State University
Atlanta, GA 30303
CURRICULUM VITAE

Melissa P. Schoene

ADDRESS: GSU-Perimeter College
Physical Sciences
555 N. Indian Creek Drive
Clarkston, GA  30021

EDUCATION:

Ph.D. 2017 Georgia State University
Teaching and Learning

Master’s Degree 1994 University of Alabama
Chemistry

Bachelor’s Degree 1991 University of Alabama
Criminal Justice & Chemistry

PROFESSIONAL EXPERIENCE:

2003-present Associate Professor of Chemistry
Georgia State University-Perimeter
College

1994-2002 Forensic Scientist
Mississippi Crime Laboratory
Jackson, MS

1999-2001 Adjunct Instructor of Forensic Science
Mississippi College
Clinton, MS

1991-1994 Graduate Teaching Assistant
Department of Chemistry, University
of Alabama
AWARDS:

2016  Outstanding Ph.D. Student Award, Georgia State University, College of Education and Human Development, Science Education

PRESENTATIONS AND PUBLICATIONS:


Schoene, M. & Wade, K. (2015, October). *Tweaks to a Traditional Chemistry Lab: From Research to Practice*. Southeastern Association for Science Teacher Education, Columbus, GA.


PROFESSIONAL ORGANIZATIONS:

Southeastern Association for Science Teacher Education (SASTE)
National Science Teachers Association (NSTA)
Georgia Science Teachers Association (GSTA)
2-Year College Chemistry Consortium, Division of Chemical Education (2YC3)
EXPERIENCES OF BLACK WOMEN IN COLLEGE SCIENCE LEARNING SPACES: A CRITICAL RACE THEORY PERSPECTIVE

by

MELISSA P. SCHOENE

Under the Direction of Dr. Renee’ Schwartz

ABSTRACT

Multiple studies speak directly to the unique challenges women of color face in college learning spaces due to their intersectionality which include gender and racial discrimination, deficit-based thinking about their abilities, and negative stereotyping. In these studies, Black women are typically not disaggregated from other women of color so the results reflect the experiences of all women who do not identify as White, which includes Asian, American Indian, and Latina women. Intersectionality theories and Black Feminist Thought illustrate the ways Black women in the U.S. have created a collective, specialized knowledge based on their unique backgrounds, cultural traditions, perspectives and experiences that result specifically from the intersection of their Blackness and womanness. Additionally, most of the studies that examine the realities of women of color in science learning spaces focus on high-achieving or STEM majors. However, many non-STEM majors must successfully navigate the terrain of science courses to earn an Associate’s or Bachelor’s degree as well. The literature is clear regarding the
benefits of obtaining a degree in higher education and the impact of this degree on future salary expectations and on an individual's quality of life.

This research used a critical race theory perspective to explore the experiences of Black women in college science learning spaces who are not STEM majors. Results indicate that, due to race-based differential treatment, the women perceived science professors as obstacles to entry into the allied health field. Women who did not have to take specific science courses as part of their degree requirements did not experience science faculty in the same way. The findings from the study highlight the need for faculty acknowledgement and institutional recognition that racism inside college science learning spaces negatively affects the science learning trajectory of some Black women. The findings from the study may serve as a springboard to critical self-examination of science faculty regarding how they think about race and racism inside their classrooms.

INDEX WORDS: Science education, Race, Gender, Racial Colorblindness
EXPERIENCES OF BLACK WOMEN IN COLLEGE SCIENCE LEARNING SPACES: A CRITICAL RACE THEORY PERSPECTIVE
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A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Philosophy

in

Teaching and Learning

in

Middle and Secondary Education

in

the College of Education and Human Development

Georgia State University

Atlanta, GA
2017
ACKNOWLEDGMENTS

It has been an honor and a privilege to interview the women in this study. I thank them for their time, honesty, and most importantly, their trust in me. Their stick-with-it-ness when the conversations became clumsy around race and the strength they exhibited when discussing emotional aspects of their science learning trajectories were inspirational. I thank them too for helping me become more critically aware of the impact I may have on my science students and how important it is for me to share their stories and experiences.

To my fiance, Monica – you have been a constant source of strength, positivity, and light throughout this process. You have listened to all of my ideas, spent months proofreading, and made sacrifices to ensure I had everything I needed to complete this journey. I thank you from the bottom of my heart and I love you very much.

To Katie – you are the yin to my academic yang. Your support, encouragement, and sense of humor have kept me afloat through the most difficult times and I truly appreciate you. You and Dr. Valora Richardson were two friends who I knew I could count on to drop everything to help me when I needed it. Thank you.

Thank you to my encouraging and supportive advisor, Renee’ Schwartz. Without you Dr. Schwartz, I would not have seen this journey through to its completion and I cannot express the gratitude I feel for you in a few short sentences. You helped me more than you can ever know.

Thank you to my committee members, Natalie S. King, Christine Thomas, and Suazette Reid Mooring for your time, advice, insights, and support. I have enjoyed working with each of you and I appreciate you!
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1 THE PROBLEM

The intersection of Blackness and womanness in the U.S. is a location which often requires Black women to navigate overlapping stereotypes based on our society’s deeply ingrained biases of equating both blackness and womanness with inferiority (Collins, 2008; Crenshaw, 1995; Delpit, 2013; Hill Collins & Bilge, 2016; Tatum, 2007).

Various studies have shown Black women science learners face skepticism about their intellectual abilities, have unwanted characteristics ascribed to them, and face racism and sexism in science learning spaces (Coker, 2003; Jackson, 2013; Charleson, Adesrias, Lang, & Jackson, 2014; Carlone & Johnson 2007; Ong, Wright, Espinosa, & Orfield, 2011). Sociocultural research in science education has shown the ways in which the culture of science is aligned with social norms of White, middle-class, heterosexual males (Anderson, 2007; Brickhouse, 2001; Hussenius & Scantlebury, 2011), thus potentially privileging students who enter science classes with these attributes over students who do not (Ko, Kachchaf, Ong, & Hodari, 2013; Ong et al., 2011; Seymour, 2000).

In order to earn an Associate’s or Bachelor’s degree in the United States, many colleges and universities require successful completion of at least one natural or physical science course. Success in college-level science courses is also necessary for access into STEM and allied health career paths such as nursing. Although educational requirements vary for different types of allied health career paths, according to the American Nurses Association, successful completion of at least four college science classes, combinations of chemistry and biology, are generally required for access into the field. The U.S. Bureau of Labor Statistics estimated that from 2014-2024, job opportunities for nurses were expected to grow 16% which is “much faster than average” (Occupational Outlook, 2015).
Additionally, Title VI of the Civil Rights Act of 1964 protects students from discrimination. The Office for Civil Rights, an arm of the U.S. Department of Education, enforces these laws. Any college or university that receives federal financial assistance from the U.S. Department of Education is required to issue notices of non-discrimination and identify the employee or employees responsible for coordinating the compliance efforts. The statements of non-discrimination are required to notify students that the institution does not discriminate on the basis of “race, color, national origin, sex, disability, or age” (Office for Civil Rights, 2010).

Ideally, science classrooms and laboratories would be race- and gender-neutral learning spaces where all students felt equally supported, respected, and encouraged. Research shows however, that Black women are often caught in what is called a “double bind” which refers to the unique challenges minority women face as they simultaneously experience sexism and racism in their STEM paths (Ko et al., 2013; Ong et al., 2011).

**Statement of the Problem**

Black women science students may face negative stereotypes that are often applied to women in science (Carlone & Johnson, 2007; Cheryan, Master, & Meltzoff, 2015; Reuben, Sapienza, & Zingales, 2014) as well as deficit-based stereotypes that are often applied to minority students in science (Aronson, Fried, & Good, 2002; Ford, Harris III, Tyson, & Trotman, 2001; Mutegi, 2013; D. Solorzano & Yosso, 2001).

Teachers bring to the profession perspectives about what race means, which they construct mainly on the basis of their life experiences, vested interests, and media portrayals (Crowley & Smith, 2015; Leonardo, 2009; Picower, 2009). Given stereotypical beliefs about women in science and deficit perspectives of Black students that have been present in education
research, the idea that the science learning trajectory of Black women non-STEM majors is negatively affected by professors who judged them through the lens of stereotypes is plausible.

Many teacher education programs in the U.S. have recognized and addressed race-based educational equity issues by requiring at least one multicultural teacher education course to prepare teachers to work effectively with diverse students and to develop cultural awareness, sensitivity, and a critical consciousness (Gorski, 2009). Although the need for educators to have awareness, exposure, and sensitivity to different cultural ways of being has been realized and acted upon by teacher education programs and many K-12 teachers, no such parallel exists for college faculty and staff.

**Purpose of the Study**

The purpose of this study was to explore Black women’s experiences in college science learning spaces. The focus was on Black women who were taking college science classes as a requirement for graduation or as pre-requisites for access to a career in nursing, not on science- or STEM-majors. A Critical Race Theory (CRT) perspective was used as the framework for the study. Although a CRT perspective was used to analyze and interpret data, participants were not recruited based on whether or not they experienced racism inside these spaces. Each of the participants indicated their science professors noticed the race of students more so than age or gender, so race became the primary focus of the study.

The goal was to understand how non-STEM Black women experience science learning spaces in relation to interactions with their science professors and how those interactions affected their science learning trajectories. The case studies reveal both positive and negative experiences inside of the women’s science learning spaces as well as advice the women provided for both
Black women who will be taking college science courses and the science professors who will be teaching them.

As a White researcher, my approach to this study was not only to collect narratives about the women’s science learning, but also find out what meanings they constructed around the concept of racial colorblindness and how my Whiteness may have affected the ways they engaged in discussions with me about their experiences with science professors. These narratives served as my data. I gained rich and thick descriptions of the participants’ experiences as Black women science learners through their stories (Bogdan & Biklen, 2007; Chase, 2007; Foote & Bartell, 2011; Milner IV, 2007). Through an analysis of their stories, I investigated how interactions with science professors affected their science learning trajectories.

**Research Questions**

The following research questions guided this study:

1. How do Black women science learners describe their experiences with science faculty?
2. How do these experiences influence their science learning?
3. What type of learner characteristics do Black women perceive as important to be successful in college science learning spaces?
4. What type of science professor characteristics are most helpful to Black women in college science learning spaces?

**Theoretical Framework**

Theory provides a framework that guides a study and its analysis. Therefore, theoretical frameworks provide a conceptual guide for choosing the concepts to be investigated, for suggesting research questions, and for framing the research findings (Corbin & Strauss, 2008). In this study, I used critical race theory (CRT), particularly CRT in education, as
the guiding theoretical and analytical framework to collect data and examine the experiences
Black women in college science learning spaces. At its core, “CRT begins with the notion that
racism is normal, not aberrant, in American society and because it is so enmeshed in the fabric of
our social order, it appears both normal and natural to people in this culture” (Ladson-Billings &
Tate, 1995, p. 11). Critical researchers aim not just to expand the knowledge of society, but to
contribute to transform the society and emancipate the disempowered people (Kincheloe,
McLaren, & Steinberg, 2011).

Critical Race Theory is a body of scholarship that provides a lens for challenging the
methods in which race and racism are constructed in society (Delgado & Stefancic, 2012;
Ladson-Billings & Tate, 1995). It “seeks to illuminate racial power and subsequent racial
hierarchies, analyze their effects, understand why and how they persist, and advance social
action to disrupt and alter them” (Parsons, Rhodes, Brown, 2011, p. 953). Although CRT does
not have a standard definition, a number of scholars (Crenshaw, 1995; Delgado & Stefancic,
2012; Ladson-Billings, 1998; Ladson-Billings & Tate, 1995; D. Solorzano & Yosso, 2002;
Taylor, Gillborn, & Ladson-Billings, 2009) have offered basic unifying purposes of scholarship
that use CRT as a framework. Ladson-Billings and Tate (1995) are largely credited with
bringing CRT to the field of educational research. In a 2005 article, The Evolving Role of
Critical Race Theory in Educational Scholarship, Ladson-Billings supports Solórzano &
Yosso’s (2002) description of a family tree for CRT which loosely traces the lineage of critical
theory from women’s and ethnic studies, through legal studies to critical theories used now (p.
474). The article references five tenets of CRT that should inform theory, research, and
pedagogy as described by Solórzano (1997, 1998) for the field of education which are (p. 472-473):
1) the intercentricity of race and racism and their intersectionality with other forms of subordination;

2) the challenge to dominant ideology;

3) the commitment to social justice;

4) the centrality of experiential knowledge; and

5) the utilization of interdisciplinary approaches.

In the Handbook of Research on Science Education (Lederman & Abell, 2015), Parson’s (p. 181) chapter on *Unpacking and Critically Synthesizing the Literature on Race and Ethnicity*, she references the CRT tenets outlined by Harris, Crenshaw, Gotanda, Peller, and Thomas (2012):

1) Racism is endemic and normal in the U.S.;

2) racism has contributed to the advantage and disadvantage or groups;

3) the existence and attainability of neutrality, objectivity, meritocracy, and color blindness are, at best, questionable and are, at worst, vehicles to maintain existent social hierarchies like the racial one in America;

4) a historical and contextual analysis of phenomena are imperative;

5) recognizing the experiential knowledge of people of color and their communities as valid is central to the examination of phenomena; and

6) ending all forms of domination and oppression is the goal.

Whichever set of tenets one follows, critical scholars agree that CRT is a body of scholarship that provides a lens for challenging the methods in which race and racial power are constructed in society, that CRT recognizes the legitimacy of the lived experiences of people of color in working to eliminate racism, and that CRT continuously critiques dominant ideologies that use neutrality, objectivity, and colorblindness to camouflage the socially constructed meanings of
race, power, and privilege (Bonilla-Silva, 2010; Ladson-Billings, 1998; Ladson-Billings & Tate, 1995; Leonardo, 2009; Solorzano & Villalpando, 1998).

Intersectionality and Black feminist thought were also used to frame this study. Much of the research on Black women in higher education settings incorporates an intersectionality framework. Black feminist thought is a perspective that centralizes and validates the intersecting dimensions of race and gender that add unique experiences in the lives of African American women. Black feminist thought is a critical social theory that encompasses bodies of knowledge that actively examine issues facing U.S. Black women as a group. It recognizes Black women as one group among many that are differently placed within situations of injustice; what makes it “critical” is its commitment to social justice (Hill Collins, 2009, p. 35). Thus, Black feminist thought as a critical social theory aims to aid African American women’s struggles against intersecting oppressions (Hill Collins, 2009, p. 36).

According to Howard-Hamilton (2003), Black feminist thought and CRT offer promise for understanding the intersecting identities of Black women and explaining ways in which their needs can be addressed effectively. What made CRT a more appropriate framework for this study is CRT’s inclusion of tenets which name and challenge traditional views in education regarding issues of racism, equal opportunity, and colorblindness. CRT also addresses the limitation of presentism that is present in much of the science education literature (Mutegi, 2013; Parsons, 2015) by addressing the historical grounding for the construct of race.

Role of CRT

CRT was the most appropriate framework for this study for many reasons. First, CRT recognizes that the experiential knowledge of people of color is legitimate, appropriate, and critical to understanding the effects of racism (Solórzano & Yosso, 2002). Using a CRT
perspective informed the research questions by gathering stories and perspectives grounded in the experiences of Black women which exposed racism in their science learning spaces.

Second, this study has the potential to promote social justice and empowerment by providing a deeper understanding of the experiences of Black women science learners. This will benefit both Black women who will be taking science classes and science professors. Black women who will be taking college science classes may be empowered by the advice provided by the participants. The study will inform science professors about how their interactions with students of different racial backgrounds may not be consistent, impartial, and free from bias. Science professors may have cause to engage in critical self-evaluation that could lead to anti-racists or more culturally sensitive teaching practices. This potential shift in science professor behavior is a step towards eliminating racism and racist practices inside science learning spaces which would provide Black women a more level playing field when they enter college science learning spaces.

Third, CRT challenges claims of objectivity, race-neutrality, and colorblindness. Due to the prevalence of colorblind ideologies and resistance strategies used by educators (Crowley & Smith, 2015; Haviland, 2008; Henfield & Washington, 2012; Manglitz, 2003; Manglitz, Johnson-Bailey, & Cervero, 2005; Matias, Viesca, Garrison-Wade, Tandon, & Galindo, 2014; Price, Hyle, & Jordan, 2009), discussions of race are unlikely to move forward without those in control of science learning spaces hearing honest, personal, and sometimes disturbing narratives from Black women who are affected by perceptions of racism. My hope is that the use of CRT in this study will lead to epiphanies about race and racism that otherwise might be minimized or ignored.
Because of CRT’s commitment to social justice, the potential for positive impact on both Black women and science professors, the value it places on experiential knowledge shared through narratives of Black women, and its role in challenging colorblind ideology, CRT serves as a useful analytic and interpretive lens for this research.

**Significance of the Study**

A critical first step toward understanding and changing conditions that undermine the success of Black women in science learning spaces is listening to what they have to say about their academic and emotional experiences in science courses. An objective is to see their experiences through their eyes, the way it actually is rather than the way professors think it is or want it to be. The findings from this study will reveal to science educators, researchers, and other Black women science learners how classroom experiences and teacher interactions influence the science learning trajectories of Black women in science classes.

By examining the experiences of Black women in science learning spaces, the goal of this study is to contribute to a body of literature that centers the voices of these learners to better understand their experiences with science faculty. The findings in this study will be useful for college science faculty, current and future Black women science learners, administrators who are tasked with hiring and evaluating science faculty, and college staff who support marginalized students. There is no real stimulus in place to encourage a science professor to critically examine his or her classroom practices and how those practices may lead some students to feel stereotyped, marginalized, or minimized. The experiences collected in this study may serve as a stimulus for science professors who are interested in examining how their classroom practices and personal ideologies may impact student motivation and learning. It will provide professors an opportunity to engage in processes that will allow them to analyze and evaluate their
classroom practices and interactional styles and to be mindful of the potential effects that a seemingly meaningless or small interaction may have on a student.

It is expected this study will be significant to current and future Black women in science classes because participants will provide learner characteristics they feel are important for Black women to be successful in science learning spaces. The descriptions provided by the participants with science faculty will inform both faculty and administrators about student-professor interactions and the impact those interactions can have on science learning of this unique population. Additionally, this study answers a call to action from other researchers (Harper, 2012; Mutegi, 2013; Ong et al., 2011; Scantlebury, 2012) who acknowledge Black women reflect unique, nontraditional profiles and trajectories through undergraduate science learning spaces and that their journeys through these science learning spaces merit study.

**Researcher Positionality**

Simons (2009) explains that the common practice of stating one’s values and assumptions in a research proposal is a start, but it does not go far enough to explain how the researcher acted in relation to those values throughout the research process (p. 92). By making my biases and assumptions visible, I hope to bring further credibility to the study. With that standard of disclosure and reflexivity in mind, I will attempt to explain my positionality and account for how my interests, biases, and assumptions may affect this study.

Professionally, I am a white, female associate professor of chemistry at a two-year college who has an awareness of racial and gender biases inside science learning spaces due to my professional and personal relationships with other science instructors and former students. My career in law enforcement prior to teaching chemistry exposed me to the realities of racism and gave me an understanding of how people who were given power in society, whether through
racial or gender privilege, career choice, or institutional position, could use their positionality to either empower or constrain others at their discretion. I find unfairness and unexamined biases that privilege some while holding-back others extremely frustrating. The confluence of listening to experiences of former science students (many of whom were Black women), informal communications with other science faculty in both on-campus and off-campus environments, and observing other science instructors while they were teaching (some were observed out of professional responsibility, and some were observed out of curiosity after hearing student stories) provided me with a basis for this study. I have learned through informal conversations with students that contextual nuances and realities that shape student-faculty interactions can have major effects on the student in ways that a faculty member may not realize and for students who may already have efficacy challenges and/or feel pressures due to their intersectionality, these interactions can be very impactful. I believe that bias is a naturally occurring characteristic based on life experiences, lack of integration with others who are different, and the nature of the culture in which we were socialized and that the beliefs, ideologies, and biases of science faculty are often communicated to students in ways that may not be obvious to us.

As a researcher, I am concerned that Black women may have negative experiences in science learning spaces and interpret those experiences as being the result of their inadequacies or deficiencies when the reason may be entirely outside of their control. Likewise, I want to capitalize on positive experiences that Black women have with science educators so that we as science faculty can learn what is helpful, motivating, and uplifting to students who are often marginalized in science learning environments.
2 REVIEW OF THE LITERATURE

This review will map the territory of the literature on which this study is based. Currently, there is minimal research that disaggregates Black women from other women of color in science in science learning spaces. Additionally, no research could be located that centers the experiences of Black women who are not STEM-majors. All of the Black women in these studies either are STEM-majors or high-achieving science students.

Education is the most-often cited way in which Americans can pursue economic success and social mobility (Horvat, 2006, p. 5). However, due to hierarchical historical constructions of both race (Mutegi, 2013) and gender (Brickhouse, 2001) within the U.S., racism and sexism persist in ways that leave Black women on the margins of many learning environments (Tatum, 2007). The term “double bind” refers to the unique set of challenges faced by minority women as they simultaneously experience sexism and racism and was first used in the American Association for the Advancement of Science (AAAS) publication *The Double Bind: The Problem of Being a Minority Woman in Science* (Malcom, Hall, & Brown, 1976). In a call to action in 2011, Ong and colleagues published *Inside the Double Bind* and reported that “the unique, collective experiences of women of color in STEM have been largely excluded from the research agenda” (Ong, Wright, Espinosa, & Orfield, 2011, p. p. 182). Many of the empirical research studies that examine the experiences of Black women and other women of color in higher education use an intersectionality framework.

Intersectionality refers to the way overlapping oppressions such as race and gender operate together to produce forms of discrimination and social inequity that can amount to minority women experiencing hardships that are greater than the sum of racism and sexism (Crenshaw, 1991; Hill Collins, 2009; Hill Collins & Bilge, 2016). Intersectionality has been
used as a way of understanding and analyzing complexities in human experiences in relation to social and historical contexts and has been described as:

- A theory based on the idea that we experience life based on a number of different identities,
- A metaphor or symbolic image to illustrate the collision of racial differences from one direction and gender differences from another - that race and gender cross and collide with each other in Black women’s lives in ways that cannot be fully understood or anticipated;
- A term to explain that discrimination can happen on the basis of several different factors at the same time; intersectionality gives us a language and way to see it in order to address it, and
- A lived reality for Black women living in the U.S.

Intersectionality is a component of all of the studies contained in this critical literature review either as a theory, a metaphor, a term, a described lived reality, or some combination of each. A critical offshoot of intersectionality is Hill Collins’s Black feminist thought. Black feminist thought is described by Hill Collins as a collective knowledge created by Black women for Black women to foster Black women’s empowerment; Black feminist thought aims to empower Black women within the context of social injustice sustained by intersecting oppressions (Hill Collins, 2009). Many of the Black female researchers in this literature review have access to and use the more specific Black feminist thought framework instead of the more broad intersectionality framework. The major difference in the literature reviewed here is that researchers who use the Black feminist thought framework are able to integrate their lives,
narratives, and experiences into their findings about Black women and most of them include themselves as participants in the studies to varying degrees.

**Statement of Purpose**

The purpose of this review is to identify and describe the current state of research in terms of findings and methodologies using empirical studies aimed at extending what is known about the experiences of Black women science learners with college science faculty and to identify limitations in this literature.

**Criteria for Inclusion/Exclusion**

Online educational databases such as EBSCOhost, Google Scholar, and Journal Storage (JSTOR) were used to obtain relevant articles of interest using various search combinations that identified gender (women, female), race (Black, African American, underrepresented minorities, women of color), subject area (science, science education, non-majors science, allied health science, STEM), and education level (undergraduate, adult, reentry). References from these articles were also searched using the names of researchers the author knew from previous work to have written papers in these areas. Studies that used the terms *women of color, minority women, or underrepresented minorities* without specifically identifying an African American female or a Black female were excluded as were quantitative studies that reported findings in terms of gender and race/ethnicity only as it could not be determined how many participants were both Black and female in those studies. No exclusions were made on the basis of a theoretical framework. Searches were conducted using the terms *intersectionality, Black feminist thought, and critical race theory* in combination with the terms above as these frameworks best describe the historical and sociocultural positionality of Black women.
The studies were chosen on the basis of five criteria. First, the articles reviewed were reports of empirical research. Second, the articles were published in peer-reviewed journals. Third, the articles addressed the experiences of at least one Black or African American woman. Fourth, the articles addressed sociocultural factors in science learning environments and/or higher education learning environments. Finally, the review was limited to articles published since 1996.

**Critical Review of the Literature**

Part one of this critical literature review will examine empirical research that has centered the experiences of Black women in higher education (Coker, 2003; Johnson-Bailey, 1999; Johnson-Bailey & Cervero, 1996; Sealey-Ruiz, 2007; Thomas, 2001). Part two contains reviews of studies that focus on students of color in science learning spaces (Brand, Glasson, & Green, 2006; Carlone & Johnson, 2007; Grossman & Porche, 2014; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Johnson, 2007; Ko, Kachchaf, Ong, & Hodari, 2013) and part three focuses on studies that specifically examine the experiences of Black women in science learning spaces (L. Charleston, Adserias, Lang, & Jackson, 2014; L. J. Charleston, George, Jackson, Berhanu, & Amechi, 2014; Jackson, 2013).

**Part I: Experiences of Black Women in Higher Education**

This section contains reviews of five empirical studies that speak directly to the distinctive challenges Black women confront in colleges and universities in the U.S. These studies indicate that this population faces obstacles in college learning spaces as a result of their race, gender, or the intersection of both identities.

In a study addressing the unique challenges faced by Black women in college, Johnson-Bailey and Cervero (1996) presented an analysis of the educational narratives of reentry Black
women that uncovered ways the dynamics of American society, which often negatively impacts the lives of this unique population, are enacted in their higher education learning experiences. In this study, reentry women are defined in two ways: as women who delayed or interrupted their initial college experiences for a period of five or more years or as women over thirty who have enrolled in college (Johnson-Bailey & Cervero, 1996, p. 143). The study was “designed to examine the educational narratives of reentry Black women in an effort to determine the ways that the dynamics of the larger society are played out in higher education” (Johnson-Bailey & Cervero, 1996, p. 144). No explicit research questions are provided. The theoretical framework is based on Black feminist thought and the epistemology that evolved from that conceptual structure. Black feminist thought is an outgrowth of Black feminism which is a movement that addresses issues of race, gender, class, and color as they pertain to Black women and acknowledges that Black women’s lives are often impacted negatively by sexism and racism. In accordance with the nature of Black feminist thought, which supports the perspective of the researcher be made explicit and the narrative process be reciprocal, Johnson-Bailey, a Black woman, made her personal narrative and her perspective part of the study in two ways. She created her narrative using the same interview guide that was used with her participants, and her data collection process was conversational and mutually constructed. Although the researchers state that Johnson-Bailey created her narrative, information about how this was used in the study or when it was created is not provided. Whether the narrative was created before, during, or after interviewing the participants could address and clarify potential researcher bias for the study.

The sample was described as purposeful, but no additional information was provided to explain how the women were selected. The participants consisted of eight women: Johnson-
Bailey, five Black female undergraduates, and two other Black graduate women between the ages of 34 and 54 from five different colleges.

Narrative analysis was used as the methodology and data was collected using an unstructured interview format in conjunction with an opening statement and an interview guide. Interestingly, the interview questions did not address gender, race, class, or color. No mention is made of an attempt to establish credibility or validity. Triangulation, peer debriefing, member checks, or an external auditor could have been used to establish trustworthiness. Researcher bias was not addressed or how the interpretation of the findings may have been shaped by the background of either researcher.

The research findings are presented in two sections: “Making a Way Out of No Way” in which the participants describe why they returned to school, how it felt, and their reasons for reentering and the second section, “Strategies for Making a Way Out of No Way” where they describe techniques used to find their way through the world of academia. Each of the participants described returning to school as an act of personal courage in some way, each of the women was motivated to do better than her mother, and all were seeking better lives. For some women, it meant going against the grain of their circle of friends and community, and each woman considered returning to school a necessary foundation for survival. The authors report that “reentering meant balancing a full-time job, a family, and school for each woman” (Johnson-Bailey & Cervero, 1996, p. 146), however, no demographic data was provided about the number of women who were married or how many had children. Additionally, they report that Shelia was the only undergraduate woman of the five who worked full-time while pursuing a degree (Johnson-Bailey & Cervero, 1996, p. 147), so the claim that each of the women had to balance
school with a full-time job seems incongruent. The author does not provide strong evidence to
support the assertions with the quotations that were provided from three of the participants.

Findings from the second section are more clearly presented as methods of persisting
during the reentry process. The authors describe the coping strategies used to deal with the
societal forces of race, gender, class, and color used by these women as silence, negotiation, and
resistance both inside and outside of the college classroom. These assertions are strongly
supported by similar representative quotations from multiple participants and are presented in a
cohesive way. Of the coping mechanisms used by the women, negotiation was the most
frequently used. Jean states that negotiation is a way of life for any minority and explained that
on a daily basis these groups must weigh options that members of the majority don’t have to
entertain (Johnson-Bailey & Cervero, 1996, p. 150). Silence occurred as an internal and external
coping strategy and supporting data was provided for how silence was used by the women both
inside and outside of the classroom. Silence and negotiation appeared in all of the narratives.
The third coping mechanism, resistance, was defined as “open defiance of rules or actions that
the women perceived as unfair” (Johnson-Bailey & Cervero, 1996, p. 151). Resistance is the
only mechanism which occurred on the external level and was the least used of the coping
strategies. Although it was the least used, resistance was the strategy that appeared to be the
most salient in the women’s memories due to dramatic nature of the times it was used. One
participant, Faye, described her overall school experience as “hostile until all the flags are raised,
and everyone knows where everyone stands. Until there was a chance to demonstrate ability, I
just think that a question mark registers subconsciously in Black-White relationships” (Johnson-
Bailey & Cervero, 1996, p. 152). Most of the time resistance was used, it was an act of speaking
out to be heard. A commonality shared by seven examples of resistance is that they involved
resistance against a White male. The total number of examples of resistance collected by the researchers was not reported.

Johnson-Bailey and Cervero conclude that the college reentry women in the study illustrated how their lives inside academia mirrored their lives in society as a whole. The participants recognize that the same enduring hierarchy of privilege and power affects them wherever they are and that they are at the bottom of that hierarchy due to their race and gender. To cope with historically existing dilemmas, the women relied on familiar strategies they had used throughout their lives to deal with racism, sexism, classism, and colorism. Although colorism is mentioned in the conclusions, no supporting data was provided that addressed issues of colorism or how colorism affected the participants. Another important finding reported was that Black women employ the concept of “ethgender” in thinking of and describing themselves to others. “Ethgender suggests the idea that gender and ethnicity are tightly fused in the conscious mind and that they cannot be conceived separately. Respondents consistently joined gender and race and overwhelmingly spoke of being a ‘Black woman’ rather than a woman or Black only” (Johnson-Bailey & Cervero, 1996, p. 154). Their data shows that the reentry Black women were deterred from participating in schooling processes such as classroom interactions by classroom and societal experiences with gender subordination and racism. The authors do not address generalizability, but state that this study addresses issues of race, gender, class, and color and that Black women represent an untapped source of significant research opportunity since most of the research done on reentry students do not identify Black women as a separate unit of analysis. No implications were provided. A limitation of the study is that neither researcher addresses the potential for racial bias in collecting and interpreting the data. One of the researchers was situated as both a participant and a collector of data. Although she states that
she is a Black woman and a college reentry student, no more information is provided about whether or not these overlapping dual roles could have affected her coding or her interpretation of the data. Another limitation is that no measures were reported to have been taken to establish creditability or validity.

In a follow-up study which continued the examination of Black reentry women’s educational experiences, Johnson-Bailey (1999) focused on extracting common themes in the educational narratives of Black reentry women and on identifying factors that affected their participation and retention. Black feminist thought, which asserts that Black women have a collective consciousness that is based on their experiences in U.S. society that places them at a disadvantage based on their overlapping oppressions of being both female and Black, was her theoretical framework. No explicit research questions were provided. The sample was purposeful and consisted of ten Black women, both graduate and undergraduate, who were enrolled in four schools within the college of education at major research universities. Information clarifying how the participants were recruited or chosen is not provided. Many of the women received multiple degrees from the same institution, and in these cases, the researcher interviewed them about each of their reentry experiences.

Narrative analysis was used as the methodological instrument, and semi-structured interviews with an interview guide were used to direct data gathering. Care was taken not to introduce questions about race, gender, and class. Researcher field notes about non-verbal behaviors, the interview setting, and “interpersonal issues” were also collected as data. No additional information was provided about the researcher’s field notes. The data was analyzed by the researcher for emerging themes which she describes as a step-wise technique of finding commonalities throughout the women’s stories. She states that the commonalities represented
categories of meaning and that the “interlocking nature of these categories made obvious the parameters of the emerging themes which formed the major findings in the study” (Johnson-Bailey, 1999, p. 12). No additional information about the coding process used by the researcher was given. Quotes from the participants were then used to support the emerging themes. The researcher does not mention any attempts to establish reliability or credibility. Member checking or peer debriefing could have been used.

The findings are presented separately as issues that affected the reentry women’s participation and issues that affected their retention in college. Findings revealed three major issues affecting the participation of the Black reentry women studied: 1) encouragement from the department’s graduate coordinators, 2) recruitment by Black and White students who were in the program, and 3) encouragement from Black college career counselors and/or Black professors. Since no demographic data was presented about the racial composition of the faculty and staff from any of the colleges of education, it is unclear if only Black mentors were encouraging because the majority of faculty and staff was Black or if the implication is that White faculty and staff were less helpful to the participants. With the exception of one woman, all described a tentativeness about applying because of stories they had heard about the inherent unfairness toward Black students at most major research universities (Johnson-Bailey, 1999, p. 16). Each of the categories is supported by representative quotations from multiple participants. All of the women in the study had some school experience that negatively impacted their opinions of higher education.

An implication is that the presence of Black faculty, support staff, and students are very important to the participation and retention of Black reentry women. The study could have been improved if the researcher addressed her positionality and explained the measures taken to
minimize researcher bias. Additionally, no mention of validity or credibility was made. Finally, no racial data for students or faculty was provided for any of the colleges, so it is unclear if the participants simply had more positive interactions with Black students and Black professors because there were more Black students and professors than White students and professors or if the White students and professors were less engaging and helpful.

A paper by Thomas (2001) presents two studies that examine motivators, obstacles, and support systems of college reentry women. The first study was a mail survey to collect data from college reentry women and study two specifically targeted the Black women who participated in the first study. Reentry is defined by the author as “a cohort of women who had not completed their higher education at the traditional age but later returned to school while simultaneously maintaining other responsibilities such as full-time employment, family commitments, and other obligations of adult life” (Thomas, 2001, p. 139). Some of the research questions embedded in both studies were:

- What is the salience of education in the lives of these women?
- What do reentry women view as the most positive and negative aspects of college reentry?
- What do reentry women see as their major motivators and obstacles?
- How supportive are members of their support system?
- Are there specific challenges and barriers unique to African American reentry women?

Both studies were framed by Cross’s three major categories of barriers (situational boundaries, dispositional/psychological boundaries, and institutional boundaries) faced by older women returning to college and Tinto’s assertions that older students face greater and different
challenges in a college environment than traditional college students such as having to find a workable fit for full-time job, family commitments, and school responsibilities. The overall theoretical framework was sociocultural in nature and was not explicitly discussed. Although intersectionality is used in the finding, intersectionality is not described as a framework.

The sample in Study 1 was reported to be a random sample of 147 participants enrolled in the Weekend College degree program at a women’s college located in the northeast U.S. The researcher selected a random sample from a list of students provided by the college administration who were enrolled in the Weekend College program and each student was sent a survey packet. The author reports that the sample was 40% European American, 43% African American, 7% Native American, 4% Hispanic American, 1% Asian American, and 5% women of other origins. None of the women were science or allied health majors.

Justification for the results of Study 1 are reported as representative quotations from the participants, and multiple examples are given for each. Thomas (2001) found that education played a significant role in the lives of these women, 43.7% indicated that it was the single most important thing to them, and the majority (85.6%) reported that their desire to earn an education was currently greater than it was ten years ago. Many of the women indicated the reasons were related to job advancement, personal fulfillment, and being a role model. Their biggest challenges were balancing multiple roles such as parenting, being partnered, and time pressures. More African American women (40%) than European American women (28%) perceived their college reentry as having a negative impact on their relationship with their partners and 65% reported that their re-entry brought them closer together with their children. The positive effects of college reentry for the women focused on enhancements that had occurred in their self-esteem and self-efficacy. The negative effects were related to personal barriers, such as fatigue, juggling
multiple responsibilities, and institutional barriers such as cost and inadequate childcare. Ethnic differences were most pronounced in the results of sources of support. Almost twice as many African American women compared to European American women named a parent as the person who encouraged them the most to further their education while almost four times as many European American women named their partners as being the most supportive, compared to African American women. Study 1 illustrated some of the similarities and differences women of various races/ethnicities encounter when they attend college as adults. The claims made by Thomas (2001) are supported by the evidence she presented in the form of representative quotations and personal stories of the participants. Other than to report that the interviewers and the principal researchers were African American women, potential researcher bias was not addressed in either study. The researcher does not state whether or not she was a reentry student, which could have had an impact on her interpretations. Validity or reliability strategies were not mentioned. Member checks, peer debriefing and/or an external auditor could have been used as strategies for both studies.

Study 2 took place approximately one year after the first study and was a qualitative analysis using 19 of the African American women who participated in Study 1. Letters were sent to all of the African American women in Study 1 and nineteen were willing to participate in this more in-depth study. The average age of the women in Study 2 was 42. Data were collected via face-to-face semi-structured interviews which focused on their reasons for returning to school, the impact of reentry on their self-image, sources of support, challenges associated with reentry, and their advice to other African American women interested in returning to college. Additionally, two other instruments were used: Rosenberg’s Self-Esteem Scale and Pearlin and Schooler’s Mastery Scale to measure their sense of personal control over various aspects of their
lives. Thomas described the limits of each Scale and the meanings of the high and low scores but did not include information about whether the instruments had been previously used or published.

The major findings are presented as motivators for college reentry, impact of reentry on self-image and well-being, sources of support and discouragement, special challenges faced by African American women, and advice they would give to other reentry African American women. The majority of women reported that professional reasons were their primary reason for returning to college and that returning to school had a positive influence on their self-image, due to enhanced self-confidence and self-efficacy. The results on the Self-Esteem Scale showed a mean score of 38.2 on a scale of 10-40 with higher scores indicates greater levels of self-esteem. The mean score on the Mastery Scale was 18.9 on a scale of 7-28 which Thomas reported as a moderately high sense of personal control. In alignment with Patricia Hill Collins’s insight into Black feminist thought, although Thomas does not mention Collins’s work, most of the women (89%) identified a particular woman, generally a relative, friend, or co-worker, who encouraged them to further their education. The advice participants would give to other African American women considering college reentry were summarized as, make the decision to return to school, make the necessary adjustments to be successful and to develop good support networks (Thomas, 2001, p. 151).

A salient point of this study was the special challenges African American women perceive they face as reentry students that are specific and unique to their intersectionality as women and African Americans. Almost 80% of the women identified specific challenges they believed were amplified by their intersectionality. The barriers were situational and institutional in nature. The situational barriers included financial challenges and inadequate support systems,
and the institutional barriers were racism and sexism. The college that was attended by participants was mostly White with mostly White female professors and staff. The researcher uses examples through voices of her participants to illustrate that they have found interacting with faculty and other students challenging, that Black women are limited in the ways they can deal with institutional racism and sexism and that they believe White women have been exposed to better learning and study skills than people who grew up in the inner-city. Despite the additional challenges and burdens perceived by African American women in the study, Thomas’s results show they remain optimistic about reaching their goals and believe they have what is necessary to be successful. The challenges experienced by the racially/ethnically heterogeneous group of women in Study 1 were magnified for the African American women in Study 2. Thomas’s finding support and broaden two of Cross’s three major categories of barriers faced by non-traditional aged women returning to higher education, which are situational barriers and institutional barriers. The researcher does not address generalizability for either study. An implication is that as more African American women reenter college, the college environment should be responsive to the diverse needs of these students. The successful completion of college for these women not only directly benefits the women, but also their families, communities, and society as a whole.

In a study that specifically examined the motivations, challenges, and coping strategies of adult African American learners in higher education, Coker (2003) used Black feminist theory and Womanism to frame the unique vantage point of the participants. These frameworks take into account the intersectionality of gender, race, and class and positions the black female’s story as unique and resulting from overlapping oppressions. The participants were purposefully selected from a group of 61 women who attended a mid-sized working-class university in the
Midwest and who responded by completing an initial questionnaire indicating they were interested in participating in the study. It is unclear how the researcher first found or contacted the women or how the study was described to the potential participants. Ten African American women with ages ranging from 21 to 52 were chosen for the study. The ten participants were chosen because they not only expressed an eagerness to be involved, but were also described by the author as “articulate, sociable, and displayed an openness and reflective nature about exploring their higher educational experiences” (Coker, 2003, p. 661). Three were undergraduates, seven were graduate students, and nine were first-generation college learners. The researcher purposefully selected “mature women,” which was not defined, because she believed they would be more likely to articulate experiences with greater self-examination and have a more developed understanding of the world.

Following the initial face-to-face interviews, the primary source of data collection was a series of five bimonthly focus group meetings. Common themes were noted, and the resulting themes were placed into several categories. Not every category had sufficient examples, so some were eliminated on that basis. The remaining categories became the findings of the study because the researcher concluded there was sufficient evidence to support a commonality of experiences. Attempts to establish validity, such as triangulation, member checks, or peer debriefing were not mentioned. Researcher positionality or potential researcher bias was not addressed.

The three main themes that emerged from the Black women were motivations, challenges, and coping strategies. Motivations for the women were, (a) self-development, (b) family development, and (c) community development. Challenges for the women were grouped as “racism and sexism” and “marginalization as adult learners.” The coping strategies and
sources of strength for the women were: (a) humor, (b) silence, (c) compromise, (d) excellence, and (e) confrontation. Multiple supporting representative quotations from the women were provided for each category. Some participants reported being challenged by prejudice and cultural misunderstandings as a part of their academic experience, and some reported negative interactions with White instructors whom they believe negatively stereotyped them on the basis of their race, culture, and/or gender (Coker, 2003, p. 667). Others reported feeling as if they were “stuck between a rock and a hard place due to the cultural differences and expectations which exist between their higher education environment and the communities they were socialized in” (Coker, 2003, p. 668). In terms of their marginalization as adult learners, some of the women shared that they felt anxious about their ability to do college work after being out of school for a number of years. They were worried that they would have to “fake it” and pretend to be intellectual.

Coker (2003) reports the significance of the findings is that they confirm sexism and racism are still part of our society and the same oppressive forces that affect African American women outside of the classroom impact them inside their learning spaces as well. Racism and sexism are part of the college experience for these adult African American women, and they continue to be unfairly burdened in ways that other learners are not. Generalizability is not discussed. An implication is that educators who work with African American adult learners should be willing and open to engaging in discussions about how race, gender, and class affect the lives and educational experiences of their students.

Building from her unpublished dissertation, Sealey-Ruiz (2007) examines the significance of a culturally relevant curriculum (CRC) to a group of 15 Black women, 23 to 57 years of age, in a writing course she instructed and probed how the women responded to a
curriculum that centered their sociohistorical backgrounds and life experiences. This research study was included to add to an understanding of the experiences of Black women in college science learning spaces. Her conceptual frameworks were based on CRC with Black adult learners, transformative learning, and Black feminist thought. Sealey-Ruiz explains, “research on culturally relevant adult education with African American students suggests that learners are able to validate self- and group-identity and use their cultural knowledge to facilitate transformative learning experiences; embedded within CRC for African American adult learners is an Africentric philosophy” (Sealey-Ruiz, 2007, p. 46). Black feminist thought was used as a theoretical frame for curriculum construction of the writing course. Sealey-Ruiz wanted the class to write about their life experiences as Black women, as well as a lens through which to analyze the data. Sealey-Ruiz is a Black woman. The questions guiding her study were (a) How do Black female adults respond to a curriculum centered on their cultural ways of knowing? (b) What happens when these women are instructed using a culturally relevant curriculum?

All of the students in her writing class agreed to take part in the study and all self-identified as Black or African American (acknowledging family roots in the U.S.) and poor or working class (Sealey-Ruiz, 2007, p. 49). The students’ self-described positionality led Sealey-Ruiz to incorporate reading material by past and present Black feminists, nationalists, and civil rights activists in the forms of autobiographies, personal essays, diaries, and scholarly articles from different fields. The data consisted of three written assignments per student, weekly journal entries by the students, researcher notes on class discussions, three student-teacher conferences (used for member-checking), and the researcher’s analytic log entries. Sealey-Ruiz points out that the women used dialog to validate knowledge claims they vouched for with their life experiences which are a component of Black feminist thought (Sealey-Ruiz, 2007, p. 51). Data
were analyzed using the constant comparative method. Three major themes emerged from using CRC with this population of Black women: Language validation of African American Vernacular English, the fostering of positive self-identity and group-identity, and that CRC encourages self-affirmation and affirmation of goals.

Sealey-Ruiz (2007) indicates that all 15 Black women in her study were fluent speakers of African American Vernacular English (p. 53) and that language validation was the most frequent theme as she used CRC with her class. Sealey-Ruiz incorporated readings that used both African American Vernacular English and Standard English and she provides multiple participant quotations showing how the Black women used dialog to assess knowledge claims regarding their language which is a tenet of Black feminist thought.

The second most frequent theme was fostering a positive self-identity and group identity. She explains using culturally relevant teaching with African American learners gives students a framework to problematize domination and the authority of the dominant culture. Each of the participants claimed an ancestral history involving slavery and racial oppression, and she reports they responded positively to the curriculum and began viewing their history, themselves, and their communities in positive, affirming ways. The researchers support this assertion with representative quotations from student journals, essays, and written responses after viewing videos documenting racial unrest in the U.S.

The third theme, self-affirmation and affirmation of goals, was also strongly justified by Sealey-Ruiz. She used multiple representative quotations from different participants and included journal entries, in-class writing assignments, and class discussions. Many of the students explained that Sealey-Ruiz’s writing class was the first time they had committed to writing their goals and aspirations and that the process of “putting your dreams out there” was
“fearful, “empowering,” and “enjoyable” (Sealey-Ruiz, 2007, p. 57). Sealey-Ruiz weaves the use of her class notes of observations and participant quotations as well as quotations from students’ various types of written work (journals, essays, in-class writing assignments) as she develops each theme making her thought process transparent and strengthening her justification for each theme in a clear, easy-to-follow, and straightforward way.

Sealey-Ruiz states she is a Black female researcher. Although she does not acknowledge being a Black woman gave her access to information that may not have been readily accessible to a non-Black researcher, the safe learning space she created by effectively using culturally relevant teaching with these Black women and her thorough note-taking and observations created rich, descriptive, and powerful data. She concludes, “the women in this study drew on their lived experiences as a criterion of meaning, used their writing and class discussions to assess knowledge about themselves (individually and collectively) and exhibited an ethic of caring for themselves and their sisters” (Sealey-Ruiz, 2007, p. 58) which are tenets of Black feminist thought. She makes and strongly justifies the claim that her findings show using a CRC with Black female adult students can enhance their learning experience.

The participants in each of these studies were Black women in higher education. Some were identified as being first generation science learners, similar to the participants chosen for this study. Each of the studies connects challenges the women encounter in higher education to challenges they face historically and currently in U.S. society. These studies are sociocultural in nature, and most indicate the use of Black feminist thought in their frameworks. However none but Sealey-Ruiz (2007) actually linked their findings to components of Black feminist thought. All of the researchers in these studies are Black women with the exception of Ronald Cervero who co-authored with Juanita Johnson-Bailey who is a Black woman. All of the studies report
that Black women, as a result of their intersecting identities, faced various forms of sexism and racism in higher education. None of the researchers described their frameworks as intersectionality or intersectionality theory. However Black feminist thought, an offshoot of intersectionality theory, was the most common framework used. None used critical race theory as a framework.

Unlike much of race-related research in science education where race is used as a way to subdivided groups for data analysis (Parsons, 2014), race in these studies was a foundational component of understanding the experiences of the women in higher education learning spaces. Each of the studies describes an aspect of systemic racism that has affected the academic experiences of the women. In addition to obstacles, the studies in this section addressed advice for Black women and positive learning spaces for Black women. Each study confirms racism and sexism, in the form of situational and institutional barriers, has affected the learning trajectories of Black women to various extents and in various ways. The next section is not limited to Black women, it reviews literature pertaining to the experiences of both men and women of color inside science learning spaces.

**Part II: Experiences of Students of Color in Science Learning Spaces**

This section contains reviews of six empirical studies that address how science students of color are affected by the practices common within the culture of science. The studies explore the experiences of female students described as urban, of color, minority, or underrepresented and some studies also contain male participants. To be included in this review, the population of interest necessarily included at least one Black female. The studies differ in terms how many women in the populations identify as Black, data collection methods, reported methodological
rigor, analytical lens used, validation strategies, the ages of the participants, and whether or not the researchers addressed potential researcher bias.

In the first of two studies by Angela Johnson, Johnson (2007) investigated how women of color experienced their undergraduate science courses using common features of university science classes documented by Seymour and Hewitt (1997). Seymour and Hewitt (1997) studied enrollment patterns and interview responses of 335 well-prepared undergraduate science, mathematics, and engineering students on seven diverse campuses across the U.S. Of the 23 factors/concerns given by students contemplating leaving the STEM fields, all but seven criticized faculty teaching, advising, assessment practices or curriculum design. Their results indicate students are very disappointed with college STEM courses and professors—comparing them unfavorably both to high school science teachers and to professors in other college disciplines. The STEM students reported consistent experiences across the seven campuses that they disliked: poor faculty pedagogy (didactic styles, poor class preparation), competition and the weeding out process of introductory science classes, large classes, an unsupportive culture, the tradition of grading on a bell curve, and their perception that professors made the material “unnecessarily hard so as to perpetuate the image of science as “hard majors” (p. 99). Seymour and Hewitt (1997) explain that the participants accepted that some of the subject matter and skills needed to do science are inherently “hard.” The students in Seymour and Hewitt’s (1997) study wondered if science and math faculty conspired to make their learning experiences more difficult than what was needed to understand the concepts and “persistence was portrayed in terms of moral fiber, physical stamina, and the capacity to tolerate frustration, loneliness, and self-doubt” (p. 103). Survival under these conditions, Seymour and Hewitt contend, was easier for male students and White students.
Building on the work of Seymour and Hewitt (1997), Johnson (2007) sought to examine the ways that science professors, often unintentionally she contends, discourage women of color in science learning spaces. Johnson (2007) explains that she was “dubious about the most frequent explanation for the low numbers of Black, Latina, and American Indian women scientists: lack of interest and lack of adequate schooling to succeed in science” and she suspected that at least part of the explanation for the underparticipation of women of color lay with science departments rather than with the students (p. 808). Using Black, Latina, and American Indian women as participants within feminist and sociocultural frameworks, Johnson (2007) investigated what meanings Black, Latina, and American Indian women made of the common practices documented by Seymour and Hewitt (1997) in undergraduate science classes.

The researcher is a White female physics instructor who instructed an enrichment program for high-achieving students of color who is transparent about her positionality, reasons for wanting to conduct the study, and her relationship with the participants. She invited all of the juniors and seniors in the program who were still taking science classes other than physics to participate, and 19 women agreed to be in the study. Of the 19 women of color in the study she recruited, six were Black (five African Americans and one African immigrant), seven were Latina (Mexican Americans and southwestern Hispanics), two were American Indians, and four were Asian American. For reasons that are not provided, Johnson concentrated the study around the Black, Latina, and American Indian women, not the Asian women. Johnson established through institutional research data that the grade point average of her participants was higher than the average of other students of color with declared science majors, so she inferred that the women in the study would not experience academic difficulties any worse than those of other science majors. Twelve of the nineteen women of color agreed to be interviewed. However
Johnson does not separate the women of color into individual units of analysis, so it is unclear how many of the participants who agreed to be interviewed were African American women.

The researcher conducted interviews focusing on experiences studying in college science, their reasons for studying science, and the impact of a student’s ethnicity on those reasons and experiences. The interviews were recorded and transcribed. Participants were invited to read and respond to the transcripts. Some students did, it is unclear how many, and the researcher incorporated the changes into the transcripts. Johnson also attended lecture classes and laboratories with the participants to conduct participant observations in eight classes. Field notes were created. She paid particular attention to the institutional practices and repetitive personal interactions that were in common across the settings. No examples or definitions were provided. During and after data collection, Johnson read and reread her field notes and interview transcripts. Using semantic structure analysis, she searched for categories of cultural meanings. She organized and collapsed her domains using taxonomic analysis, then used componential analysis to compare and contrast the terms in different domains along potent dimensions of contrast (Johnson, 2007, p. 810). She started coding by hand, then used coding software to complete the coding process. Based on the coding, themes emerged in different domains and Johnson generated assertions that she checked against both old and new data looking for discrepancies. The assertions and themes became her findings. Johnson addressed her positionality of being a White woman studying women of color by indicating her awareness of this and stated that, because of this positionality, she was particularly careful in drawing conclusions from the data. She made all of her findings available to her participants at every stage of analysis and discussed findings with them as they emerged during analysis. She member-checked by sending emails of particularly surprising findings to the participants. She
triangulated data from interviews and participant observation, coding the two data pools separately, then observed which assertions and themes emerged from both sets of data. Johnson requested feedback on her initial findings at focus groups of women who had not been formally interviewed. The researcher states that “informants read and commented on drafts of every written product that emerged from this study and were present at public presentations of this work” (Johnson, 2007, p. 810).

Two institutional practices the women found discouraging were the way questions were asked and answered in class and the large size of the science lecture classes they attended. A third practice, engaging in undergraduate research, was seen as an obstacle for some women and helpful to others. One of the science cultural values the women found dispiriting in their classes was the way the material was presented to them. The participants explained that science professors presented the material in an abstract and decontextualized way and they felt little effort was made to connect the material to similar concepts or to link its use to the real world. Another was the depersonalized way the science professors interacted with the students; from what Johnson observed in the science classes she attended, it seemed that the professors centered their relationships with the student around learning science, rather than around the students which discouraged the women because they did not want to be seen as only learners of science, but as individuals. The other cultural value that the women found discouraging is that within the culture of the science classroom, science was presented as a meritocracy giving the illusion that science is and has been gender and race neutral. The women felt that the silence around race and gender made people of color look like special cases with White men as the norm in science. The findings are clearly reported, and multiple examples of lengthy representative quotations and participant stories were provided to support the assertions.
Johnson describes some ways in which Black, Latina, and American Indian women have difficulty fitting into a system that has historically been created by White males for White males. She shows how women of color face, not only the same obstacles as science students including the rigorous nature of weed-out courses and unhelpful professors, but have additional challenges based on their ethnicity, race, and gender. She explains that some of the obstacles emerge from pragmatic practices, such as large lecture classes, as well as from good intentions of some professors, such as asking questions in lecture and taking on undergraduates as researchers, to show that although the women of color are being disadvantaged, it is not necessarily the will of the individual professors that is causing the issues.

Johnson notes that before any meaningful changes can be made to address the issues that are faced by women of color in science, professors must first recognize and acknowledge that science has a culture of its own and that certain types of students may find it challenging to understand and navigate that culture. Johnson’s (2007) findings support those documented by Seymour and Hewitt (1997) indicating there are features common in college science learning spaces that discourage women of color in these spaces.

In a second study involving Johnson’s former students, Carlone and Johnson (2007) created a model of science identity to better understand the science experiences of undergraduate and graduate women of color. Using a sociocultural framework and identity theories, the researchers wanted to contribute to science educators’ current theoretical discussions about science identity. The research questions were: (1) How do successful women of color negotiate and make meaning of their science experiences? (2) How do women of color develop and sustain their science identities throughout their undergraduate and early science careers (3) What is the relationship between the women’s science identities and racial, ethnic, and gender identities?
The science faculty is approximately 25% female and 10% nonwhite; over half of the nonwhite faculty are Asian Americans. The sample for the study consisted of 15 women of color: 4 Black women (3 African Americans and 1 African immigrant), 4 Latinas (Mexican Americans and Southwestern Hispana), 3 American Indian women; and 4 Asian American women. All of the women self-identified as a woman of color and considered themselves to be “science people.”

The participants were recruited through an academic enrichment program for high-achieving students of color in the sciences in which one of the researchers, Angela Johnson, was an instructor. Thirteen of the women graduated with science majors, one graduated in another field that required extensive science coursework, and one had not graduated at the time the manuscript was written. All 14 graduates pursued advanced degrees in science-related fields and were pursuing science-related careers. The study uses data collected from ethnographic interviews that took place in 1999 and 2000 and follow-up e-mail interviews in winter 2005-6 following a span of six years of participant trajectory. Initial interview questions centered on the women’s experiences as science majors in a predominantly white setting and focused on their perceptions about how their ethnicity shaped their science experiences, whether they wanted to persist in science and why, and whether they felt like they had been successful science students. Of the seven women who responded, five responded entirely positively, and two responded with suggestions for improvement which the researchers incorporated.

Carlone and Johnson (2007) analyzed data using semantic structure analysis. They used the science identity model they created as a guide, searching for patterns and developing categories of cultural meaning. Their science identity model is informed by Gee’s theory of identity and also consists of the interrelated dimensions of competence, performance, and recognition, but their science identity model is “based on the assumption that one’s gender,
racial, and ethnic identities affect one’s science identity, a connection hinted at, but not made explicit, in previous literature” (Carlone & Johnson, 2007, p. 1191). Each category was given a cover term to describe it, a list of included terms in the examples, and a semantic relationship which described the relationship between the included terms and the cover term. This was followed by a taxonomic analysis which allowed the researchers to resolve the participants’ experiences into three main categories: those who formed research scientist identities, those whose science identity formation was disrupted by others, and those who formed alternative scientist identities. The researchers point out that it became clear as their data analysis progressed that the “recognition” component of the model was the most helpful in making sense of the experiences and trajectories of the women as well as the interactions between gender, race, ethnicity, and science identities (Carlone & Johnson, 2007, p. 1196). Recognition is given prominence as a key component of their science identity model for women of color because they found that recognition most critically explained the differential experiences for women in the three identity groups of research, altruistic, and disrupted science trajectories. Carlone and Johnson (2007) note that they did not directly observe any of the incidents described by the women and relied on the women’s reports of recognition as well as on their member-checking strategies which were not explicitly provided. Their primary goal was to understand the participants’ realities. The researchers address potential researcher bias by explicitly stating that they are both White women, which allows them only partial insight into the experiences of their participants. Because they were both White women with limited tools, they state that they were particularly rigorous in their validation procedures which included member checking and triangulation. “We placed more trust in findings that emerged from several different data
sources (formal interviews, e-mail interviews, participants’ current occupation)” (Carlone & Johnson, 2007, p. 1196).

Analysis of the data resulted in labels for three different science identity groups based on the women’s science identity trajectories: Research science identities, altruistic science identities, and disrupted scientists identities. The four women who had research science identities recognized themselves as scientists. They were engaged in science at an early age, and they were able to imagine themselves fitting into the science community of practice. The women who had altruistic science identities redefined what they meant by science. They saw scientific knowledge and skills as deeply tied to their altruistic values. When asked why they majored in science, all five of the women incorporated an interest in humanity, so their reasons for pursuing science became less about science itself and more about science as a way to carry out altruism. The six women who fit into the disrupted science category reported experiences where they felt discriminated against, neglected, or overlooked by meaningful others within science. It is interesting to note that women in every trajectory reported some negative school experience in science. Representative quotations and participant stories are provided to support each of these trajectories.

Carlone and Johnson’s’ goal was to develop a science identity model. They used data collected from the participants to test and refine their model and used the model to better understand the women’s experiences. They found that recognition was problematic for the women because it was completely dependent on external sources and they concluded that recognition can be viewed as a mechanism to reproduce the status quo in science. It is much easier to get recognized as a scientist if your ways of talking, acting, looking, and interacting align with the historical image of a scientist (Carlone & Johnson, 2007, p. 1207).
This study emphasizes the importance of recognition in science identity development for women of color, shows examples of subtle racism and sexism and how those factors can affect science identity, and how some women are able to succeed in science despite sometimes “unpleasant and culturally asynchronous conditions” (Carlone & Johnson, 2007, p. 1211) in college science environments.

In a study that analyzed undergraduate science students’ experiences in structured research programs, Hurtado, Cabrera, Lin, Arellano, & Espinosa (2009) used a blend of Carlone and Johnson’s (2007) grounded model of science identity and Bandura’s scientific self-efficacy to examine how underrepresented minorities (URM) experience these programs. The authors describe the contemporary culture of science and note that there are numerous psychological and social factors that both promote and inhibit whether a student becomes a scientist. They acknowledge that “while many recognize a distinct and pervasive ‘culture of science’ at colleges and universities, creating a definition for this culture is challenging” (Hurtado et al., 2009, p. 193). In addition to navigating the culture of science, which may be more difficult for some students than for others (Seymour & Hewitt, 1997), the authors describe negative social stereotypes that give rise to stereotype (Steele & Aronson, 1995) and that URM students frequently experience social stigma that can constrain their academic development, self-confidence, and development (Hurtado et al., 2009, p. 194). Hurtado and colleagues explain it is important to study how URM students navigate their paths in science learning spaces so that the scientific workforce can be diversified; they believe the role of programs that target underrepresented groups for engagement in science academic activities and research has been understudied.
The researchers (Hurtado et al., 2009) report using a phenomenological approach to examine, among other topics, how URMs experience the culture of science and their views on racial and social stigma inside college science learning spaces. A total of 65 student participants were purposefully recruited from four minority-serving institutions:

Data was reported to have been collected from interviews with program administrators, campus and institutional documents, observations, and focus group interviews. At each of the four sites, the researchers conducted interviews with program administrators and focus group discussions with students participating in the undergraduate research programs. Each visit lasted between one and two days. At the end of each visit, the researchers compiled notes from focus groups, interviews, campus documents, and observations in a single notebook and combined those with institutional documents. No information is provided regarding the campus documents, institutional documents, or the nature of the observations. The researcher state that the documents provided the basis for triangulation across multiple sources of data, but no information is provided regarding the triangulation process. It is unclear why a phenomenological approach was chosen in this study with 65 participants.

Students were purposefully recruited as student focus group participants through their campus science programs and were offered a gift card and refreshments for their participation. Semi-structured focus group questions were created to address categories such as, how did the students develop an interest in science and subsequent educational/career goals and what were the ongoing challenges and obstacles facing URM students. The focus groups lasted between 45 and 90 minutes and ranged from 4 to 12 participants. Two focus groups were conducted at each of the four sites, and each session was recorded and transcribed verbatim. There was a total of 65 racially diverse students who participated in the focus groups and women made up 62% of the
sample. The racial groups represented by the students were 60% Latina/o, 22% African American/Black, 5% Asian American, 8% multiracial, 3% American Indian, and 3% White. It is not known how many of the students were African American females. The majority of the students were biology, biochemistry, or chemistry majors. After the data collection from the focus groups was completed, multiple members of the research team reviewed focus groups transcripts to establish emergent themes relating to student development of scientific interest, support received, and present or continuing obstacles and challenges faced by the students. Across the different focus groups and campuses, the researchers “focused on themes that highlighted the promotion or hindrance of URMs developing a science identity and scientific self-efficacy” (Hurtado et al., 2009, p. 197). The researchers began coding manually, then used NVivo coding software. To ensure validity, the researchers conducted inter-coder reliability checks by pairing off into two pairs and reading a randomly selected portion of the transcript, five to seven pages, then independently coding the excerpt. Reliability results were calculated by dividing the number of agreements by the total number of passages and their inter-rater reliability for each pair averaged 75.5%. The researchers state that inter-coder agreements above 70% are acceptable, but above 90% is preferred.

By analyzing the focus group transcripts, the researchers identified seven major themes. They present only three of the themes to address issues surrounding the way in which students become a scientist, how they navigate the culture of science, and the role of social stigma in both of these processes. In response to questions about becoming a scientist, the data indicated that a majority of the students had early interests and aspiration before coming to college and that exposure to research as undergraduate gave them a sense of what a research career would entail. Conducting research was frequently sited as a primary activity that helped the students solidify
their career plans and gain confidence in their ability to pursue a profession in science. The participant quotes are reported by giving the participant’s school and gender, for example, “an MIT female student” or “a male UNM student” (Hurtado et al., 2009, p. 198). Multiple representative quotations were used to summarize questions about becoming a scientist; the majority of the quotations used were from male students.

The culture of science was described in two environments, the culture of science relating to the field of study as a whole, and the culture of science at their local, college campus level. The researchers point out that while similar themes emerged across institutions, the way science was practiced on each campus was unique. The participants tended to describe the culture of science in three ways: Collaborative, competitive, and academically intimidating. The competitive nature of science was described by students using both positive and negative experiences, and academic intimidation was characterized by students having the sensation they do not feel adequate or on par with what is expected of them. Most of the examples provided as examples of academic intimidation were quotations from women. One example illustrates racial difference as a perceived barrier for a female student who was uncomfortable asking her White or Asian professors questions. Several participants described not knowing or fully understanding a concept while the professor would state that the concept is “obvious,” thus making students feel as though they are ill-prepared for class material (Hurtado et al., p. 204). No pseudonyms are provided, and the data is not disaggregated in a way that makes it possible to have a clear understanding of the gender or racial background of the participants.

Students across all campuses described a range of experiences with social stigma specifically associated with being a minority in science and some had personally encountered White majority resentment of the opportunity to perform research in a minority program or had
internalized some of this resentment. This study supports Carlone and Johnson’s (2007) findings about the ongoing process of science identity formation and the importance of recognition of science identity formation. While recognizing that there are numerous factors that both inhibit and promote whether a student becomes a scientist, the researchers include the overall racial climate of the university, the frequency in which students encounter competitive science environments coupled with stereotyping and social stigma, and the presence of supportive peer networks as important. Hurtado and colleagues (2009) recognize that creating a definition for the culture of science is difficult, but indicate most can agree that the culture is competitive, the introductory courses are known as “gatekeeper” or “weed out” courses due to their rigor, and pedagogical practices in science classes discourage cooperation by creating a highly competitive environment. The researchers provide two limitations to their study. One, using focus group transcripts as the primary data source does not allow for participant observation, so they had to rely on the validity of the students’ reporting. Limitation two was that the purposeful sampling technique restricts the generalizability of the findings. The researchers report using a phenomenological approach, however other than their reporting that they “saw the benefit of examining how students interpret and experience becoming a scientist in a variety of context” and “because this is based on the meaning that underrepresented students construct, a phenomenological approach was warranted” (Hurtado, et al., p. 197), the use of phenomenological data collection methods such as in-depth individual interviews or phenomenological data analysis methods such as bracketing and horizontalization was not demonstrated.

In an ethnographic study that limited its population to African American students, Brand, Glasson, and Green (2006) analyzed sociocultural factors that influence the mathematics and
science learning of both female and male students. A sociocultural theoretical framework was used to interpret the perspectives of five African American students as they discussed their learning experiences in science and mathematics classrooms. The researchers build from Aikenhead’s (1996) idea of science learning being a type of border crossing and that minority student, when crossing borders into the subcultures of school science, may confront societal-induced barriers that may be difficult to negotiate and from Atwater and Riley’s (1993) assertion that “minority students are estranged from science and mathematics due to reinforcement of the monocultural, Eurocentric underpinnings of Western science” (Brand et al., 2006, p. 229). The researchers wanted to explore how African American students define their experiences in science and mathematics classes.

The participants were involved in a program called “Tomorrow’s Teachers” which is described as “a funded initiative in which minority students were supported in their pursuit of a teaching career” (Brand et al., 2006, p. 230). The students were recommended to the program by their guidance counselors based on their interest in education as a potential career and their academic performance. Three of the participants were male, and two were female. All were enrolled in or had taken advanced science and mathematics courses, and all were from school settings described as “urban.” The researchers provide a brief description of each student describing their motivations, plans, and general beliefs. Four of the participants were high school seniors, and one was a college freshman.

Data was collected using open-ended questions with the purpose of obtaining the participants’ perceptions of their experiences and needs as a minority student. The interview questions focused on the following questions (Brand et al., 2006, p. 230):

- What science and mathematics courses are you taking and why did you choose them?
• Describe your experiences in these courses.
• What are your preferred learning environments in science and mathematics classrooms?
• What do you plan to major in college and why?
• What can educators do to improve the numbers of minorities in science and mathematics-related fields?

The data were coded and categorized in accordance with emerging themes related to students’ perspectives of sociocultural factors influencing their participation and achievement in science and mathematics classes. Inter-rater reliability was not discussed. Other reliability measures such as member-checking were not mentioned.

The focus of the study involves the impact of social influences on the students’ learning. Students described negative stereotypes, negative perceptions they believe are in the minds of their teachers, and the lack of minority role models. The students provided insight into how these factors impacted their self-efficacy as students. The responses are reported to portray the accounts of the students’ feelings as African Americans in science and mathematics learning spaces and are summarized in two themes: (a) disenfranchising stereotypes have a negative impact on student learning and participation and, (b) meaningful student-teacher relationships have a positive impact on student learning (p. 231). Four assertions emerged from the interview data that describe how negative stereotypes affected the African American students (Brand et al., 2006):

1. Students struggled to prove or distinguish themselves from negative stereotypes.
2. Students struggled to prevent stereotypical images from affecting their self-esteem.
3. Science and mathematics are perceived as subjects that only smart people can succeed in.
4. Negative stereotypes discourage minority students from choosing science and mathematics careers. (p. 231)

The authors provided multiple representative quotations and student stories to explain and justify the interpretations. In terms of student-teacher relationships, students depicted their relationships with teachers in terms of fear that their teachers’ perceptions of them are in agreement with negative stereotypes. A Black female, Lezly, described by the researchers as assertive and confident, explains (Brand et al., 2006):

> From day one, when we walk into the classroom, it has always been said that we minority students have to be one step ahead of everyone else, just to make it, just to make it to the point where everybody else has made it. Well, I see that in the school systems, when we walk into the classrooms together because we’re wearing dreads, [this] is determining whether we’re a problem child or not. It determines whether I’m smart or not. We don’t get a chance from day one. (p. 232)

Two assertions emerged from the students’ perceptions of their relationships with the teachers: (a) Students’ perceptions of teachers’ beliefs cause students to assume defensive stances in the classroom; (b) Students’ level of academic performance is influenced by their relationship with their teacher. The authors provide multiple representative quotations and student stories to explain and justify the interpretations.

The students in this study provided powerful insight into the damaging effects that perceived stereotypes had on their relationships with teachers. No teacher data was collected, although it is unknown how the researchers could have gone about collecting information on stereotypes that teachers may have. The students believe that the negative characterizations of African Americans in society placed them at a disadvantage. These results indicate that being
accepted and acknowledged by their teachers as capable learners plays a significant role in
determining their academic performance. The students most valued teachers who were
accessible, approachable, and had high expectations for their academic performance.

Generalizability of the results is not addressed. An implication is professional development of
preservice and in-service teachers should target ways to enhance their understanding and
awareness of negative stereotypes they may hold. A limitation of the study is that the
positionality of the researchers is not made clear, nor is the relationships they may have had with
the participants. Additionally, potential researcher bias and researcher positionality to the
participants are not discussed.

In an investigation of the perceived racial and gender barriers to STEM success,
Grossman and Porche (2013) conducted a study using urban adolescents’ perceptions of barriers.
The term “urban” was used to describe Black and Latino students (Grossman & Porche, 2013, p. 711).
Their study is situated around the fact that women and people of color continue to be
underrepresented in STEM pursuits and that the pipeline of potential scientists narrows early for
girls and minority students. The researchers propose that adolescents’ science engagement is
shaped by messages from surrounding social systems such as teachers, peers, and family and that
while both females and underrepresented minorities face obstacles to STEM success, the
challenges confronting each category may take different forms. While underrepresented
minorities may face institutional and individual level discrimination and stereotyping, females
may face additional burdens within the culture of science. The frameworks used included
science identity theory (Brickhouse, Lowery, & Schultz, 2000), racial and ethnic identities of
adolescents (Cross & Cross, 2007), stereotype threat (Steele, 2003), and microaggressions (Sue
et al., 2007). The researchers do not reference Carlone & Johnson’s (2007) model of science
identity which shows the importance of recognition by meaningful scientific others as foundational to science identity formation of women of color. Their research questions were, (a) do girls and Black and Latino participants (underrepresented minorities), in comparison to boys and White and Asian American participants, perceive lower levels of science support? (b) Do STEM aspirations, controlling for self-concept, correlate with perceptions of higher levels of support for girls and women and underrepresented minorities?

Working with the Science Director of a large urban school district in the Northeast to find schools that had a STEM focus and that also demographically represented the range of schools in the district, the researchers chose five schools. The average 4-year graduation rate for the district was 61%. All ninth and tenth-grade students were asked to complete a survey that focused on STEM-related experiences and aspirations. The compliance rate was 70.6%. Although this study used a sequential mixed methods research design, this review will focus on the qualitative analyses which explored the perceptions of microaggressions and support for girls and underrepresented minorities in STEM.

Qualitative analysis was conducted using interviews from a subset of 53 participants who were purposefully chosen based on survey data that reflected a range of responses on science and math self-concept and aspirations for college STEM pursuits. No additional information was provided regarding how the interview sample was selected. The participants in the qualitative study of 53 students were 56% female, 16% of which identified as Black, African American, or Afro-Caribbean. The interview protocol was semistructured and included questions about STEM aspirations and experiences including barriers and supports for STEM endeavors. Some of the interview questions were, “Do you think girls and women face discrimination because of their race/gender that limits their opportunities to be successful in science jobs? Do you think it is
equally easy for African American, Latino, and White students to become scientists or to study science in school? Female and minority participants were asked: Has there ever been a time when someone discouraged you as a minority/female from working towards a career in science?” (Grossman & Porche, 2013, p. 706). Two independent coders used content analysis to code narrative data for overarching themes, then grounded theory was used to search for emerging patterns and concepts that related to perceived barriers to STEM achievement. To ensure trustworthiness, the researchers “incorporated relevant literature to confirm and refine existing theories” and “resolved coding disagreements through discussion” (Grossman & Porche, 2013, p. 707). No additional information was provided to indicate how these measures would ensure the trustworthiness of their study.

From the results of the interview data, three overarching themes were developed. One relates to the participants’ perceptions of microaggressions which were further divided into subthemes: microassaults, microinsults, progress on microaggressions, and no microaggressions. The other two themes addressed student responses to microaggressions and perceived gender-based and race-based support from teachers and family members. A Black female participant, Bio10, said:

A lot of people look at a Black person and see that they’re not gonna succeed. Like you know, they’re going to be always depending on somebody else, and they might look at Chinese and see that they’re always going to be good at science and like that’s not always the case. I know a lot of Chinese people that get D’s in science. (p. 712)

The themes were not mutually exclusive, so one participant’s response could generate more than one code. A limitation is that the interview data included a wide range of examples some of which were not limited to school interactions. Another limitation is that the gender,
race, or ethnicity of the teachers who were reported to have exhibited microaggressions toward the minority girls was not reported. They include direct experience stories, opinions shared by family and friends, as well as perceptions of what the students see in home and community contexts. When students identified microaggressions, they often felt optimistic about their potential to overcome them. The conclusion that “participants were more likely to describe gender barriers as reduced or eliminated, while at the same time identifying existing race/ethnicity barriers” (Grossman & Porche, 2013, p. 718) is notable. Overall, an implication of the study is that students’ responses demonstrate that support from teachers and family members about STEM participation can help to counteract stereotypical gender and racial/ethnic baggage loaded on these students by society. The results are not generalizable. Other limitations include the participant gender and race data was not aggregated in a way that would represent Black female students as a group, and the use of self-reporting makes it difficult to evaluate the perceptions of student experiences with microaggressions. The study’s findings included many stories describing experiences the participants had witness among family and friends outside of the school STEM environment which dilutes the impact of the study. The inclusion of Carlone and Johnson’s (2007) science identity model, which was not mentioned by the researchers, indicates that recognition from meaningful others in science is fundamental to the creation of a science identity for females. The results from this study somewhat support Carlone & Johnson’s model (2007). The researchers do not address the science identity model they chose as a framework (Brickhouse, Lowery, & Schultz, 2000) in the results or discussion portions of the paper and researcher positionality or potential researcher bias is not addressed.

In the final study reviewed in this section, Ko, Kachchaf, Ong, and Hodari (2012) used a framework of intersectionality theory to analyze how the intersections of gender and race affect
performance, identity, and persistence of women of color the physical sciences. The study was conducted in part as a reaction to a call made by the National Science Foundation’s Career-Life Balance Initiative to learn more about the career-life needs of women of color in STEM. The researchers used 51 narratives, 41 written texts and 10 oral interviews conducted by research team members, of 23 women of color who have been in physics, astrophysics, and astronomy. The researchers describe the narratives as “full life stories created from interviews, observations, and documents; brief stories told in response to a single question; long sections of talk over the course of one or more interviews; or written accounts of varied lengths” (Ko, et al., 2012, p. 223). Ko and colleagues found texts online using journal databases and online searches, in books, magazines and in emails to members of women and minority organizations. The women who were interviewed were recruited from professional networks and solicitous emails to organizations. No information was provided about the ages of the participants or the parameters of the description of women of color. “Women of color” is a broad category and it is unknown how many participants would consider themselves African American, Asian American, Latina/Hispanic, or Native American.

The data were analyzed using narrative analysis. The researchers explain “narrative analysis requires transparent processes of laying out stories and identifying codes, then creating conceptual groupings and orderings from the data [so they] formed a codebook, and to ensure high inter-rater reliability [they] assigned each narrative two coders who were responsible for agreement” (Ko, et al., 2012, p. 223). No information was provided to describe the protocol the researchers followed if the coders were not in agreement other than that they held monthly meetings and required the entire team to code a part of a common narrative and further negotiate implementation of the coding system. Inter-rater reliability information was not provided.
The two major themes that emerged from the women’s life stories were activism, which the researchers define as STEM-related volunteer work and importance of school/work-life balance to the women. Ko and colleagues found STEM-related volunteer work was often motivated by experiences of race, gender, or both. They used the intersectionality framework to describe how the intersection of two or more marginal identities in STEM environments acted as a catalyst for the women’s activism. Representative quotations are provided to explain the researchers’ interpretations and their claims that activism for these women carries deep and multiple meanings. Motivations for activism were described as experiencing rewarding feelings both in terms of having others look up to them as scientists, and as seeing students, they have helped advance in STEM pursuits. The researchers conclude, “These women were interested especially in helping under-resourced and underrepresented populations, perhaps because they could personally relate to people in those situations” (Ko et al., 2012, p. 223).

Many of the school/work-life balance issues described by the women of color in this study, the researchers point out, are not unique to women of color in STEM. One participant (Lola) described how societal expectations benefited men who were able to dedicate their time to career over family. Other participants described the importance of having hobbies and interests, such as physical fitness or piano playing, outside of physics, astrophysics, and astronomy. None of the representative quotations provided in the school/work-life balance theme support the framework of intersectionality; each pertains to women in general, not necessarily women of color. However, the researchers site literature suggesting a greater propensity for black families to be female-headed and led by single mothers and explain there are significant differences in family support involvement between black and white women. If the researchers had disaggregated the data to indicate how many women of color in their study were Black women,
the link between their findings and intersectionality might have been made clearer. Finally, although the researchers report many of their findings “support the existing empirical literature on women of color in STEM, including, but not limited to: chilly science environments, isolation, not fitting the conventional image of a scientist, doubts from authority figures, the importance of support, and learning to navigate their own environments” (Ko, et al., 2012, p. 222), the data presented in this paper does not provide evidence to support that claim strongly. The researchers conclude that the findings from this study add to what is known about the ways in which the experiences of women of color are shaped by the intersection of race and gender and how that intersection influences STEM persistence, however persistence is not mentioned in any of the data or findings, so it is unclear how they linked their study to STEM persistence. No claims of generalizability are made. The implications provided include calls to create or enforce policies that make it easier for students and employees to have families and lives outside of work and to use women of color in STEM as resources to diversify the fields of physics, astrophysics, and astronomy.

This section included a brief overview of the work conducted by Seymour and Hewitt (1997) which documented practices common in college science learning spaces that tend to support students who are White and male more so than students who are non-White and female. Women of color describe negative stereotypes, microaggressions, stereotype threat, isolation, and academic intimidation from both faculty and peers in science learning spaces. The frameworks included intersectionality, models of science identity, Aikenhead’s cultural border crossing into the subculture of science, and Bandura’s scientific self-efficacy. The studies in this section focus on students of color in science learning spaces without disaggregating the experiences of Black women. Specific challenges noted that relate to this study include negative
racial stereotypes, intimidating and uncaring science professors, and the frustration students of color face because they were not recognized as individuals. Ultimately the studies show how students of color not only face the same obstacles as science students including the rigorous nature of weed-out courses but have additional challenges in science learning spaces based on their race and sometimes gender. Two of the studies showed women felt that race was more salient than gender in science learning spaces.

This research in this section examined the environment of science learning spaces and how practices inherent in the culture of science may disadvantage students of color. Although Parsons and Carlone (2013) point out “science education...is in its infancy regarding cultural lenses...it has only been within the last 20 years or so that science education has taken seriously the concept in empirical research, and the inclusion of “culture” in science education’s policy conversations is just emerging” (p. 10), there is ample data to illustrate how the culture of school science or Western science is infused with norms and values that align with and promote White, male, middle-class, and heterosexual world views, thus privileging some in science learning spaces while constraining the success of others. The next section of this literature review focuses on the only three studies that could be located at the time this literature review was written that describe the experiences of Black women in science learning spaces. None are dedicated to the experiences of non-STEM majors.

Part III: Black Women in Science Learning Spaces

Three papers were located that reported research on Black women in science learning spaces. Two of the papers share two of the same authors and report essentially the same data using slightly different frameworks. The third study, described as a “small pilot study” by Jackson (2013, p. 261), explored the role of community colleges and HBCUs in fostering the
success of Black community college STEM transfer students. The findings from the studies were built from the experiences of STEM-majors only.

The two studies that share the same data will be described as Charleston et al. (2014a) and Charleston et al. (2014b). The one which employed intersectionality theory as a framework will be referred to as Charleston et al. 2014a. The second paper used critical race feminism and Black feminist thought as frameworks and will be referred to as Charleston et al. 2014b. Both studies lack methodological rigor, provide questionable data collection and validation strategies, and neither address the positionality of the researchers in a meaningful way.

Both of the Charleston studies lack methodological rigor as they report using a phenomenological design which requires in-depth interviews with individual participants, but the data were collected in one 60-90 minute focus group conducted during an African American Researchers in Computing Science Conference, and no follow-up interviews or member-checking was reported. The validation strategies provided by both studies are reported in nearly identical terms, and the strategies the researchers claim to have used are not well supported by the methods they described. Both studies report using purposeful sampling techniques to recruit 15 Black women who attended this conference. The participants had “either majored or were majoring in an area within or related to computing as an undergraduate or graduate student” (Charleston et al., 2014b, p. 169) or as reported by the other set of researchers, “each participant either majored in or were majoring in a computing-science related area of study as an undergraduate or graduate student” (Charleston et al., 2014a, p. 279).

Both of the papers were published in 2014, so for this review, I will focus on the paper that uses intersectionality as a theoretical foundation and a methodological framework to explore the role race and gender play in the STEM pursuits of Black women. The research question
driving the study was, what role does race and gender play in the academic pursuits of African American women in the STEM field of computing sciences? All 15 participants were women who self-identified as African American or Black between the ages of 18 and 35 who were either enrolled full-time or were recently, within the past three years, in an academic computing program within the U.S. Twelve of the Black women were current graduate students, two had recently obtained their PhDs in computing science, and one participant was completing her baccalaureate degree. The undergraduate was attending an HBCU, and the remainder of participants were attending or had received their degrees from predominantly White institutions.

The researchers claim “a phenomenological design was well suited to the study because our inquiry aims to understand a common experience of a group of people, allowing the researchers to use data from participants to develop foundational knowledge about a phenomenon” (Charleston et al., 2014a, p. 279). They referenced Moustakas (1994) however Moustakas describes the phenomenological approach in a much more specific and thorough way:

The empirical phenomenological approach involves a return to experience in order to obtain comprehensive descriptions that provide the basis for a reflective structural analysis that portrays the essences of the experience…The human scientist determines the underlying structures of an experience by interpreting the originally given descriptions of the situations in which the experience occurs. (p. 13)

Creswell (2009) describes phenomenological research as a strategy of inquiry in which the researcher seeks to understand the essence of human experiences about a phenomenon by studying a small number of subjects through extensive and prolonged engagement to develop patterns and relationships of meanings (p. 13).
Data were collected for this study during a single 15-person group interview lasting approximately 90 minutes. Within the 90 minutes, the researchers report that participants provided oral consent. The focus group session was videotaped, and the tape was transcribed for “possible future use as a promotional/professional aid (based on the consent of the participants)” (Charleston et al., 2014a, p. 279; Charleston et al., 2014b, p. 169). The interview protocol consisted of 10 questions and was provided in the sister paper (Charleston et al., 2014b, p. 175). The questions contain both closed and open-ended questions the researchers describe as being designed to gather information relative to the Black women’s experiences with specific attention to the roles gender and race play within their academic trajectories within the computing sciences (Charleston et al., 2014a, p. 279). The focus group was reported to have been moderated by an African American woman, but it is not clear if she is one of the researchers or if she played any role in data analysis.

The researchers claim, “prolonged engagement, persistent observations, field notes, and the analysis of multiple data sources helped to establish credibility based on triangulating these multiple data sources” (Charleston et al., 2014a, p. 280) however the only data that was reported to be collected was a videotape. They report the digital audio recordings and the physical transcriptions of the audio recordings as multiple forms of data that were used in triangulation in both papers. Also in both papers, the researchers state that the 90-minute focus group allowed them to explore the experiences of the Black women “in sufficient detail, enabling persistent observation to occur” (Charleston et al., 2014a, p. 280). Finally, the researchers assert credibility of the study was gained through the processes of “peer debriefing, revising working hypothesis throughout the data collection process, clarifying preliminary findings with the study participants, and audio/videotaping the interviews in an effort to compare to other means of data
collected” (Charleston et al., 2014a, p. 280), but there were no other means of data reported to be collected other than a videotape of the focus group session with the 15 women, so how any of these claims can be substantiated is unclear.

The themes that emerged from the data in the paper in which intersectionality was used as the framework were (a) racial and gender challenges related to the computing sciences educational trajectory and (b) the women shared a sense of isolation. The findings reported in the sister paper which used critical feminism and Black feminist thought as frameworks were (a) the challenges of being a Black woman in the computing science, (b) isolation and subordination, and (c) sacrifices participants made as Black women pursuing computing science. Both papers use identical participant quotations to justify their interpretations of challenges, some of which are “My belief is that the perception is that I am seen as a Black person first” (Charleston et al., 2014a, p. 281; Charleston et al., 2014b, p. 171) and “At the end of the day, I am who I am. I am a Black woman, and there’s no middle ground” (Charleston et al., 2014a, p. 281; Charleston et al., 2014b, p. 171).

The second theme of both papers, that the women shared a sense of isolation, was somewhat supported by similar representative quotations. The identical quotations shared by the papers to support this theme are, computing “isn’t seen as a discipline for women” and “Why aren’t you married and taking care of somebody?” (Charleston et al., 2014a p. 282; Charleston et al., 2014b, p. 171). Both studies report the Black women felt a lack of support from faculty and that the field of computing as a whole is sexist in nature. Both studies state the Black women recognized many similarities and parallels between being Black in academic spaces and being Black American society in terms of feeling isolated. Unfortunately, it is unclear from the way the data was presented how many of the 15 Black women actually contributed to the discussion
in the focus group. It is possible only a few women had the opportunity to answer all 10 questions presented in the focus group in the 90 minutes that was allotted for data collection in this study.

The data collection and data analysis methods were not articulated in a manner that demonstrates methodological rigor in this study. Methodological concerns involving data collection include the authors’ claim to have used a phenomenological design with 15 women in one 90 minute focus group with no follow-up interviews or member-checking described. According to Moustakas (1994), phenomenological studies should involve a series of steps: epoche or bracketing, horizontalization, transformation of clusters of meanings, and generalizations involving textural and structural descriptions. The data analysis methods were not described so whether or not the data were analyzed in a manner consistent with what is recommended for phenomenological studies is unclear. In terms of researcher positionality and attendance to potential researcher bias, both of the Charleston papers include sections on positionality which are nearly identical even though both papers do not have the same four authors. Both indicate the team of researchers sought to be reflective of their own positionality and how their multiple identities might impact data collection and analysis, but no specifics are provided about any single researcher either paper. It is unknown whether either paper had as a researcher a Black female. This is especially concerning for the study that claimed to use Black feminist thought, a framework that necessarily must include the story being told from a Black woman’s standpoint, as a framework (Charleston et al., 2014b).

In the third paper that focuses specifically on Black women in science spaces, Jackson (2013) explored the role of community colleges and HBCUs in fostering the success of African American female community college STEM transfer students. This is the only study in the
review that specifically addresses African American female community college students as the population of interest. The researcher points out that most of the research has focused on either women in STEM or minorities in STEM, but it has not acknowledged to any large extent the population that results when these two marginalized populations intersect, therefore a gap in the science education literature exists for this population in STEM programs. Since community colleges serve as entry points for many underprepared, low-income, ethnic minority students, understanding its role and how community colleges can foster success in this population is important. Jackson’s research questions were, (1) what are the experiences of African American female community college transfer students in STEM disciplines at an HBCU? (2) What experiences impacted the success and persistence of African American female community college transfer students in STEM disciplines at an HBCU? Triple Quandary Theory was reported to have been used to link the minority socialization experience, the Black cultural experience, and the U.S. mainstream experience. The researcher indicated Triple Quandary Theory, along with African-rooted Black cultural ethos, provided a framework for making sense of the content of racial and cultural communications.

Seven African American female community college transfer students who were enrolled in a southern HBCU and were pursuing STEM bachelor degrees during the spring of 2012 were chosen for the study. They were recruited by the researcher who contacted her personal, professional contacts at the HBCU who reached out to their students and described the study. Jackson states that the snowballing effect occurred, so all of the women in the study may not have been in the classes of her personal, professional contacts. The students who volunteered were contacted by email and informed that the study would occur in two phases. A total of 12 women responded, and seven participated in both phases of the study. No information is
provided describing how representative these women were of the whole invited population. The seven women in the study represented two different feeder community colleges within a 30-mile radius to the HBCU. No information was provided about the number of semesters or how many class credits were earned at the community college, whether or not the women earned associate’s degrees before transferring, or the amount of time that lapsed between their attendance at the community college and enrollment in the HBCU.

Data was collected over three months, and it occurred in two phases described as photo collection and semi-structured interviews. During the photo collection phase, the women were given a disposable camera and were instructed to take pictures “within their daily lives that illustrated their experiences and thoughts as a community college transfer student in STEM at an HBCU” and were encouraged to “highlight factors that facilitated their successful transfer and adjustment to the HBCU as an African American female transfer student in STEM” (Jackson, 2003, p. 260). The basis of the request provided to the participants is vague; other than telling the women that the photos could be of images they drew or of objects they created, no clarifying information was provided. The women were given three weeks to take the pictures. The cameras were returned to Jackson; she developed the pictures, then returned them to the participants. The participants were asked to describe each photo, provide narrative about each photo, explain what each photo represents and their reasons for choosing to take the photo. The second phase of data collection was face-to-face semi-structured interviews consisting of questions adapted from a Photovoice PHOTO mnemonic that Jackson credits to Wang (1999) and included questions such as: What does this photo represent? What is really happening in this photo? Jackson indicates that the interview protocol she used “included additional questions that further explored the experience of the participants as supported by the literature” (Jackson, 2003,
p. 261), but the meaning of this is unclear. No additional references were provided. Jackson transcribed each interview verbatim. The data used for analysis consisted of photos, photo descriptions, narratives, and interview transcripts.

Jackson explains that her data was analyzed using Creswell’s steps for analyzing qualitative data to understand the themes that emerged across all of the sources. Aside from describing theoretical data analysis procedures offered by Creswell, Jackson does not describe to any real extent how the data was coded or how themes emerged. She reports that triangulation was achieved through multiple data sources including researcher memos, participant interviews, and photographs. Creditability could have been improved by member checking and peer debriefing. Additionally, the researcher is a black female who graduated from an HBCU and took classes from a community college. However potential researcher bias was not addressed. It is unclear whether the researcher critically reflected on her own role within the data collection and interpretation processes and how it may have influenced her findings.

The seven women were asked to discuss their experiences as African American female community college transfer students in a STEM bachelor degree program at an HBCU and factors that promoted their success; three themes emerged: (1) consistent relaying of information, (2) understanding career capital and, (3) development of a STEM identity. For each theme, Jackson presents supporting representative quotations and/or descriptions of photographs as evidence for the themes. The students detected somewhat of a consistency or partnership between their community colleges and the HBCU in terms of faculty expectations, faculty encouragement, and ways to be successful STEM students. Jackson uses representative quotes from two women; Rayleigh who discussed her photo titled “consistency” of numbers to illustrate consistency between institutions and Erin who explained her ease of transition from community
college to HBCU to explain this category. This is the only theme that contained sample quotes of women who both directly link their experiences to the community college they attended. No additional information was provided about the other women in this category. The second theme, career capital, was supported by comments from Lillian and Traci. Lillian provided a photo titled “building and increasing” of a stack of books and described it in a way that represents growth and expansion. Lillian says that although she has gained much academic knowledge, her knowledge about what she can do with her degree is lacking. Traci was inspired by an internship in a STEM field, animal aquatics, that she participated in while enrolled in the HBCU. She expressed the importance of exposure to different STEM fields, but it is unclear the impact the community college experience had on the success of these women. For the final theme, development of a STEM identity, one participant (Lyah) shared how the opportunity to transition into an environment that was culturally similar was helpful; she felt the HBCU environment was a safe place to begin developing an identity and begin self-identifying as a student in STEM. Lyah provided a photo of different types of faces with one face having a question mark, and she titled it “finding of self.” When asked to elaborate on how she was able to begin developing a STEM identity, she said it helped that at the HBCU her peers looked like her and had many of the same goals and values, so it was an easy transition. If she had gone to a school that was all white, then she would have to find people who looked like her, that she got along with, and then find people who looked like her in STEM. She concludes by saying that being at the HCBU is better for her because her support system and cultural foundation is already built in. The second representative quote in this category was from Jace who explained that her socialization into STEM was borne from her mother having a STEM career, so she was already “very familiar with the sciences.” Neither of these representative quotes directly or indirectly reference the women’s
experiences at a community college. Finally, Jackson states that to determine transferability, she used direct quotations from participants and their photographs (Jackson, 2003, p. 262). However she does not report sufficiently detailed descriptions to allow for a claim of transferability to be made.

The study sought to understand the roles that community colleges and HBCUs play in fostering the success of African American female community college STEM transfer students. Jackson concluded that both the community college and HBCU played important roles for the women, but the data does not show the role of the community college was necessarily involved in their success. Of the three themes that emerged, only “consistent relaying of information” used examples in which both women specifically mentioned the role that their community college played. In the second theme, “career capital,” the only representative quote that mentions community college is in reference to it building a good foundation in math and science (Jackson, 2003, p. 263). In the representative documentation to support “development of a STEM identity” category, Lyah mentions a transition, but it is in reference to her being a Black woman transitioning into the culture of an HBCU and how it would have been more difficult if it were an all-white school. Her point seems to be that the HBCU is a better fit for her than an all-white school because her “support system and cultural foundation are built in already” at the HBCU (p. 264). The other example provided for this category is Jace who says her socialization into STEM occurred as a result of her mother being an OBGYN, so she was already familiar with seeing successful Black people in science. The quotes used for both Lyah and Jace refer specifically to the cultural environment of the HBCU, no part of the community college experience or environment is used in this category.
The researcher indicates in her theoretical framework that she will be using Triple Quandary Theory to situate the Black socialization experience and the nine dimensions of African-rooted Black culture, but the application of these frameworks to the analysis of data or in the findings of the study was not clearly understood. Perhaps a discussion on intersectionality or consideration of black feminist thought would have been more appropriate and applicable. Jackson reports that an implication of this study is establishing support networks and resources is vital for students who aspire to transfer from community college to the four-year institution, but this claim is not supported by the findings presented in this study. The researcher provides limitations of the study and that this study was intended to be a small pilot study of the experiences of African American female community college transfer students at a single HBCU.

What is known about Black women in science learning spaces is that their path to success in science learning environments is a challenging path to navigate. They face skepticism about their intellectual abilities, have unwanted identities ascribed to them, experience social stigma that can inhibit their academic development, and they face racism and sexism in science learning spaces. Frameworks reported to have been used for these studies are intersectionality, Black feminist thought, critical race feminism, and triple quandary theory. The findings in the studies that focus on the experiences of Black women in science learning spaces mirror the findings of the studies that focus on Black women in higher education, namely that Black women must deal with racism and sexism in STEM environments too. What is missing from the studies that center the experiences of Black women in science learning spaces is methodological rigor and validation strategies that would have made the findings from studies more useful and powerful. If either of the Charleston and colleagues’ papers would have used a case study approach or a true phenomenological design and in-depth interviews as a data source instead of a single focus
group lasting 60-90 minutes, the data would likely reveal more personal and meaningful stories from the participants. In order for science faculty to create more inclusive and equitable learning environments, it may be necessary for them to become aware of how their current practices may impact some marginalized students and none of the three studies in this section used data collection methods that allowed in-depth, nuanced, and textured experiences of the Black women participants to be told. None of the women in any of the studies were non-STEM majors.

**Conclusion**

The studies in the first section of this review illuminate challenges Black women face in college learning spaces while the studies in the second section focus on barriers and challenges science students of color must negotiate practices common within the culture of science. The third section shows how Black women in science learning spaces experience racism and sexism in ways that lead to feelings of isolation, frustration, and discouragement.

What is known from the current literature that centers Black women in higher education is that students who are both Black and female face obstacles in college learning spaces as a result of their race, gender, and most frequently the intersection of both of their identities. One of the studies indicate Black women find racial barriers more substantial than gender barriers (Grossman & Porsche, 2013), but it is unclear how many of these studies attempted to separate and rank these identities. Had race been the focus, perhaps some of the frameworks would have included a critical race theory perspective. Some science education researchers have advocated for inclusion of a critical race theory perspective to transform science education to become more equitable and socially just (Mutegi, 2013; Parsons, 2014; Parsons, Rhodes, & Brown, 2011).

The literature up to this point shows that these students see themselves as Black women and rarely are the two identities imagined separately. The intersection of race and gender is
particularly salient for Black women in the U.S. because they have experiences that make their lives different from those of White women and Black men because they are simultaneously affected by both racial and gender challenges in our society (Cho, Crenshaw, & McCall, 2013; Crenshaw, 1991; Hill Collins, 2009; Hill Collins & Bilge, 2016). The literature reviewed here indicates that Black women often must deal with the same unique challenges they face in society inside of college learning environments and science learning spaces as well. Science classes and laboratories were shown to be especially difficult to navigate as science students of color describe instances of gender and racial discrimination, their perceptions of negative stereotyping, racial microaggressions, cultural misunderstandings, isolation, and a lack of support and recognition from science faculty. The studies that include Black women in their population of science students of color do not disaggregate the data to the level at which Black women’s experiences are articulated in a meaningful way. No disaggregation of data from these studies makes it difficult to draw an accurate picture of the experiences of Black women in science learning spaces.

Unfortunately, the research that has explored the experiences of Black women and how they navigate science learning spaces is minimal. There is no research that centers the experiences of Black women in science learning spaces who are not STEM-majors. What is missing in the current research other than attention to the experiences of non-STEM majors is an attendance to researcher positionality, potential researcher bias, and methodological rigor. With the exception of Angela Johnson and Yolanda Sealey-Ruiz, few of the researchers disclosed what their relationship is to the participants, their reasons for conducting the research, or whether or not they have considered how bias may have affected their data collection and data analysis. There is no study that could be found at the time this literature review was conducted that
focused specifically on Black women science learners’ experiences with science faculty and how those experiences influenced the science learning trajectory of the women.

3 METHODS

Study Purpose and Research Questions

The purpose of the study was to explore the experiences of non-STEM major Black women in college science learning spaces to understand how interactions with their science professors supported or constrained their science learning. The overarching research question was: How do Black women science learners describe their experiences with science faculty? To aid in answering the overarching question, following sub-questions were explored: (1) How do these experiences influence their science learning? (2) What type of learner characteristics do Black women perceive as important to be successful in science learning spaces? (3) What type of science professor characteristics are most helpful to Black women in college science learning spaces?

Research Design

This qualitative case study is situated in intersectionality, Black feminist thought, and Critical Race Theory (CRT) perspectives. According to critical race researchers, narratives are essential when gathering vital sources of information, in that “they make the social realities of people of color, as influenced by racism, visible to the rest of the world” (Wallace & Brand, 2012, p. 348). Narratives guided this study as I sought to explore the experiences of Black women in science learning spaces and how interactions with their science professors affected their science learning.
The foundation for the research was built from intersectionality studies, primarily Black Feminist Thought. Intersectionality refers to the way overlapping oppressions such as race and gender operate together to produce forms of discrimination and social inequity that can amount to Black women experiencing hardships that are greater than the sum of racism and sexism (Crenshaw, 1991; Hill Collins, 2009; Hill Collins & Bilge, 2016). Black feminist thought is a body of knowledge which explains how Black women occupy a unique standpoint in the U.S. resulting from the intersection of two interlocking components, their womanness and their Blackness, which have historically been seen as oppressions. Although the study incorporates intersectionality, Black feminist thought, and CRT, the CRT perspective was chosen as the framework for two reasons. First, the tenets of CRT were organically addressed as the data collection process proceeded and second, I am a White researcher which is a limitation of using Black feminist thought as a framework. Black feminist thought consists of specialized knowledge produced by Black women intellectuals that reflect a Black woman’s unique standpoint. Therefore White women and Black men are situated on the outside of this margin as researchers.

The types of issues that can arise from interactions between science professors and Black women science learners can best be understood by examining the experiences of Black women who have recently taken science courses. Such examination is exploratory and descriptive in nature making qualitative research and case study methodology appropriate for this research. Merriam and Tisdell (2015) describe qualitative research as a process that seeks to understand how people interpret their experiences and what meaning(s) they attribute to their experiences using words as data which can be collected and analyzed in all sorts of ways (p. 6). This study was qualitative because its intent was to understand the experiences of Black women in science
learning spaces and the meanings they have constructed using their words as a primary source of data. It was interpretive (Merriam & Tisdell, 2015) or constructivist (Creswell, 2013) because it is assumed that there is no single, observable reality, but that multiple interpretations exist and that reality is socially constructed by those who take part in or witness an event. Creswell (2013) explains that individuals develop subjective meanings of their experiences and often those meanings are negotiated through social, historical, and cultural norms that operate in individuals’ lives (pp. 24-25).

A case study design was employed to investigate how the Black women describe their experiences with science faculty. Merriam and Tisdell (2015) state, “a case study is an in-depth description and analysis of a bounded system” (p. 37) and “the unit of analysis, not the topic of investigation, characterizes a case study” (p. 38). For this study, each Black woman was a unit of analysis, a case. Merriam (1998) defines a case as “a thing, a single entity, a unit around which there are boundaries” (p. 27). Each case is fenced in or bounded by activity (science learning), gender, age, race, location, and time in history.

**Research Context**

The case study was conducted and bounded during the 2016-2017 school year within Tubman College, a two-year college located in a suburb of a major metropolitan area in the Southeastern U.S. Tubman College was chosen because the city it is situated in has been recognized nationally for its diverse population and it is a major provider of associate degrees and student transfer opportunities for the region. According to its publications, the college is a gateway to higher education, and its faculty, staff, and leadership are committed to providing students who want to earn a college degree the chance to do so. Tubman College offers more than 30 paths leading to associate degrees and has a student population of over 20,000 students
from over 150 different countries. More than half of the students who attend Tubman College attend school part-time and close to 30 percent are the first in their families to attend college. The average age of students is 25-years of age, approximately 60 percent of Tubman College students identify as female, and just over 40 percent identify as Black or African American.

**Participants**

Participant selection was purposeful (Merriam & Tisdell, 2015; Patton, 2015). Purposeful sampling is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned (Merriam & Tisdell, 2015, p. 96). More specifically criterion-based selection (Lecompte & Schensul, 2010) was used. Criterion-based selection of participants requires the researcher to decide what attributes are crucial to the study, then find participants that meet those criteria. The criteria that are established for purposeful sampling directly reflect the purpose of the study and the researcher must not only state the criteria that will be used but also state why the criteria are important (Merriam & Tisdell, 2015, p. 97).

Participants were recruited through the TRIO Student Support Services program of Tubman College. TRIO programs provide opportunities for academic development and support designed to increase the retention, graduation, and transfer rates of first-generation, low income and/or disabled college students and to motivate students toward the successful completion of their postsecondary education. Participants were identified through a process of nomination by academic professionals involved with the TRIO program who had advised, tutored, and/or mentored the women through TRIO support services. The participants selected met the following criteria:

- self-identified as Black or African-American women
- were age 21 years or older
• have been enrolled in a face-to-face college-level science course within the past year
• were willing to explore their academic and emotional experiences in college science courses with me
• were not STEM-majors
• agreed to review their written cases to improve or validate the findings constructed by me.

Each participant chose her own pseudonym. Table 1 describes the participants in this study. Ten women were nominated for participation by the TRIO administrators. Of those ten, seven signed consent forms and agreed to participate in the study. Of those seven, only five women completed both interviews and agreed to member-check their cases. One of the women, a 62-year old physical therapy major, withdrew from the college and was unreachable for her second interview. The other woman, a 42-year old who started as a nursing major, changed her major so that it was not necessary for her to take additional science classes. She is now a social work major and decided to withdraw from the study after the first interview.

Table 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Number of science classes (includes laboratories)</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim</td>
<td>39</td>
<td>8</td>
<td>Nursing</td>
</tr>
<tr>
<td>Mickey</td>
<td>21</td>
<td>2</td>
<td>Nursing</td>
</tr>
<tr>
<td>Alanna</td>
<td>32</td>
<td>6</td>
<td>Elementary Education</td>
</tr>
<tr>
<td>Beck</td>
<td>58</td>
<td>4</td>
<td>Journalism</td>
</tr>
<tr>
<td>Sweets</td>
<td>39</td>
<td>6</td>
<td>Nursing</td>
</tr>
</tbody>
</table>

Negotiating Access as a White Science Instructor

Experiences strengthening cross-race trust

Distrust may be an important factor for Black women in decisions to participate in research. Corbie-Smith, Thomas and St. George (2002) found that a major impediment to Black
participation in medical research is a lack of trust. Mouton, Harris, Rovi, Solorzano, and Johnson (1997) posit the lack of trust “may represent an individual’s personal experiences of racial inequality or result from centuries of institutional-based mistreatment of the Black community” (p. 726). Merriam and Tisdell (2015) explain participants in marginalized groups may be especially suspicious of critical researchers who are doing research on people of oppressed groups because they “often worry about what the researcher’s agenda is and how they will be portrayed as participants” (p. 64).

Within the context of this study, it is necessary to acknowledge the influence my own identities as a White woman, and a science professor may have had on participants. Additionally, as the researcher, I am the primary instrument of data collection, analysis, and interpretation and my shortcomings and biases can have an impact on the study (Merriam & Tisdell, 2015). My biases and assumptions will be addressed below. In this section, I will discuss how I attempted to acknowledge and minimize, as much as I was personally capable, the metaphorical elephants in the room which were my Whiteness and the fact that I was a science professor.

First, over the course of many years, I have had the opportunity to teach and get to know TRIO students, most of whom have been Black women. I learned from the TRIO administrators while preparing for this study that many of the TRIO women recommend my classes to other women who chose to take chemistry. The TRIO administrators, all Black women, were welcoming, supportive, and encouraging when I approached them about this research. I largely credit their trust in me, rooted primarily in what they had heard from students and strengthened by our personal interactions, as crucial to the success of this research. Because the TRIO students trusted the TRIO administrators and the TRIO administrators seemed to trust me (based
on their willingness to recruit participants and our open dialogs about race), I believe the women who agreed to participate in the study trusted me and my intentions.

As a White woman, opening a dialog about race with Black women was sometimes uncomfortable because it made me hyper-aware of my privilege and positionality. I strongly disliked using phrases such as “overlapping oppressions” and “racial discrimination” when talking to Black women because it felt as if I was reducing their enormous realities to buzzwords or catch-phrases. Also, I was uncomfortable asking the women I did not know if they preferred “African American” or “Black” to describe themselves because I did not want to offend any of them. However, I was strongly committed to starting conversations that mattered, so I did my best to push through the awkwardness and clumsiness when those feelings surfaced. I had the sense that if the women were willing to help me and I was open to answering their questions, then together we could make a difference which could ultimately lead to positive change.

Second, two of the five participants were former chemistry students of mine who were able to evaluate my intentions and trustworthiness as a result of knowing me personally. I believe they granted me access to their experiences because they trusted me, had confidence in my integrity, and did not hold my Whiteness against me. My institutional relationship had ended with these women as both of them successfully completed the chemistry sequence that was required, so neither of them envisioned an academic reward for participation.

Third, two of the women who did not know I was White expressed surprise that I was White in a lighthearted way when we met. This immediately gave me the sense they were open to talking about race and racial differences in a constructive way. Finally, there was one participant who I am not sure ever trusted me or my intentions due to my Whiteness. Although I felt we made progress in terms of trust in our second interview, when asked how she would have
responded to any of my questions differently if I were a Black researcher, she immediately answered, “I would be in it with both feet, and I wouldn’t hold anything back…” Although I believe I was able to negotiate access to my participants’ science learning and emotional experiences, it is possible that my Whiteness and/or my institutional positionality as a science professor prevented me from gaining the trust of all of the participants.

Awareness of intersectionality

My awareness and understanding of intersectionality affect this study because I am using it as a component of the analytical lens through which I am choosing to view the experiences of my participants. Intersectionality was used as a way of understanding the complexity of the experiences that Black women in science classes have when interacting with college science faculty members and the effects the interactions have on their science learning. I was first introduced to this concept in a class I took as part of my doctoral program, and it has recurred in many discussions since then. I chose to read Patricia Hill Collin’s *Black Feminist Thought* for a class assignment because I felt it would help me better understand the views of Black women and expose me to ways of seeing situations in a new way. I was interested in studying Black women in science learning spaces because I had noticed that many of my Black female students, especially older ones, disclosed they were reluctant to take chemistry, felt apprehensive and unprepared, and generally seemed to feel as if they were already doomed for failure before we really got started. I understand not everyone is excited about taking a college chemistry course, but I noticed what I interpreted as a defeated mindset in the Black women consistently more than in any other group and it concerned me.

I completed a class project for another graduate class to find out what barriers Black women felt they faced in science classes and also asked what advantages they felt they had in
science learning spaces as a result of their being Black and female. The results from that class project made me realize how the effects of intersectionality impacted my students in ways that could not be traced to their just their gender or their racial identity. Some students explain they believe the problems they have had with professors stems from their being female, others have shared they think professors thought because they were Black, they were less capable than Asian or white students. I came to understand that what my Black female science students were shaped by was the intersection of both their femaleness and their Blackness so their perceptions and experiences must be seen through a lens that takes into account both aspects of their identity.

I believe the dominant Western traditional culture of science works against science learners who are female and science learners who are Black. Often they are trying to be successful in a culture that traditionally has viewed females as not-well-suited for science and a society that has historically labeled Black people as incapable or deficient in some way. Historically, socially, and academically, Black women are embedded in cultures that see their differences as deficiencies. To minimize the effect this position has on the study, when recruiting and interviewing participants I asked them to discuss experiences they have had with college science faculty that affected their science learning, without slanting the description of the study or the interview questions towards a negative direction. The data reflects that most women had both positive and negative experiences inside their science learning spaces.

As a researcher, I am concerned that Black women may have negative experiences in science learning spaces and interpret those experiences as being the result of their inadequacies or deficiencies when the reason may be entirely outside of their control. Likewise, I want to capitalize on positive experiences that Black women have with science educators so that we as
science faculty can learn what is helpful, motivating, and uplifting to students who are often marginalized in science learning environments.

**Data Collection**

Interviews were the primary source of data for this study. Researcher memos and a researcher journal were used for secondary sources of data. Interviewing offers an inherent flexibility to change direction to pursue emergent issues, to probe a topic or deepen a response, and to engage in dialog with participants to uncover feelings and events that cannot be observed (Simons, 2009). Patton (1980) explains, “There is no single right way of interviewing, no single correct format that is appropriate for all situations, and no single way of wording questions that will always work. The particular situation, the needs of the interviewee and the personal style of the interviewer all come together to create a unique situation for each interview” (p. 252). With this flexibility in mind, the interviews were semi-structured in nature. The same questions were addressed in each of the interviews with the women, but the order of the questions varied somewhat based on the conversational direction each woman decided to take. For example, when I asked each woman for a description of her overall experiences in college science learning spaces, some of the women would provide a brief description, then discuss at length salient experiences with science professors and how those experiences made them feel. Each participant was interviewed twice, and each interview lasted an average of 75 minutes. Every interview was recorded and transcribed. In every case, the time and place of the interviews were chosen by the women. The interviews occurred at either my home, the home of a participant or on campus in a room they chose (typically the TRIO conference room or my office). One interview took place at a coffee shop. All of the interviews took place between November 2016 and May 2017.
Glesne (2006) explains “a common mistake in interviewing is to ask questions about a topic before promoting a level of trust that allows participants to be open and expansive” (p. 84). She also advises researchers “to be mindful of status differences inherent in any research interaction and work to minimize them when possible” (p. 99). As a White science professor interviewing Black science students about their personal experiences with race inside science classes, I was cognizant of both potential hazards. To minimize these gaps, I felt it important to facilitate a conversational tone and to be as transparent with my participants as possible. In an effort to achieve these goals, I strongly encouraged each of the women to ask questions about anything that came to mind throughout our interviews. Some women asked questions right away about my motivations for researching the experiences of Black women in science classes. One participant prefaced some of her questions with the phrase, “because you are White,…” For example, one of her sets of questions for me was,

Because you are White, I know you probably seen a lot of things in the science department that goes on with other White instructors…what makes them feel like we are not competent to do the work? Do they just believe that a White person always has the advantage over us because they know the sciences better? Why do they think we are not smart enough to learn the material like everyone else?

All the participants asked questions. Their questions were generally about me, science professors, or White people which I did my best to answer. Sometimes my answer would lead to more questions which created a thicker, more nuanced and comfortable dialog between us. I considered their reflexive engagement to be a crucial component of our trust building. An additional trust-building component I enacted in this study was, at the end of each interview (since at times I was taking notes while the women were talking), offering to show them my
notes. Two of the women took me up on my offer and reviewed my notes at the conclusion of their first interviews. None wanted to see my notes after our second interviews.

_First Interview_

I started each interview by reviewing: 1) the informed consent, 2) the purpose of the study, 3) their right to drop out of the study, and 4) asking each participant think about the pseudonym they would like to use for the study. The first interview discussed life histories, personal experiences inside science learning spaces, and whether or not the women believed Black women in science learning spaces have different experiences than other students. It also addressed advice the women would give to science professors, as well as learner characteristics they believed were important for Black women inside science spaces. I offered electronic transcriptions of the first interview to each of the women within a week of the completion of the interview and sent each woman a draft of the case I constructed based on our first interview to elicit additions, improvements, and comments. Two of the women added or corrected information about themselves and one woman added information about positive interactions with a science professor. None asked that any information be removed from her case.

_Second Interview_

Based on data from the first interviews indicating race was the most salient feature noticed by their science professors, more so than gender and age, and the increased level of comfort and familiarity I felt with most of the women, the focus of the second interview was primarily on race. In the second interview, we discussed racial colorblindness and the potential impact researcher Whiteness could have on the data collection process of this research. The data collected in the second interview was the basis for the shift from intersectionality to a CRT perspective.
Researcher Journal

It was important to distinguish the voices of the participants from the voice of the researcher. The researcher journal was used before data collection began and throughout the data collection and analysis processes to record my experiences, feelings, and thoughts about the study, participants, and my conscious biases. The researcher journal was primarily autobiographical in nature as it served to create a record of my emotions, observations about my feelings, and decision-making processes throughout data collection. I kept this notebook with me throughout the data collection process and regularly recorded what I was thinking about my own insights. In it, I described my reactions to interviews, potential paths to follow, connections to literature, and challenges I felt being White in relation to this study. It was necessary to be clear about my biases in order to act to minimize them. For example, I recorded the process of making the shift to focus on the participants’ science learning experiences instead of focusing on their negative experiences or only recruiting participants who had negative experiences. The process of reflecting on and recording my biases and tendencies in this journal made it possible for other researchers to monitor biases as well. The journal also contains notes generated from discussions with colleagues and peer reviews.

Researcher Memos

Throughout the data collection process, I recorded interactions with the participants. This included descriptive notes during our interviews, questions the women asked, and details about their experiences that provoked strong feelings. These notes were kept in individual folders dedicated to each woman. I noted when it was necessary to probe the women, prolonged silences, laughter, and when it seemed as if they were filtering or avoiding a topic. I also recorded when our conversations deviated from the interview protocol and planned follow-up
questions when appropriate. These notes were used as a foundation for other researcher memos used during data analysis.

**Data Analysis**

Data were analyzed using narrative analysis. This was done in conjunction with data collection (Merriam & Tisdell, 2015; Simons, 2009). Data were analyzed in stages consistent with Merriam’s (1998) levels of analysis for case study research in education. The levels of analysis include category construction, category naming, and cross-case analysis. The process of category construction began with reading researcher memos and interview transcript from the first participant. I made notations on the transcripts next to bits of data that struck me as relevant to answering the research questions. This process is described as open coding by Merriam and Tisdell (2015, p. 204). Notes emerged from this process that resulted in researcher memos. The memos acted as an interface between the data provided by the participant, my interpretations, and the literature.

From the interviews and observations recorded in the researcher journal, a case in the form of a narrative was constructed for each woman. Simons (2009) explains, “Narratives aspire to capture the experience as it was lived in the particular context through rich description, observation, and interpretation and to retain this connection in the telling of the story. This creates possibilities for others to vicariously experience what happened and/or to make their own connections” (p. 75). The primary goal of constructing the cases was to provide as much information about the women as feasible, so the reader has the information necessary to understand the women’s science learning realities within the context of her broader life experiences.
Following open coding of each of the women’s first interviews, I grouped the open codes together using axial coding (Charmaz, 2014; Corbin & Strauss 2015) or analytical coding. After this level of analysis, I incorporated my interpretation of the women’s narratives using researcher memos and the researcher journal which resulted in categories of the women’s individual experiences. The data were analyzed for common themes throughout their stories. Those themes were noted, and the resulting themes were placed into categories. I compared the categories across cases which led to themes that conceptualized the similarities in data that was present in more than one case (Merriam, 1998, p. 195). I used this process to bring into focus the main themes used to answer the research questions.

To demonstrate reflexivity throughout the research process, the researcher journal was used to explain my interpretations and how conclusions were derived which included how the data was from participants was grouped into categories. The researcher journal was also used to demonstrate credibility through transparency and to maintain a trail of each step in this study. For example, when a major decision was made, such as the shift from intersectionality to a CRT perspective, notes were made in the journal so that peer reviewers and other readers were able to follow the logic of the decision-making process.

**Trustworthiness**

Validity and trustworthiness in qualitative inquiry need to be addressed in any study so as to demonstrate that studies are credible and meet standards of quality (Creswell, 2007; Merriam & Tisdell, 2015). Validity is defined as “how accurately the account represents participants’ realities of a social phenomenon and is credible to them” (Creswell & Miller, 2000, pp. 124-125). Validity, therefore, refers not to the data but to the inferences drawn from them. Trustworthiness, on the other hand, addresses issues of credibility, dependability, transferability,
and confirmability (Lincoln & Guba, 1985). To manage and address concerns about validity and trustworthiness, member-checking, peer examination, and rich descriptions were used. Researcher bias was also clarified and addressed.

To bolster the credibility of the research, which refers to the internal validity of the study, I incorporated member-checking and peer examination strategies. Creswell (2007) describes member-checking as sharing data, analytical categories, and interpretations with the participants in a study to ensure that researcher interpretations are consistent with participants’ intended meanings. The women in this study were invited to read their transcripts as well as the notes I created during our interviews. I asked each woman to review the initial case I constructed based on her first interview which every woman did prior to the second interview. Feedback from the women was incorporated into their cases. The findings from the analysis of all of the cases were discussed with three of the participants, and each of the women agreed with the study’s findings.

Merriam and Tisdell (2015) describe peer examination as a technique in which the researcher elicits insights from peers and colleagues not specifically tied to the study. The peer reviewers assisted with research design by evaluating the usefulness and rigor of the interview questions and assisting with improvements where needed. The peer reviewers read parts of transcriptions, the individual cases, and study findings and shared comments and insights. Their insights allowed for minimization of researcher bias and strengthened the research findings.

My effort to establish transferability, or external validity, was demonstrated by creating thick, rich descriptions of the women and their science learning experiences. Data consisted of verbatim quotations with sufficient context to allow the context to be interpretable. In this way, readers are provided with not only my interpretations in each case but the actual words and precise descriptive information relative to the participants in this study.
Finally, I hope to add trustworthiness to this study through a meaningful disclosure of my positionality and bias in relation to the phenomenon under investigation. In qualitative research, the researcher is the primary instrument through which data is collected and analyzed (Creswell, 2007; Merriam & Tisdell 2015). For this reason, it was particularly important to clarify the conscious biases I brought to the study which I disclosed. By reading my thoughts and biases, the consumer of the research is positioned to evaluate how I affected the study and therefore make informed decisions about the transferability of these findings to outside settings.

4 RESULTS

Overview

This section presents case studies of five Black women who have taken face-to-face college science classes within in the past year at a two-year college in the southeastern U.S. The data are presented so the reader can gain insight about the personal, contextual, and situational variables that influenced the science learning paths of the participants.

Terminology

The term “science professor” in these cases is used to refer to assistant professors, associate professors, full professors or adjunct professors. No attempt was made to distinguish among academic ranks because students typically are not aware of these differences. Similarly, the terms “professor” and “instructor” were used interchangeably. Each science professor was identified by his or her gender, race, and sometimes age. Two of the five participants were former students of the researcher. In these cases, the researcher is referred to as a White female professor or instructor. The nature of the relationship between the researcher and each participant is clarified in the section within each case titled “Relationship with Researcher.” The term “Black” is used instead of “African American” because four of the five participants
indicated they prefer “Black” to describe their racial identity. The youngest participant did not have a preference and said she uses both terms interchangeably.

**Case Descriptions**

The cases are presented by providing background information about each participant which includes biographical information, relationship with the researcher, her interactions with school science, and her views on Black women in science learning spaces. The background information is followed by the participant’s thoughts about racial colorblindness and the fact that the researcher is a White woman engaging in research centering the experiences of Black women. The section titled “Addressing Researcher Whiteness” includes both exchanges with participants and personal reflections of the researcher. It is placed within each case, before positive and negative science learning experiences, to provide insight and give context to the sections that follow. It was important to address researcher whiteness, to make explicit the metaphorical elephant in the room, with each participant as each woman had her own ideas about the Black participant-White researcher dynamic. Each case concludes with participant advice to both Black women who will be taking science classes and to science professors. The advice they offer science professors includes ways science professors can improve their teaching practices to better serve Black women inside science learning spaces.

**KIM**

**Overview of College Science Experiences**

Kim was a nursing major who completed a total of four science lecture and laboratory courses with three different science professors. Although she described both positive and negative experiences, her overall experience in college science learning spaces was negative. All
her science professors have been White women older than Kim. Kim noticed racism in some of her science learning spaces and felt racially stereotyped by her science professors in those spaces. Some of Kim’s experiences in science learning spaces, both positive and negative, were not exclusive to Black women. For example, other negative experiences included feeling as if the majority of her science professors were unrelatable, uncaring, and limited student access to academic success which led to Kim feeling unsupported and uncertain about the professors’ motives. She felt powerless inside these science learning spaces. To Kim, science professors had the power to act as gatekeepers, limiting the access of Black women to the nursing field. Kim’s positive experiences in science learning spaces were rooted in her belief that a science professor wanted her to succeed.

**Background**

**Biographical Information.** Kim is a 38-year-old single parent with a 15-year-old son who lives with her full-time. She has worked in the healthcare field for 18 years as a certified nursing assistant (CNA). CNA training includes a minimum of 80 hours of lecture and clinical-type instruction. The certification exam involves both a written and practical skills section, and CNAs must renew their certification every 24 months. As a CNA, Kim’s main role was in home healthcare and nursing home facilities which involved providing basic care to her patients and assisting them with daily activities. She returned to school to pursue a nursing degree which will allow her to earn more money and have more career options.

Kim described herself as, “a very outgoing, outspoken person” and laughed when she added, “oh I’m a social butterfly too, I can talk to anybody.” Kim has worked with many nurses who have been in the healthcare profession for a long time; she called them old school nurses. Based on various conversations she has had with both Black and White old school nurses, Kim
believed the requirements for entry into nursing schools, especially in the South, have become exceedingly difficult to attain. For example, more science courses are required now more than ever before, and the admission standards are highly competitive in terms of grades in science and letters of recommendation. Kim’s strong belief is that these changes were made to deter or dissuade Black women from entering the field of nursing. She attributed the more competitive requirements to the fact that as more Black women are choosing to pursue careers in nursing, the additional science requirements are a way to make it more difficult for Black women to successfully meet those requirements, thus limiting their access to health care fields. “White people need to understand that they have more opportunities than we do, it’s as simple as that,” she said. “Black people have always had to sneak to learn – it used to be illegal to teach us to read…and too, depending on where you grew up, we don’t have access to the same education White people have, the schools are just not the same,” Kim explained.

She is confident that students who attend mostly White high schools come to college better prepared for science and math classes than students who attend mostly Black high schools. She used her experience of attending a mostly White high school compared to her same-aged cousin’s experience of attending a mostly Black high school as evidence to support her claim. “Things are just better in White high schools – better teachers, better resources, more enrichment-type activities – they expect the White students to do well…it’s not like that in Black high schools,” she explained while shaking her head. Her son attends a predominantly Black high school. “My son’s school sucks – they don’t even get to take their books home – I’m not even sure he has books in his school because I’ve never seen him bring one home unless it was a library book” she said and added, “I have an issue with my son going to an all-Black school, but that’s just the situation we are in – I can’t do nothing about it.” Although Kim attended a
predominantly White high school and felt student who graduated from predominantly White high schools were better prepared for college science, Kim did not feel well prepared for college science courses.

**Relationship with Researcher.** I have known Kim for almost two years. She was a student in my chemistry lecture and laboratory courses during a spring semester, and our first interview took place near the end of the fall semester of the same year. Kim sat near the front of the classroom next to her friend Travis, a White male about the same age as Kim, for the majority of the semester. Both Kim and Travis made an impression on me during the first 15-minutes of the first day of class when Kim said to Travis, “Psst – hey - do you have a pencil or a pen I can borrow?” Travis responded in a lighthearted way, “You show up on the first day of class with nothing to write with?” to which Kim responded, “Yes, just give me a pencil” which he did. This set the stage for their interactions and banter for the rest of the semester. Both Kim and Travis, sometimes as a team and sometimes individually, became unofficial representatives for the class by mid-semester. It was usually one of them who spoke up to say that that they did not understand or to ask me to re-explain a problem. Kim was the type of person who everyone genuinely seemed to like, and she got along with everyone. She was good-natured, warm, straightforward, and humorously self-deprecating in both the lecture class and the laboratory. Even on days when she seemed frustrated with the pace of the lecture or poor performance on a quiz, Kim took these academic setbacks in stride and generally vowed to work harder or study more.

Although Kim did not perform as well academically as she would have liked to during the first half of the semester, I felt like she was tuned-in and wanted to understand. Sometimes after class she would say, “Schoene, I’m just going to have to come see you,” and she would
come to my office and we would go over the material again. Following fairly poor performances on the first two chemistry tests (four tests total), we had a conversation in my office regarding her progress in class which she initiated. I recall asking if she was planning on taking the chemistry class over next semester or if she was going to buckle down and get serious about studying because those were the only two options I could see that she had. I felt comfortable being forthright with Kim in the privacy of my office and I had a fairly good idea of what she was capable of based on her questions and observations in lecture and laboratory, but at the same time, I was worried that I might have been too harsh. Kim shared during our first interview that our discussion in my office that day had a major impact on her, increasing her drive and determination to put more effort into studying. She effectively made a critical shift in how she worked problems and prepared for tests and was able to pass the course.

To facilitate the conversational tone I wanted to set for the interviews and to be transparent and reciprocal to my participants, I encouraged each of them to ask questions at any time during our conversations. Kim seemed to feel comfortable asking questions throughout the interview about my thoughts and opinions and at one time requested that I turn off the recorder while we discussed a curiosity she had that involved racial differences and racial stereotyping in science spaces. Additionally, she asked questions about why I was interested in the experiences of Black women in science classes, why I thought some science professors purposefully tried to make science so hard, and why some science professors seem to enjoy pitting students against each other to make their classroom environments feel competitive. More of the questions Kim asked are addressed throughout the case.

I trust Kim and consider her a friend. When my neighbor was looking for a home healthcare nurse to care for her elderly mother, I recommended Kim. Kim worked with their
family until the mother passed away and my neighbor shared how kind and helpful Kim had been to their family more than once. Our first interview lasted over two hours and took place in a small, quiet, corner classroom on campus. Kim chose this place and time to meet because she had planned to be on campus to study for an upcoming biology test which was scheduled for the following week. Our second interview took place at my house over dinner and lasted about 90 minutes.

**Interactions with School Science**

When I asked Kim if she considered herself a science person, her immediate response was “hell no – are you being serious right now?” She explained how science and math have always been hard for her and she strongly disliked both subjects in high school. “I had one White math professor in high school that made sense, he could break it down so we could get it,” she said, but other than that teacher, her high school experiences in math and science were not especially helpful or confidence building. “Science is just hard for me,” she stated, “I just don’t understand it…it all seems foreign to me.” To Kim, a science person looked like “somebody nerdy – they White and probably wear glasses.” She added, “Don’t get me wrong, there are some Black scientists and Black people who are really smart, but people don’t think about Black scientists when they think of what a scientist looks like.”

Kim found certain aspects of college science learning frustrating, such as there being “only one way to do it and if you don’t learn it just the right way, you get the answer wrong.” She explained that in science learning spaces the information was so “cut and dried” that there was no room for creativity or individuality and that was one reason she did not like science. She enjoyed classes such as English, Public Speaking, and Psychology more than college science classes because she had the opportunity to incorporate her personal views, thoughts, and
experiences into her assignments. “The professors in other subjects care what you think about things,” she said. Kim considered that she might have enjoyed science more if she had the opportunity to incorporate her interests and opinions, but she did not see how that would be possible, especially with the amount of material there is to learn in each science class which she described as “overwhelming.” When I asked Kim to describe her overall college science learning experiences, she crinkled her face, rolled her eyes and moaned “ugh – they were not good Schoene, not good – it’s like they are set up for you to fail.”

Views on Black Women in Science Learning Spaces

Kim believed that mature Black women faced disadvantages in science learning spaces that younger White students and Black men did not. She explained that in general, White students entered college science learning spaces better prepared for science classes than Black students because predominantly White high schools placed a higher value on science learning than did Black schools. Kim explained mature Black women, more so than younger students or Black men, are also more likely to have “real-life responsibilities” in addition to their academic responsibilities such as childcare and being the head of a single parent household. Kim believed that many mature Black women have been away from formal schooling for an extended period due to needing to work full-time or other life circumstances. She used the way some of her science professors presented material in class (fast-paced, non-interactive) and their demeanors (disconnected, detached, condescending) as characteristics that are more likely to benefit younger students regardless of their race and disadvantage older students.

In contrast to Black women, she felt Black men in science learning spaces had the advantage of receiving more respect and encouragement from science professors because men are more highly valued in health care professions. She also pointed out that because there are
fewer Black men taking science classes than Black women, the Black men are more likely to get higher-quality attention and assistance from science professors when they are struggling than do Black women. Kim added that Black men are less likely to have child care responsibilities so they have that advantage over Black women as well.

Kim could not identify any advantages Black women have in science learning spaces. For the most part, she felt White women were generally treated more favorably by her science professors than Black women in both lecture classes and laboratories. Kim thought that science professors more often suspected Black women of copying the work of others or of cheating on a test than White students. Kim believed science professors were more likely to take a White student aside if he or she was struggling to offer advice on how to be successful in the science course than a Black woman. Interestingly, Kim had a science professor who took her aside because she was struggling and offered advice, but she felt this was a characteristic of that particular chemistry professor, not an advantage that most Black women experience in science learning spaces. When probed why she felt that a science professor was more likely to help a White student than a Black student, specifically what would motivate a science professor to do that, Kim replied, “I think to keep us back...it goes back to our history, where White people want other White people to get ahead of a Black person, we have to work harder to get to the same place …if you are not Black, the color of your skin gives you more opportunities.” I asked what having more opportunities looked like to her in science learning spaces, and she explained that science professors expect success from White and Asian students, but Black students have to prove themselves more to show they can succeed. “The playing field is not level Schoene,” she said, “not at all.” Kim felt strongly that the experiences of Black women in science learning spaces were different from the experiences of White women and Black men.
Racial Colorblindness

Kim was the only participant who felt it was possible for people to be racially colorblind. When asked what “racially colorblind” meant to her, Kim thought for moment and said “I guess it means that they not looking at someone’s color to figure them out – you know, that they read people the same regardless of their color, that they don’t care if a person is Black, White, purple, or yellow.” Kim felt it was possible for two reasons: One, because she had a White female science professor whom Kim believed was racially colorblind, so she knew it was possible; and two, she did not believe that a person’s skin color necessarily revealed anything noteworthy about them. When asked what she would think if she heard a science professor say that he or she was racially colorblind, she rejected the question based on its absurdity. “Why would someone say something like that?” she asked, and added, “How would a conversation like that even get started – no one would come out and say that to someone.” It is important to note that Kim essentially refused to believe that claims of racial colorblindness are made by White people on a routine basis. She explained, “You know when someone is racist – it doesn’t matter if they say they are or not, it’s just their approach and the way they come at you…it’s hard to explain, you have to be in our skin for just one day, then you could start to understand.”

After considering the concept of racial colorblindness more intently, Kim felt like she was racially colorblind because she was willing to date outside of her race. “I will date a White man, but I wouldn’t really be looking at him as if he is White, I mean, I know he is White, but I’m not associating anything negative with him being White,” she explained. She added, “for instance, I know you are White, but I don’t think you are prejudiced against Black people or whatever, I’ve never gotten a vibe that you don’t like Black people, so you must be colorblind.” Kim’s notion of racial colorblindness was abstract. She seemed to view it as a way to look at
someone and not associate negative stereotypical qualities to them on the basis of their skin color alone, which she felt was entirely possible.

The concept of someone claiming to be racially colorblind was new to Kim. Although she reluctantly accepted that people sometimes make this claim to avoid being called racist, she felt as if doing so was ineffective and nonproductive. As we spent more time going back and forth about the reality of this claim, she connected racism and people who may claim to be colorblind with people who simply do not make an effort to get to know Black people on an individual level. She explained,

You know a lot of White people do not get to know our culture fully, and I think because the media has this bad coverage about Black culture, that is all they know and want to know, but we all not bad - you don't hear anything about the other cultures but ours to make like we are bad - we are hoodlums and we thugs and we this and we that, but all of us are not bad, so you can't stereotype me because what you seen on TV…I think it’s easier for professors who don’t want to get to know students who are different from them just to use those images and feel like they know us.

Kim pointed out that Black people can be prejudiced too and felt as if it would be more difficult for a Black person to be racially colorblind than a White person. “A lot of Black people are prejudice because they still live in the slave mentality so they can’t or aren’t willing to forget what happened back in slavery days – some Black people still living that shit out in 2017 – I don’t even look at White people like that, what’s the point?” she said. Kim’s ideas about racial colorblindness were not grounded in a reaction she would have if someone claimed not to notice a person’s skin color. Her sense of the concept of racial colorblindness was much more literal, unencumbered by an emotional reaction. She felt as if she was racially colorblind, she had a
science professor whom she believed was colorblind, so she concluded it was possible for both Black and White people to interact and not make judgments about one another based on the color of their skin.

**Addressing Researcher Whiteness**

As mentioned earlier, Kim asked more questions than any of the other participants throughout our interviews. Two of her questions included the phrase “because you are White.” A third question was about my perception as a White professor of the academic performance of Black students compared to White students. The first question was,

> Because you are White, I know you probably seen a lot of things in the science department that goes on with other White instructors – I know you are not able to – I mean, I know you can’t expose certain things and I understand that because you have to work with these people you got to withhold some stuff, but why – what makes them feel like we are not competent to do the work? Do they just believe that a White person always has the advantage over us because they know the sciences better? Why do they think we are not smart enough to learn the material like everyone else?

In a separate discussion, Kim wanted to know what I have seen as a White professor that led me to conduct this research. She said, “because you are White, so why, I mean my thing is, what did you see and you be honest about the science department – you in the science department – so what have you experienced because somewhere for you to do this research, you seen some prejudice in and amongst White instructors – I want to know what that was.”

I told Kim that she was right. I have been in conversations with other science professors, overheard comments, and been included in written correspondence among White faculty
members in my department that I felt were racist. At the same time, I did not get the impression that most of them were aware they were being racist, but it felt that way to me, and I wondered if Black or Brown science students picked up on what I perceived as their “dysconscious racism” (King, 1991) too. I explained that dysconscious racism was a way of being racist without necessarily realizing it. I said, “It’s the sort of racism that people who don’t take the time to think about why they have a certain negative assumption about a Black or Brown person has – it’s like unconscious racism, but it’s still racism – the effect is the same.” To answer Kim’s question about what led me to pursue this research, I shared that if the experiences of the Black women I interviewed revealed any of them felt racially stereotyped in science learning spaces, then I would use their experiences to encourage science faculty to examine their beliefs and assumptions about students.

I noted in my researcher journal that I was hyperaware of my Whiteness when discussing dysconscious racism with Kim. I had a sense that the discussion about racism and the acknowledgment of my perceptions of racism within the science department deflated Kim on some level because she did not have much to say which was uncharacteristic. It was a notably clumsy part of our second interview partly because I had a hard time trying to explain dysconscious racism in a way that seemed rational. Racism, intentional or unintentional, is not rational. In hindsight, I believe it felt awkward because explaining to someone who is discriminated against on a routine basis that sometimes people treat you as less than unintentionally seems ridiculous. In my journal, I likened it to someone trying to explain to me, a gay woman, that discriminating against gay people/being homophobic is something people may do without realizing it which seems utterly ridiculous.
The third question was about being a White science professor and my interpretation of how Black women perform in comparison to other students based on my experiences. She asked, “I know that some Black women are smart and know science like the back of their hand or whatever, but, you know, because you are White, I mean, you a White professor with Black students, how do your Black students do in chemistry – is it about the same or what? What differences do you see when it comes to grades comparing Black, White, Asian, or whatever?” I told Kim that since the majority of my students were often Black women, it was difficult to draw a comparison, but I did not see a consistent pattern between a student’s race and his or her course grade.

When I asked Kim what impact she felt me being White would have on this study, she replied, “I think it’s a good thing because I don’t think anybody would have ever done a study about Black women in science.” When asked how she would have answered any of the questions differently if I were a Black researcher, she responded:

Hell no – for what? Why would my answers have been any different if you were whatever color, I don’t care...I guess it goes back to me, that I don’t see you as White – I mean, I know you are White, but that’s not how I think of you I guess. If a Black researcher was doing the same thing as you, asking the same questions, I would tell her the same things – she would probably have more input because she might have dealt with it in her career because she’d be a Black professor teaching science – she would have put in more of her own first-hand story about what it’s like.

With Kim, I am either less aware of my Whiteness or more comfortable inside my own skin than with most of the other participants. She and I have developed a relationship that has made space for racial questions to be asked in ways that reveal both of our vulnerabilities and
curiosities to each other. We each had questions about racial differences, and over the course of our friendship, we created a safe space to talk freely about race which I believe was made possible by our mutual trust in one another.

**Negative Experiences in Science Learning Spaces**

Kim described negative experiences with two of her science professors, both White women older than Kim. She gave two reasons for the negative experiences: (1) she distrusted her biology professor and felt as if science professors will stick together and (2) she believed science professors tend to make science courses more difficult than necessary. They made the courses more difficult than necessary by being disorganized, making the classroom environment less friendly than non-science courses, and by restricting routes to academic success.

**Mistrust of Science Professors.** Kim offered two examples where she questioned the intentions of science professors. The first involved a biology professor who changed the format of testing from online tests to in-class only tests and the other is her perception that science professors are likely to support each other or stick together regardless of the circumstances.

*At the time the first interview took place, Kim was struggling through a biology lecture course in which she felt the professor lied to the class about the reasons for changing the format of their tests from all online tests to face-to-face in-class tests only. The vast majority of students in the class, Kim estimated 25 out of 30, were Black women. Kim said the science professor stated in her syllabus that tests would be given online and their first test was online. Kim explained online biology tests were quite common for this course citing a few other biology professors who test this way according to her friends who had taken the course and referencing a free website where students can rate their professors. Many of the students in Kim’s class did*
well on the first online test, including Kim. After discussing the results of that test, the science professor announced that all of the remaining tests would be given in class, that there will be no more online tests. When questioned by students about the change, the professor placed blame on the Science Department Chairperson saying it was a departmental policy that tests in face-to-face (not online) courses must be given in class. Kim and many of her classmates did not believe the biology instructor and, in fact, had evidence to prove that what she was telling them was not true. Kim strongly believed the reason the biology professor changed the format of the test was that so many of the students, mostly Black women, passed the test so the professor assumed they must have cheated. Kim felt the professor then lied to them about her real reason for changing the format.

Kim: When we first started her class, she stated that we would take the tests online – that was something that she decided, and she put in her syllabus…but everyone was getting good grades, passing grades…you can’t just assume that if everyone does well on a test that cheating is going on…but she switched on us; now we don’t have the online tests anymore…but, why did she do that? What was her whole purpose of doing that? We know other professors still do tests online so, to me, it seems like she lied to us…and was it because it was just us in there?”

Researcher: What do you mean by “us”?

Kim: Mostly Black women…would she have done that if there was a majority of White women in there, White people?

Researcher: Is your instructor a White woman or a Black woman?

Kim: She a White woman. An older White woman in her 60s probably…I just think that sometimes, you know, there are just challenges with races, racism anyway in science
classes, so we don’t get ahead, I think that’s just something that will never go away – especially in the South...I mean, I don't know, I just think there is some prejudice - you could never know for sure - that is something that will always be, umm, behind closed doors I guess.

In class during the discussion about the test and the new format, Kim questioned the professor about her reasons for changing the format of the tests. Kim pointed out the syllabus stated that tests would be given online and gave examples of other professors who use online testing. During this discussion, a White female student countered Kim’s question in support of the professor and said essentially that it did not matter how they were tested because “if you know it, you know it and if you don’t, you don’t.” Kim felt shut down and diminished by the student and was upset that the White student’s comment seemed to bring an end to the discussion. The biology professor did not respond further to Kim’s question, and she felt as if the White student was trying to flatter or win favor with the biology professor. This left Kim feeling unsupported, unheard, and unvalued in that science learning space. It also caused her to mistrust the biology professor who became detrimental to her science learning process. Kim explained that if she mistrusts her science professor, she does not believe the professor has “her best interests at heart.” The lack of confidence in her professor’s motivations and intentions left Kim feeling disconnected and discouraged about her ability to succeed in that science course with that professor. Kim’s science professor who changed her course policy from online tests to face-to-face tests lost Kim’s trust by blaming the department chair for the change which caused Kim to question the motives of the professor in general. She explained,

When you have a science professor who tip-toes around things you are not sure – are you doing some underhanded things that you really don’t want to express? The only thing
you can say is to blame it on the Science Department Chairman, but that’s not right – they not running your class…at the end of the day, it’s up to the professor if she gonna help you learn or not…I don’t see how she can blame the Department Chairman when other professors teaching this class do online tests, so she lied – she straight up lied because I have two co-workers taking this class from different instructors and all of their tests are online.

Science Professors Will Stick Together. Compounding Kim’s mistrust is her expectation that science professors will stick together regardless of what they believe is the right thing to do. This belief prevented her from going to the Science Department Chairperson to express dissatisfaction with the biology professor who changed the testing format that was described on the course syllabus after the majority of the class passed the online assessment. She doubted going to speak to the Science Department Chairperson about concerns would make a difference because her professor told the class the impetus behind the change in testing formats came directly from the Chairperson, but also Kim believes that science faculty will stick together regardless of the circumstances. She explained,

You could have one instructor who is a White instructor and don't have any issues with Black students, but you can have her colleague that is against us, and then now they going to bump heads and then 9 out of 10 times she gonna fall on the side of the colleague even though she might not agree with it because she has to work with that person and students go away after one or two semesters…instructors got to stick together to have each other’s backs.

Her mistrust of college professors is limited to science faculty, in part because she reasoned science faculty are aware of their powerful positions in the lives of students who are
pursuing healthcare related degrees and some seem to take advantage of or abuse their power. Her mistrust of science faculty also stems from the nature of the way science classes are taught. Specifically, because science classes contain so much more content than non-science college courses and that many people believe that science is only for certain types of people, science professors act as if they know that many students will not pass and that they just do not care. Due to the implication that grades in science courses are more important than grades in other college courses for health science majors, Kim believed science faculty know “they have the upper hand and control,” so they were more likely than other professors to be condescending and less interactive with their students. She also felt science professors were less transparent in their grading processes because, compared to professors in other classes like English or Public Speaking, they give very little or no explanation about incorrect or insufficient answers (multiple choice tests) and do not provide feedback about how to improve one’s performance. She believed that student evaluations of science professors were not taken as seriously by Department Chairpersons as student evaluations of other professors because more students fail science courses than humanities and social science courses so negative feedback, in her opinion, is expected from students who do not do well or enjoy the course. She also contended Science Department Chairpersons tend to take the side of the professor over the student although she did not have firsthand knowledge of this, she felt confident it was true.

**Science Courses Made More Difficult Than Necessary.** Kim felt science professors made their courses more difficult than they needed to be by being disorganized, making the classroom environment less friendly than other classes, and by limiting student access to academic success.
Lack of organization. Kim was frustrated by the lack of organization some of her professors displayed with lecture preparation, lecture presentation, and study guides. She explained that it was helpful when a science professor would write on the board the topics to be covered that day and stuck to their plan, not be “all over the place,” she added, “you don’t have a clue where they are going or what they are talking about sometimes, it seems like they just get up and talk at us…I’m not even sure they know what they have covered because they don’t write anything down and seem to talk from the top of their heads sometimes…” Although she appreciated having a study guide for a test, she noted that some are better than others and having a poor quality study guide or one that was not broken down in a way that was logical, was worse than not having one at all.

Science class environment is less friendly than other classes. Kim saw science learning spaces as having little room for personal expression and variation of content compared to courses such as English, Psychology, and History. The opportunity for Kim to express herself and pursue her individual interests within these spaces allowed her to form stronger, more personal relationships with the professors which gave her the information she needed to judge their character and motivations more accurately. When something questionable happened in class or a comment was made that could have been considered biased, she was more likely to give the benefit of the doubt to a professor whom she had come to know more personally than a science professor. The majority of her experiences with science professors left her feeling as if she could not relate to them (they had nothing in common) and that they preferred a more formal, distant relationship with the majority of their students. This was not true with all of her science professors, but two of them felt stand-offish and disengaged from the students in their classes.
and laboratories to the extent that Kim felt she could not relate to them, at least not to the extent she felt she could relate to professors in other subjects.

Limited routes to academic success in college science classes. Kim believed science professors could make science content more difficult than necessary and they limit opportunities for student success by using only a few assessments to calculate student grades. Kim equated student success with earning a passing grade in the lecture or laboratory course. Kim saw very limited routes to success in some of the science classes and laboratory courses because only a few assignments or tests determine their course grade. She referred specifically to her biology course syllabus but said she felt that way about most of her science courses. She explained that 95% of the course grade is calculated from two tests and one final exam, and the remaining 5% is based on eight different anatomy and physiology identification book activities. Her biology laboratory course syllabus was similarly frustrating because there were only two tests worth 90% and the remaining 10% of the grade was based on homework or laboratory reports. She says about these science courses, “most of your grade comes from tests that you not even well-prepared for by going to class, so hell, if you fail the first one, you doomed – there is no sense in even continuing - so that's already discouraging - you already know that you ain't gonna pass if you only have two tests and you fail the first one…” In fact, Kim did fail her first test in that biology laboratory course, and she did stop going after the first test because she did not think it would be possible for her to pass the laboratory course with the A or B grade that she felt was necessary to be considered for a nursing program.

When probed about why she did not go talk to the professor after the first test, she said “it was me being stubborn…I just didn’t connect with her at all, so I didn’t think there was anything she would do to work with me, to help me out – I certainly didn’t want to ask for special
treatment, and I did fail it, I did…” She did not know the class average for the test, how many 
other students failed, or the grade distribution because the professor did not share that 
information with the class. Kim was clear that the professor suggested students come to her 
office and speak to her if they had questions or needed help (“she had offered that or whatever”), 
but Kim did not see what good could come of going to speak with her, so she chose just to stop 
attending the laboratory course and planned to take it again the following semester from a 
different professor.

Regarding Kim’s thoughts about science professors making the science content seem as if 
not everyone is capable of gaining access to it or understanding it fully, she is not sure if this is 
because some of her science professors lack effective teaching skills or if the reason is more ego 
or control-based. She felt because science professors know they have institutional authority and 
control over student grades, some use that control to silence or minimize challenges to their 
practice, essentially taking a “my way or the highway” with students. Kim explained,

I think some science professors make things more difficult than they have to be… I think 
the professors, knowing that we need those science courses they know they have the 
upper hand and control over your grades… they know that they have that leeway and 
control in that area knowing that you need it. Because if you compare the English and 
the other regular classes like History or Psychology, those teachers not as hard or as 
difficult personality wise – they just more laid back, I think they more easily help you 
versus the science professors who know you need to pass their class or you can’t go to 
nursing school.

She said many of her science professors have specifically stated in class that “science 
courses are meant to weed people out” and have told students that science is more difficult than
any other subject they will take in college and a lot of students will not pass their course. She asked, “Why does it have to be like that? Why do they want us not to pass? That just doesn’t make any sense to me…”

While Kim’s negative experiences in science learning spaces involved some racial stereotyping, not all the negative experiences did. Lack of organization, limited routes to academic success, and the “my way or the highway” attitude of some of her science professors were experiences she described that would most likely have affected all the students in the course, not just Black women. Additionally, Kim did not place all the blame on her professor in the science course she failed. She acknowledged the professor encouraged students to come speak with her if they were having trouble, but Kim chose not to because she did not believe the professor would be willing to work with her. Additionally, although Kim believed the reason a professor switched the testing format in another class was based on the professor’s intention to limit the success of Black women, Kim made the decision not to speak with the Department Chair because she felt science professors would stick together and nothing positive would result from bringing it to the attention of the Department Chair.

Positive Experiences in Science Learning Spaces

While Kim has felt racial stereotyping in science learning spaces, she does not attribute her negative experiences solely to that, explaining that for the most part, both her positive and negative experiences were connected to whether or not she felt the science professor cared about her learning, whether or not Kim felt she could relate to the science professor, and the professor’s transparency and organizational skills. She had positive interactions and felt supported by two science professors. One was her chemistry professor who instructed two of her four science classes. The second instructor was a biology professor with whom Kim met to
evaluate the professor’s personality and temperament before deciding whether to register for her laboratory course the following semester. Both professors were White females older than Kim.

**Professor Caring.** Feeling supported in science class to Kim meant that the professor cared about whether she passed or failed the course. She realized that when she did not feel supported in a science class, she lost interest and had more difficulty investing in the process of science learning. She said the following as if having an epiphany,

> So that's what it must be - bingo - when I feel like the professor doesn't care (pause) and does not have my best interests at heart, I lose interest, and I have no drive to learn that material, none - and when I know that a professor is good and has my best interest at heart and wants me to succeed, that is very (pause) it feels very supportive, it just makes me go at learning the material even harder – bingo.

When asked how she can tell that a science professor wants her to succeed, Kim described two interactions with different science faculty members that made her feel supported and as if the faculty members had her best interests in mind. The first was with her chemistry professor who had what Kim referred to as a “come to Jesus meeting” with her when the professor felt she was not working up to her potential in class. In the meeting with her chemistry professor, Kim went to the professor’s office after class to ask for help. She explained that the professor helped her understand what she could not fully understand in class that day, then challenged her in a supportive and firm way about why she had not been coming to class more prepared. The professor explained that she knew Kim was fully capable of doing better than she was in her class and wanted Kim to tell her why she had been only half-heartedly making an effort to understand the content and not preparing for tests. Kim described feeling “good and positive when a science professor sees something in you that you don’t see in yourself,” and that
part of her motivation for working hard in that science class was since she felt she had earned the professor’s confidence, she did not want to disappoint her science professor. She recounted, “[The science professor] made me push myself to do it because I didn't want to disappoint the instructor based on what she thought of me, so I pushed harder to do what I was supposed to do.” Kim explained how this science professor’s belief in her ability made her feel pressure but also gave her the extra boost she needed to successfully learn the course content and pass the course. She recounts, “[The professor] knew to push me in the area that I felt I couldn’t be pushed – if that makes any sense (pause) because a lot of times you gonna have students that are straight A students and really don’t need any assistance…but you have other students who, you know, kinda need a little push (she laughs) and that was me.”

I started to question Kim if she would have stuck with her biology laboratory course after she failed the first test instead of giving up if the instructor had a “come to Jesus” meeting with her as her chemistry professor did. Kim did not let me finish the question before answering and said,

**I would have stayed** – if she would have gotten to know me and my situation, then she would understand why I performed that way… if she was more concerned about why I failed or whatever, but her whole thing, her whole concept was that I just didn’t study - but did she ask me why I didn't study? Because I work night shift and I had to work that whole entire weekend, and we had the test on Tuesday, but if she would have known that and understood she could have probably helped me or whatever like maybe I could have taken the test on a different day…She knows she has the upper hand and only she can determine when I could take the test…some science professors have this mentality like all we have to deal with is school, I still have life responsibilities that I have to maintain,
and I still want to finish school, but when you have an instructor that don't give a damn - then it’s like, it feels like there is no hope…

When asked to elaborate on what she referred to as the science teacher mentality, she explained, “they have attitudes like if you get it, you get it and if you don’t, well then you just don’t pass the class, it’s not their problem – we just a number, you know what I’m saying? If you drop, you drop, hell, I’m still gonna get paid - that’s just the whole mentality.” She did not believe that the science professor with whom she had positive learning experiences with shared this science teacher mentality. Kim felt she could sense whether or not a science professor cared about her success by the way he or she interacted with students. “If they go out of their way just one little bit, even to look at you in class while they are talking or ask why you did bad on a quiz or whatever,” Kim said, “then you at least feel like they give a damn about you.” Having the sense that a professor wanted her to succeed was important to Kim. Of Kim’s four science courses and three science professors, she believed only one professor genuinely cared whether she learned the material to pass the course.

**Professor Relatability.** The other science faculty member with whom Kim had a positive interaction was a biology laboratory instructor who Kim essentially interviewed to “get a sense about her” before deciding whether or not to enroll in her course. Kim heard good things about the professor from her friends, but since she had experienced both extremely positive and extremely negative science learning environments and because her science courses were critical to her access into a nursing program, Kim decided she would always try to meet a science professor before registering to take his or her class. *When Kim shared her previous experiences in biology laboratory (the course she failed) with this biology instructor, Kim was unexpectedly surprised by how helpful, understanding and relatable the biology instructor was.* Kim told this
biology instructor about the first time she took the course, that she just gave up after the first test and stopped going because, based on way that professor calculated the grades, Kim did not see how it would be possible for her to pass regardless of her performance for the remainder of the semester. Kim recounted,

I told her my situation about me failing lab, and she was like - same attitude as [my chemistry professor] "you better put on your big girl drawers and move forward" and she said, "Hey – have you ever thought to get a teacher recommendation" - I said what? Really? I had never thought of anything like that before – [the biology instructor] said, "Oh, life happens - we all have life, and it gets in the way sometimes - husbands, kids, work" so I thought, hmm - ok - that can be where in so many ways, she did help me, so that's why I say - even though I feel like the science department can be prejudice, it don't mean that everybody in it is prejudice - it's still up to the individual, the instructor - now she just told me something that could help me in the long run in a big way - I mean, I didn’t think about them helping me in that way, you know?

Kim said she was planning on speaking to another biology professor who had been recommended by her friends but decided not to after speaking with this one. Kim chose to meet this biology laboratory professor first over the other instructor she had heard positive comments about because a friend who is also a Black woman, took the laboratory course from this White female and had a very positive experience. Kim shared,

[This biology instructor] told my friend something real personal about herself when [my friend] was having a hard time. She told her, she was like, “I know you can do it” and “you need to just buckle down and get this work done, you need to finish this class and be done with school”…so Schoene, I just don’t know, now that we talking more about
this…it could just be some people, some people have biased thinking about Blacks in their class…that we have bad attitudes and are lazy, but that’s not the way everyone thinks – at least you didn’t and she didn’t.

Kim believed if she could relate to a science professor and if the science professor cared about her success, then she was likely to have positive science learning experiences inside of that professor’s science learning space. Knowing that professors are willing to have “real talk” with students and share personal insights made the science professors seem relatable to Kim which made her feel as if she could be successful. Kim realized when she felt she could relate to a science professor and that the professor wanted to help her succeed, she felt supported, encouraged, and capable.

**Transparency and Organization.** Kim pushed herself to work hard in the science classes where she felt she understood how to do well based on the clarity of expectations, organization, and consistency of the professor. If Kim sensed the professor was honest and transparent about what she expected as well as how she graded assignments and assessments, Kim felt the professor was trustworthy. Kim described “having clear expectations” as “the professor giving us a clue about how she wants us to do assignments and learn the material – like *how* to do laboratory reports and *how* to go about studying for a test.” Kim used her chemistry instructor as an example. “[My chemistry professor] left no doubt how to be successful in her class…she gave study guides that listed specific problems in the book to focus on and gave PowerPoints that were much more detailed than what was in the book,” she said. Additionally, this chemistry professor always went over the correct answers to tests in class and gave students the opportunity to ask questions if they wanted clarification. This made Kim trust the professor because she was willing to discuss why wrong answers were wrong and help students understand
why they missed the questions they missed. Her chemistry professor also made the grades and 
grade distribution for each test public by writing it on the board so students would know where 
they stood in relation to their classmates. Kim shared that she failed the first chemistry test and 
Improved her grade to a C by the second test. “I was sure everyone failed the first test because I 
thought it was written in a foreign language,” she laughed, “but when I saw there were only four 
students who failed the first test, and I was one of them, I realized there must really be a way to 
learn this stuff and decided to get serious.”

Kim also valued personal transparency from this instructor in a way that seemed to build 
trust. Kim felt as if the professor was a good person because she was willing to talk with 
students in an informal way before and after class and share information about herself if a 
student asked. An example she provided was when a friend of Kim’s asked what the professor’s 
zodiac sign was after class one day. “I looked at [my friend] like she was crazy – I couldn’t 
believe she asked that,” Kim said. “[The professor] just answered her and asked what [my 
friend’s sign] was right back – then she said she had no idea what any of that meant, so [my 
friend] sat there and talked with her about zodiac signs, like anyone cared, but it’s that kind of 
talk or whatever that made her seem like a real person,” Kim explained.

The professor’s consistency and organization added to Kim’s positive science learning 
experience as well. Kim’s science learning was supported by the professor always starting class 
on time and writing an outline on the board each day of what was going to be covered. “When 
you sat down, you knew what was going to happen and when class ended, you knew if you 
didn’t understand what she was talking about,” Kim said, “it was on you because she did her 
part.” This professor explained to students on the first day of class that her vision for their 
science learning followed a specific path. Kim explained the path was “chaos, confusion, clarity,
mastery” and the professor wanted students to get through the “chaos” portion, which was reading over the material and trying to work problems on their own, before coming to class. “She wanted us to come to class confused,” said Kim which at first seemed “crazy,” but if you didn’t come to class confused, explained Kim, “then you would surely leave confused and Lord I should know, I was confused the whole first half of the semester.” Although Kim failed her first chemistry test, she had confidence in her instructor and believed that because the instructor made a strong effort to be transparent, organized, and consistent, that the instructor wanted the students to succeed. Kim explained that learning the science content even within the positive spaces was not easy and the classes and laboratory experiments were not always enjoyable, but what she appreciated was that the professor was willing to work as hard as she expected the students to work which made the professor seem caring and trustworthy.

Ultimately Kim felt that when she could relate to a science professor and the professor saw her as a capable individual, she was motivated to work harder. Kim found that she was more committed to science learning if she sensed that a professor genuinely cared, or “gives a damn,” about her success. Positive science learning experiences for Kim took place in spaces where she felt as if she could relate to the professor, she trusted that the professor wanted her to succeed, and in spaces where she sensed the science professor took the time to be organized and consistent in class.

**Advice to Black Women**

Kim’s advice to Black women who will be taking science classes is that, if you are struggling and feel that it is impossible to pass the class, it is critical to stick with it. She says emphatically, “you can do it, but you've got to stay focused and don't get discouraged, don't allow fear to overtake you - stick with it and don’t let no one tell you that you can’t do it.”
questioned Kim about why she did not take her own advice, pointing out that she stopped going to her biology laboratory course after she failed the first test. “Schoene,” she said slowly, “you got me (long pause), you got me there…I wish I had stuck with it; I wish I had gone to talk to her even though I felt like I knew what she would say, I wish I had at least tried…I guess you don’t know until you try…” Kim strongly suggested going to speak with a science professor during his or her office hours, which are usually posted on the professor’s office door. She said she will always do this going forward in her science classes because regardless of how another student described his or her experiences in a professor’s class, it does not mean that you will have the same experience. If a woman is unable to meet a professor face-to-face, then she recommended using a website such a ratemyprofessor.com or asking other Black women who have taken the professor what they thought about the professor’s science teaching and attitude towards students. Finally, Kim recommended looking for the professor’s syllabus online to determine how much value he or she places on tests, quizzes, homework, and other assignments. She pointed out that it is possible in some cases for students to get a feel for what a professor is like by the tone of their syllabus, but that it is not always a reliable indication of how they teach. She discussed her chemistry professor’s syllabus which devoted space to telling students explicitly how to do well in her class as an example in which she had a positive outlook about the professor and the class from the tone of the syllabus. On the other hand, she added, “If you have a professor who says things like, ‘I will only open emails with such and such in the subject line,’ then you know they gonna be hard to work with.” Kim’s bottom line to other Black women was that, above all else, make the decision to complete the course, regardless of how helpless you may feel. “Fact of the matter is,” she said, “the professors know that you need them to get where you going, but most
of them not going to do much to help you get there – you’ve got to plan on doing it all yourself – don’t quit, just don’t quit.”

**Advice to Science Professors**

Kim believed science professors could be more effective teaching Black women if they would take the time to get to know their students as much as possible and be willing to build a rapport with them, even if it seems as if they have nothing in common with their students. She explained that this is “the downfall of the science department, it’s not like that in other subjects, in other classes on campus – no one cares to get to know their students which makes everything feel more difficult, more disconnected…” Kim believed that science professors who take the time to get to class early and talk to students about their weekend or engage students in discussions that do not necessarily involve science would be a way for professors to build rapport with students. One of her science professors would break up the lecture with pictures of birds or the professor’s dogs which Kim felt livened up the time in lecture and kept students interested. “Even if it’s not about science, damn, just show us you are human and have a life,” Kim said. Kim also felt that if science professors would be more interactive and personal, then students would likely feel comfortable approaching them to ask for help.

Kim highly valued straightforwardness and thrived in science learning environments where the professors were organized and clear about the topics they intend to cover in class on a given day. Professors who wrote the topics they plan to cover on the board and frequently checked-in with students by making eye-contact and asking if the students are following what they are saying help her stay focused and engaged. This in-class communication between science professors and students also gave Kim the sense that the professors cared about student understanding, progress, and success in the class. She had the most trouble in science learning
spaces where she felt the professor “was all over the place” during lectures (disorganized), did not engage with students in a friendly, respectful way, and in courses where the professor provided only limited opportunities for students to achieve a passing grade by setting up the course so that their entire grade is decided by just a few tests.

Kim understood that giving quizzes, homework, and other assignments is more work for the instructor and she, to some extent, believed the science professors who only use a few tests to determine a course grade are lazy, checked-out, and are doing the bare minimum to collect a paycheck. Kim explained that to increase student success in their classes and laboratory courses, science professors should not have students,

Put all of our eggs in one basket – give us quizzes, give us homework, give us more opportunities to actually engage with the material instead of just giving us tests that count for such a high percentage of our grade…they know we need those science classes and they make it hard as hell for you to get it and pass it – I don’t think it has to be that hard, why they gotta make it that way – one midterm and one final exam, that don’t even make sense if you really trying to help us learn the material.

She believed this is one of the ways that science professors set students up to fail their courses and wanted science professors to know that they may be losing students who could have been successful if the students had more opportunities for assessment.

**Conclusion**

Kim’s learning experiences in college science spaces have varied over the four courses she has taken with three different White female science professors. She described two courses taught by the same instructor as positive regarding science learning and the other two as
frustrating and discouraging. Some of Kim’s negative experiences were the result of negative stereotyping, such as Black women are more likely to cheat or need to cheat to do well on assessments. Kim strongly believed the culture of science professors as a whole is undergirded by the desire to hold Black women back and prevent them from entering the nursing field. Because science professors have a great deal of power, in part because they are seen as gatekeepers into certain careers, their “my way or the highway” attitude was especially dispiriting. She described her spirit being broken when she thought about attending the science classes where she did not feel that she is learning the material or making progress and being disheartened by the idea of having a D or an F on her transcript because, in part, she had the understanding that in order to gain admittance into a nursing program, she must earn an A or a B in all of her science courses. One of her science professors kept reminding the class that if they were to fail the course, the failing grade would remain on their college transcript for the rest of their lives. She felt frustration because she knew she needed to do well in science courses to be accepted into nursing school, but she did not see a realistic, attainable path to success and therefore lost her motivation and confidence. Additionally, Kim distrusted one science professor because that professor lied to the class about her reason for changing a test format from online to face-to-face, then the professor allowed Kim to be silenced by a White student inside of the same science learning space.

Kim’s sense of powerlessness in science learning spaces is apparent. Kim did not contact the Science Department Chairperson about her concerns because she had the belief that science professors will stick together and protect each other, for the most part, regardless of the circumstances. She also decided not to speak directly with her biology professor after failing the first of only two tests in the course because she did not think it would do any good even though
the professor encouraged students to come speak with her if they were having issues. It is only inside science learning spaces that Kim felt this way. She trusted non-science professors more because inside of their learning spaces, the professors interacted with students on a more personal level, and she was encouraged to share her opinions and experiences, which Kim felt indicated that the professors cared about her success. Kim also believed complaints made to the Science Department Chairperson would not lead to any real improvement (“it won’t do any good”) for two reasons. One, she reasoned the Science Department Chairperson receives a large quantity of complaints because many students dislike the overwhelming amount of content in science courses, so they blame it on the professor and the complaints are not taken seriously. The second reason was that since she believed science professors stick together and defend one another, nothing meaningful would result from her effort.

Kim felt the science department as a whole was prejudiced against Black women and had lower academic expectations of them, but she struggled somewhat with this view because she offered two examples of White science professors helping her in unexpected ways. When describing those instances, she shifted the locus of prejudice and deficit thinking from the science department to individual instructors. Kim explained, “I think the science department is prejudice…but I also think it is still up to the individual professor…I think we are stereotyped and pre-judged from the beginning…, but it is up to the professor how she is gonna run her classroom and interact with students.” In addition to Black women being stereotyped as less capable and less intelligent than other students, Kim felt science professors label them as having bad attitudes and think Black women are less willing to work hard in their class than students with different racial or ethnic backgrounds. She indicated that this was more of a feeling because professors who have a bias against Black women do not speak about it openly. At the
time this research was completed, Kim was anxious about completing the science requirements for nursing, but was determined to do so. She lacked only four more science courses (two lecture classes and two laboratory courses) and two non-science courses.

MICKEY

Overview of College Science Experiences

Mickey was a nursing major who completed all of her non-science courses and attempted two science courses, a chemistry lecture and laboratory course. She chose to withdraw from her chemistry laboratory course mid-semester due to insurmountable challenges with her laboratory instructor who was an older White male. She noticed racism inside of her science laboratory and felt racially stereotyped by her laboratory professor. Mickey believed that she was racially stereotyped in a negative way more so than other Black women in the class because she has very dark skin compared to bi-racial women and Black women with a lighter complexion. She felt because of the favorability of lighter-skinned Black women, those women would likely have different experiences in science learning spaces. Mickey strongly believed her science laboratory instructor abused his institutional power by having a “you have to go through me to get to nursing and what I say goes” attitude because he was aware that grades in science courses play a major role in one’s ability to earn a nursing degree. Mickey had positive science learning experiences in her lecture course which was taught by an older Black male.

Background

Biographical information. Mickey is 21-year-old nursing major who chose to attend a two-year college because she wanted to start off in a small college environment. In a small college environment, she felt she would have more one-on-one, personal attention from instructors. She
also believed starting off at a local two-year college would allow her to ease into the pressures and workload of college without having the additional stresses associated with being away from home. Some of her friends went away to large universities and returned home after a few semesters, and she did not want the same thing to happen to her. Mickey described herself as happy, peppy, and social, although she also valued time spent alone. She enjoyed her part-time job of working in a grocery store because she liked to help people. Her other interests included writing poetry, biking, hiking trails, and shopping with her friends at the mall. Mickey said her friends would describe her as helpful, confident, strong-minded, and as someone who gives great advice.

Mickey chose nursing as a career because throughout high school and during the time Mickey was choosing her college major, several of her family members were ill and spent time in hospitals for various lengths of time. She noticed that some of the nurses were very helpful, attentive, and caring while others were not as tuned-in and seemed nonchalant or dismissive towards her family members. She observed time after time the impact the nurses had on the well-being and comfort of her family members and decided she wanted to become a nurse. She also described a medical emergency that occurred at the grocery store where she worked. A customer severely injured himself on their CoinStar machine and was bleeding profusely. She stepped forward to help him by cleaning and bandaging his hand while everyone else was just standing around watching, not knowing what to do. When telling this story, Mickey said: “if you had more people to just take one ounce of care to help each other, the world would be a better place (pause) – I like to help people, and that’s something else that makes me a good fit with nursing.” Mickey has completed all her non-science coursework to earn an Associate’s degree in Nursing.
She chose to delay taking her college science courses because, as a nursing major she explained, it was important that she learn the science content so that she will be able to make connections between what she learned in science classes to what she will be learning in nursing school. The close proximity of science classes to courses she will take in nursing school will allow her to build on the science content in nursing school more easily. Additionally, she was advised in nursing-information sessions offered by the college that nursing programs place a high value on grades applicants earn in science courses, so Mickey wanted to finish the majority of her classes so that she could focus her time and attention on doing well in her science classes.

**Relationship with researcher.** I met Mickey for the first time the day of our interview. She requested we meet on a Friday morning in my office. I sat with my office door open that Friday morning and watched her walk past. We briefly made eye contact, and both slightly smiled, but she continued down the hallway. She circled back, came closer to my door to read the nameplate, and when we made eye contact again, I asked if she was Mickey. She looked puzzled, then she laughed and said: “Yes, I’m Mickey - I thought you would be Black.” I laughed too and said, “Yeah, I get that a lot since my research focus is on Black women.” Later in the interview, Mickey shared,

It’s so funny because I didn’t know you, I didn’t know what you looked like, I didn’t know *anything about you*, I just assumed you would be African American since you were studying African Americans – even when I came up to your office, I was like – wait – what? Is that *you* – *you* are the one who wants to know about my experiences in science? When I came in, I was still like, *wow* – I am surprised that somebody of the opposite race is taking an interest…and I think it’s good because if you were Black, people would
think, ‘well, of course, you are going to say that,’ but since you are White, it will be different.

My first impression of Mickey was that she had a sunny disposition based on her huge smile and warm, friendly attitude as soon as we met. I thanked her for volunteering to be a part of the research, explained the general types of questions I was going to ask about her science learning experiences, and requested she review the consent form and sign it if she felt comfortable doing so, which she did. I had rearranged the furniture in my office so that Mickey was sitting in the larger chair behind the desk and I was sitting in a foldable chair with a small tablet arm extension. We were positioned face to face behind my desk with the office door closed. I had personal pictures in my office, and she asked about the people in them and the places where they were taken. I explained that the other women in most of the photos was my fiancé and she enthusiastically shared that she had recently chosen the LGBT (lesbian, gay, bisexual, and transgender) community as a topic to research and discuss in her Public Speaking class.

Our first interview lasted over two hours. After that interview, my sense of Mickey was that she was intuitive, compassionate, and had a generous heart. She tended to see the best in others and consistently had an upbeat, positive attitude. She seemed to be open and trusting from the moment we met as demonstrated by the way she laughingly shared she assumed I would be a Black researcher. It was also evident that fairness and ethical behavior were important to her. Her mother instilled the importance of being fair and ethical and Mickey expected others to act in the same way. For example, she described how she had a “bad feeling” about her chemistry lab instructor from the very first time she met him, but she did not want to judge him unfairly and chose to give him the benefit of the doubt. Our second interview also lasted over two hours.
During our second interview, Mickey spoke about skin color, colorism/shadeism, and how light-complexioned Black women are more highly valued and respected than darker-complexioned Black women. Mickey described herself as dark-skinned and her older sister as light-skinned, so she spoke from the perspective of a dark-skinned Black woman. Mickey’s insights into race, racial relations, and the challenges faced by darker-skinned Black women were pivotal to my understanding of how and why lighter-skinned Black women may have different experiences than darker-skinned Black women.

**Interactions with School Science**

Mickey enjoyed science in high school and said she was very good at it. She considers herself a “science person” and feels that everyone has the ability to learn science. “As long as they are willing to learn and their professor is willing to teach them,” she added, “and as long as the professors have patience and drive and they are just as dedicated to teaching as the student is to learning, anybody can learn science.” When asked to describe what a science person looked like, Mickey said that science people do not have a specific look necessarily, but a person would be labeled a science person based on his or her hobbies and interests. Some of those interests were that the person might like bugs, doing experiments, or being outdoors for long periods of time. She further explained this view using an analogy with a homeless person. “That’s like asking how a homeless person looks, you may see a homeless person dressed nicely, but they could still be homeless, so I don’t necessarily think a science person has a look,” she said. After a pause she added, “but I guess most people when they think about scientists like the ones you see on TV, they are mostly males, White or Asian males, but not always.”

Mickey enrolled in a chemistry class and the co-requisite laboratory course at the beginning of the semester in which the first interview took place. She had very positive
experiences with her lecture instructor, but insurmountable challenges with her laboratory instructor. Mickey chose to withdraw from her laboratory course around the midpoint of the semester because she did not believe it would be possible to pass the laboratory course based on the grades she had received. She also could not envision a scenario in which her laboratory instructor would help her understand the course material after attempting to understand his way of doing things multiple times. Interactions between Mickey and her laboratory professor will be described in detail below.

**Views on Black Women in Science Learning Spaces**

Mickey believed Black women have the advantage of having a certain confidence, a type of aura about them that comes out when they feel disadvantaged, or they sense they must prove themselves to others, such as within science learning spaces. She explained that Black women “feel like we always have to prove something,” and that, “determination and drive are the advantages of Black women in science” learning spaces. She explained more about why Black women, more so that Black men or White woman, feel as if they must prove themselves to others:

> You know you have to work to outdo everyone because the target is on your back as a Black woman. You know you have to prove that you can be a Black woman in sometimes a male-dominated category and you have to prove that you can do it without letting your kids or a man or all those other people who stereotype you affect your progress. You also have to face the fact that not only are you *Black* but that you are also a woman, so it's like, you are competing with boys, and you are competing with the race of those boys, and you are competing with those other girls in the class who don't have that same pressures that you have because they are of a different race.
In addition to the advantage of having a special strength to persevere under challenging circumstances, she believed some science professors might put Black women in a more favorable position than other students, at least she felt that way about her chemistry lecture professor who was an older Black male. For example, Mickey’s chemistry professor took her under his wing and gave her more attention and help in class than other students when he noticed she was struggling. He seemed to care more than she expected and she felt supported and encouraged by his reaching out to help. She described it this way:

You do have some of those professors, they will work a little bit harder with you just because they know what you are up against. I would say those are definitely advantages because there are science professors out there who do understand that there is a, umm, a dotted-line between Black women and other students sometimes – they understand we may need just a little bit of oomph, a push, you know, versus everybody else.

In contrast, Mickey pointed out she felt science professors, in general, tended to give students who were not Black women the benefit of the doubt more often and were less likely to be suspicious of them and their reasons for not studying or completing an assignment. She felt science professors did not expect White or Asian students to “jump through the same hoops” as they expect from Black women and that science professors were more lenient towards those students in general. For example, she felt science professors were more likely to say to those students, “oh well, that’s okay just turn it in when you can” if they did not get around to doing an assignment compared to wanting or expecting an explanation from a Black woman. She observed this double-standard in her chemistry laboratory. Her laboratory instructor was an older White male.
Mickey recognized another advantage students who are not Black women have in science learning spaces is that they have a higher chance of finding someone within their own race who can help them be successful. She explained that Black women sometimes feel apprehensive when asking for help from others and in science, there are benefits to being able to join study groups and feeling comfortable asking to work with classmates. When talking about White students in her chemistry laboratory, she said, “They can just be like ‘oh, you need help? Dude, come on and get in our group’.” If there are not a lot of other Black women in the class, she felt awkward asking to join a group because she does not think the other students want to work with her. On the days her laboratory professor would pair students together instead of allowing them to choose partners, Mickey worried her assigned partner might think she is not as smart as some of the other students and would not want to work with her.

Mickey believed that other students, those who are not Black women, are more likely to have the advantage of not having to deal with children and child care. She explained that Black children could be more difficult to handle than children of different races and men especially are less likely be burdened with child care, giving men more time to focus on school work.

Men have the advantage of being able to get help over us, and I would say they have more personal time to devote to school too. We as women may not be doing school work because we have kids, we have work - with men, you know, sometimes they don't even have to deal with the kids – kids of different races, they different - some may say that Black kids are the same as other race kids, and in some aspects, they are, but sometimes they are a lot rougher or harder to deal with, so Black women may also have to deal with that aspect of life where other women or Black men do not. The professor may base the assignment off of the time it takes them to get it done, but Black women may have other
additional things to deal with - and you may not be as good as others in that class, so professors can say, well if the majority of the class gets it, then you should be able to just go on along with them and get it too.

Mickey’s views on Black women in science learning spaces are split and professor dependent. On the one hand, she felt that some science professors may support and advocate for Black women because they are empathetic to what may be special circumstances the women could face such as additional childcare responsibilities. Mickey felt it was more likely that Black women in her classes had childcare responsibilities than White women because if a White woman had a child, she was more likely to have a supportive partner than a Black woman. Mickey offered no evidence of this but rather spoke as if it was a given in our society as if it was something that everyone knew and accepted as reality. This was the case of her chemistry lecture professor who was an older Black male. Mickey believed that he went out of his way to support her more than other students who were not Black women because she was a Black woman.

On the other hand, she felt some science professors required more of Black women than other students. For example, she believed science professors were more likely to require Black women to cite reasons for being late or turning in late assignments than other students, generally giving students who were not Black women the benefit of the doubt and more leniency. An additional disadvantage for Black women in science learning spaces was that Mickey sometimes felt excluded from working with other students who were not Black women. She sensed that White students who were paired with her by her laboratory instructor thought she was not as capable or as smart as other classmates who were not Black women. Regarding advantages Black women have in science learning spaces, Mickey brought to light the strength and resilience many Black women have when faced with adversity. For example, when Black
women feel as if they must prove themselves to others, Mickey believed Black women have a confidence or drive that is unique to Black women. The drive to succeed is rooted in Mickey’s belief that Black women are not expected to perform as well as White women or Black men in science learning spaces, so it is up to Black women to correct this misconception.

**Racial Colorblindness**

Mickey did not believe that it is possible for people to be racially colorblind. She described how people within the same race still make note of skin color and treat people differently because of it. “There is bias within our own culture about skin color – we are not even colorblind within our own race,” she said. “With Black people,” Mickey explained, “they say ‘well I’m light-skinned’ or ‘I’m dark-skinned’ and I’m like at the end of the day you are still *black*, you are a person of color no matter how you want to slice it.” Mickey continued,

Biracial and light-skin people, there is a split among us in that way about skin color. People of a fairer skin than us, they think they are more preferable or higher status than a person with dark skin like me and that just goes back to our history, the fairer-skinned people were put in the Big house versus the darker-skinned people who are out in the fields working. That was just something that started way back; we darker-skinned people were not up in the Big house, we outside working because of our complexion - we are not as light or as superior or as wanted as someone with fairer skin.

She felt that because of the favorability of lighter-skinned Black women, those women would likely have better experiences in science learning spaces than darker-skinned Black women regardless of the race of the professor. She explained that lighter-skinned Black women have the option of choosing the group of students with which they want to be associated, but darker-skinned Black women often do not have the same option of fluidity among races. “They can be
Black when they want to be Black and act White when they think it will work out better for
them. They can blend in when needed versus a person with darker skin like me – that is who we
are 24/7 but women with fairer skin, they can switch – that’s what an Oreo is, Black on the
outside and White on the inside,” she said.

A bi-racial friend of Mickey’s took advantage of her lighter-skin in this way. Mickey’s
friend was in her chemistry laboratory class and her English class the same semester. Mickey
described how this friend would “totally switch” depending on the environment and she was able
to do this easily:

There were more Black girls in English class, so when she was with us in English, she
was louder and more urban, but in lab, she would be really proper and quiet – she acted
more White, more like the personalities of the two Caucasian girls in there…In lab, she
would be like “oh hey” sounding proper, but in English class, she would be like “Oh hey
girl, let me tell you what happened this weekend…” It’s like you saw her color change
completely, but you know she is the same person.

Mickey said this was an example of an Oreo because when her friend was with Black people, she
would act Black and when her friend thought it would benefit her to act differently, then she
would act White.

Regarding a science professor’s ability to be racially colorblind, Mickey does not believe
it is possible. “I just wouldn’t believe they were being truthful - there is no such thing as
colorblind,” she said, then added, “you have to see people how they are, not how you want to see
them – everybody is not equal, everybody is not colorless – you have to be realistic, not
everyone is equal in our culture, and that has its basis in skin-color.”

**Addressing Researcher Whiteness**
I was aware of my Whiteness with Mickey in a curious way. Within the first 30 seconds of us meeting for the first time, she brought up the fact that I was White and she expected me to be Black. I interpreted that acknowledgment as an indication that Mickey was open to discussing racial issues in a transparent way. Not knowing if her science learning experiences were affected by race or racial differences, this perceived transparency made me feel hopeful and comfortable with Mickey immediately. I felt excited to have the opportunity to speak with her, not apprehensive like I have felt interviewing other participants whom I had not met before. Near the end of our second interview when I asked Mickey how she would have answered any of the questions differently if I were a Black researcher, she said:

I don’t think that I would have gone into much detail because I would have probably already had it in my mind that you know exactly what I am talking about. If you were Black, it would almost be like you were in my mind with me – I would think that you pretty much already understand our story and our struggle…since you are not, I felt like I needed to break it down for you – I’ve got to make you feel what I feel, see what I see, and actually hear the words the way that I hear them versus me having the idea like, “Oh I can just say it, and she already knows that I am feeling this way or that when it was said to me,” I wanted you to know that this is how it felt. White people don’t necessarily understand how we see things, so I wanted to make sure you were able to look inside and see the world through my eyes.

As a White person, she recognized that it would be difficult, if not impossible, for me to comprehend the immensity of her experiences as a Black woman unless she described them as explicitly as possible. I am aware that even with her descriptions, openness, and desire to make me feel what she felt, as a White person, I lack the perspective of lived-experience to fully
comprehend the depth of how racism has affected Mickey and her science learning experiences. However, Mickey felt that my being a White researcher collecting experiences of Black women science learners could be positive. Regarding the impact of my Whiteness on the study Mickey said:

I think more people will read the study because you are White. It will be more impactful because you are a White female science professor and a lot of people will be interested to know how you feel about the information you came across. You never really hear about a study where White people are actually sitting down listening to what we have to say…it will show that there is someone out there who is willing to listen to us and they don’t have to be Black to want to hear it…Because you are White, people will listen and realize these are real experiences, happening every day to real people…I also think Black people will read it because it’s the stories of Black women and they will be interested to see how a person of the opposite race is able to validate our words because we are so used to speaking for ourselves and struggling to be heard.

What struck me about Mickey’s statement was her belief that because I was a White researcher, the study was likely to reach more people and have a greater impact than if I were a Black researcher. The idea that a White researcher could “validate” the words of Black students by simply sharing their experiences was remarkable. After the interview, I grappled with this concept while also noting my immense appreciation to Mickey for making a strong effort to detail her experiences in a different way because I was White. I concluded in my researcher journal that she helped me realize that in some cases only White people have access to other White people when it comes to having challenging and honest discussions about race.

Negative Experiences in Science Learning Spaces
Mickey has taken two science courses from two different instructors. A chemistry lecture course with an older Black male instructor and the co-requisite chemistry laboratory course with an older White male instructor. Mickey described her overall experience inside of her chemistry laboratory as “very, very bad.” The examples she provided can be placed into three categories: (1) she was negatively stereotyped by her laboratory instructor, (2) she found it impossible to deal with her laboratory instructor’s arrogant and condescending attitude, and (3) he was generally disorganized and inattentive during the laboratory classes.

Felt negatively stereotyped. Mickey provided multiple instances of her laboratory instructor making inappropriate comments that were disrespectful and demeaning to Black women. For example, one day her laboratory instructor made a mocking reference to slaves by saying in a high-pitched woman’s voice, “oh Massa, don’t beat me, Massa, please don’t beat me Massa” while waving his hands in the air apparently attempting to mirror his interpretation of the students’ demeanor when he announced he was about to give an unexpected quiz. Mickey description of the class was that they were speechless and “you could have heard a pin drop – everyone just stared at him while he laughed at himself.” When they would have in-class assignments that were timed, sometimes Mickey and other Black women used the entire time to complete the assignment. After the students who finished early left the room, mostly women of color remained taking advantage of the allotted time. “Once you start seeing everybody getting up before you and you look around and see only Black women left, like, why are we the only ones still here working on this? It does kind of derail your confidence,” Mickey explained. “But the stuff [the laboratory instructor] would say just made us feel worse, and I feel like he did it on purpose, to get at us, you know?” she said. Mickey continued, “he would say things like ‘if you are still sitting here working on this, then you don’t know it, you need to go home and study.’
Mickey described how his actions made a tense and uncomfortable situation even more stressful for her. She already felt anxious about taking a timed quiz because she knew how important good grades in science courses were to her admission into a nursing program. Although the remaining students were still within the allotted time provided for the assessment, Mickey felt her laboratory instructor’s comments indicated that he did not expect the Black women remaining to be successful. “Even while we taking the test in the time you gave us,” she said, “you making us feel like all of us left are going to fail because we haven’t studied or whatever.”

Another day after the laboratory instructor returned several graded assignments, few of which Mickey did well on, she walked out of the laboratory to call her mom because she was upset about the low scores. When she walked back in the laboratory, her laboratory instructor said to her in front of the class, “well, I’m glad you decided to come back because I had just told the class that people who give up and walk out, people like that end up dropping out of school – they become college dropouts and just another statistic.” Mickey was shocked and embarrassed that he essentially labeled her a college dropout. She explained it like this:

I was like whoa – you been talking about me without me in the room? First of all, how you gonna say that I’m quitting school and I’m going to be a college dropout? You don’t even know why I left the room; you have no reason to automatically assume that about me, that as a Black woman you think I am going to drop out of school and become a statistic? And second, what is the point of even saying that to the class? To shame me? To make me look bad? That really pushed me over the edge with that man.

After her laboratory instructor said what he did to the class about her coupled with her immense frustration with his teaching, she did not see how it would be possible to remain in his laboratory class. She said to him in front of the class, “I am done, I do not want to be in this class anymore,
I have to take this course, but I don’t have to take it from you. I will explain to the Chairman why I am leaving this class.” Mickey described how her laboratory instructor’s demeanor changed when she made that announcement because not only was he aware of her frustration, but the rest of the class which was largely non-White students seemed to be against him as well. Her laboratory instructor then took Mickey to the back corner of the room and said that going to the Department Chair was not necessary. “I know this man and how he is,” said Mickey, “but the minute I said I was going to tell this story to a higher power and explain why I wanted to take the class from someone else, now he was trying to convince me otherwise.” She continued, “It’s not even like he said he cares about my education or my well-being or that he wanted me to be successful, he just didn’t want me to explain what happened and how he is to the Department Chair – it was all about protecting himself at that point.” Mickey believed her laboratory instructor had become accustomed to getting away with using his institutional power to intimidate and belittle students. Mickey spoke with her chemistry lecture professor, an older Black male, about her experiences in the laboratory course. Her lecture instructor provided the contact information for the Science Department Chairperson. Mickey discussed her experiences with the Department Chairperson and shared his contact information with several classmates who were having similar issues with the laboratory instructor.

An additional way Mickey felt negatively stereotyped by her laboratory instructor was the way he assigned partners to perform an experiment. “He would usually partner the Black women with a man or partner us with someone of a different race,” she observed. She further explained:

I noticed we would never be working together; it would always be a Black woman and someone else. At first, I thought he was doing that to maybe introduce us to diversity or
something because he don’t want us all working together, but then I realized he was probably like, “well they may not be able to get it on their own, so let me put her with someone who can show them how to follow directions and get this experiment done – they probably gonna need someone to help them.” It’s like he thought all the Black women were going to need a babysitter to finish the assignment.

Mickey’s experiences of feeling negatively stereotyped not only made her question her ability to be successful in science learning spaces, but it also affected her on a deeper level. After she left the chemistry laboratory course, due to college policy, it was necessary that she withdraw from the co-requisite lecture course too. Mickey was doing well in the lecture course and had a positive relationship with her lecture instructor. Due to the anxiety and stress of what she experienced in the laboratory course, Mickey sought counseling through the student counseling center to help her deal with and make sense of her experiences. “It was not good – I had anxiety, I was depressed, and I was discouraged…. the whole experience showed me that one person, [the laboratory instructor] had all the power and I didn’t have any,” she explained. In addition to negatively stereotyping Black women in his laboratory course, Mickey felt he routinely displayed a condescending and arrogant attitude towards students of color. In general, Mickey felt her laboratory instructor was “nicer and more respectful to Caucasian students,” than to others. A bi-racial friend, the same friend whom Mickey described as an Oreo because she had the ability to fit in with both Black and White students, pointed out that some of the comments her laboratory instructor would make were racist, but at other times she would defend the laboratory instructor telling Mickey she was being too sensitive.

**Arrogant attitude.** Mickey had a difficult time negotiating the “my way or the highway” attitude of her chemistry laboratory instructor and he frequently tried to make jokes
during the laboratory class that she found offensive. For example, if students asked questions, he would ask them if they have a learning disability. Assignments in her laboratory course included laboratory reports, worksheets, pre-and post-laboratory questions, and quizzes. In a laboratory exercise on measurements and unit conversions, Mickey’s laboratory instructor attempted to explain how he wanted the problems worked, but it did not align with the way her lecture instructor had explained the material. Mickey understood how to solve the problems in her lecture class, but her laboratory instructor insisted she work the problems using a different method which she could not understand or follow. After meeting the laboratory instructor to go over the assignment during his tutoring hours and still not following his reasoning, Mickey sought the help of the TRIO science tutor and her lecture professor. Neither of them could make sense of the reasoning of the laboratory professor, but both agreed on the way to set-up and solve the problems in question which was different from the way her laboratory instructor required that it be done. She brought the work that the TRIO tutor had helped her with, and her lecture instructor said was correct to her laboratory instructor, and he said: “No, this is all wrong – this is not how I want it, this is not how it is supposed to be done.” Mickey explained her frustration about this in the following way:

It seemed like he was trying to do shortcuts, but I was so confused by what he wanted, I needed him to go step-by-step like I need to know why you are moving this variable here and what does that variable stand for? I was familiar with how to solve the problems because we had already covered it in lecture, but the way that he wanted us to do it was confusing – there was only one specific way he wanted us to solve the problems, and if we didn’t do it his way, it was wrong – even if we solved it and got the correct answer. He would say, “No, your answer is wrong because of the way you solved it.”
These sorts of interactions left Mickey feeling frustrated and discouraged. She was worried about her grade point average and how a low grade in the laboratory course would affect her ability to get into nursing school. “In the nursing seminars, they would stress to us how important grades in science courses are…we have to do well in all of our science courses if we want to get in,” she explained. As the semester progressed, Mickey set up multiple meetings with her laboratory instructor to let him know she was struggling in his class and to ask for help, but she felt like he did not care. “He would say, ‘just go to the website and work more problems’ I really can’t help you if you are that confused,” but Mickey knew from talking with many of her classmates that almost everyone she spoke with was confused and making poor grades in his course.

Due to my institutional positionality inside of the science department, I can confirm Mickey’s suspicion. Her laboratory instructor had one of the highest student failure rates in our department. Ultimately Mickey attributed her laboratory instructor’s way of doing things to his personality. She said, “He had that attitude, it just seemed like his personality where if it doesn’t go his way or someone disagrees with him, he just doesn’t care because he is in charge and it’s his class – so it’s his way or no way.” Her laboratory instructor’s way of being in that science learning space distressed Mickey because she knew how important science classes were for her entry into nursing school and she believed failure in these spaces was not an option. She worried, “are all of my science classes going to be like this? Because if so, I want to run and I don’t want to do it – I can’t survive it, him, the way he is – he pushed me to my breaking point and made me seriously reconsider my ability to make it into nursing school.”

**Disorganized and inattentive.** Mickey’s negative experiences inside the chemistry laboratory were compounded by her instructor’s lack of organization, lack of preparedness, and
poor time management. She said he would often arrive late and not offer an apology. This frustrated Mickey because promptness is a trait that is expected of students, but that he was not held accountable nor did he take responsibility when he was late felt unfair and disrespectful. Frequently the materials needed for experiments were not out for students, and the instructor would tell the students who brought it to his attention to just “do the best you can – be resourceful, I’m not a magician.” Mickey felt this lack of attentiveness encouraged some students to cheat because “if he don’t care, then we don’t care,” and some students would sit in the back and make up fake data or copy an experiment from someone who took the course in a previous semester.

Regarding time management, Mickey described how her frustration would build when her laboratory instructor would waste time at the beginning of the class telling jokes or unrelated stories which would cause the students to have to rush through the experiment. She said:

We wouldn’t always have time to finish our labs because when we would come in, he would be talking, but what he was talking about didn’t have anything to do with the experiment that day…so he would just be talking, but no one seemed to really be understanding and he didn’t care that we don’t understand. Sometimes he would give our papers back and we’d compare grades, and it was just so discouraging, then he would give us a quiz on the papers he just returned which was a total waste of time because no miracle occurred between when we didn’t understand it then and now…The only quiz we all passed was the one on lab safety (laughs) - that’s probably because he didn’t teach it, we just watched a video that someone else put together.

The laboratory instructor’s lack of interaction with students during the experiments was also a source of frustration. “He would just sit in the front on the computer,” she said, “we would
always have to come to him – he didn’t know what we were doing, or if he did, he didn’t care.” Mickey felt she would learn better under different circumstances. She explained, “I know that he was not the type of professor that I needed – I need somebody who is interested in us and cares about our progress – I need a professor who is organized and willing to share intel in a way that makes sense.” Overall, Mickey felt as if the environment inside the chemistry laboratory was confusing, chaotic, and more difficult than it needed to be. This left her feeling disappointed and nervous about passing a science course that was required before she could apply to nursing school.

**Positive Experiences in Science Learning Spaces**

Mickey’s science learning trajectory was supported by her chemistry lecture professor, an older Black male, whom she described as helpful, attentive to students, and encouraging. Her positive learning experiences can be placed into two broad categories: (1) Her lecture professor treated students as individuals, and (2) he was caring and encouraging.

**Treated students as individuals.** Mickey felt noticed and heard when she was in her chemistry lecture class. Her lecture professor noticed a change in her and showed concern. Mickey explained:

That is something that I appreciated about [my lecture instructor] because there was a point in his class when he noticed that I started to fall back because of what I was experiencing in lab, he was able to realize that. He didn't wait for me to come to him, he didn't shy away from stepping out of the box and coming to me - because sometimes that is what a student needs - they need maybe that one time to just come and show me that
you care and that you are paying attention to me – that I’m not just another student
number on your roster.

Mickey felt engaged with on an individual level which had a huge impact on her well-being at
the time. She felt her lecture instructor recognized the importance of seeing students as
individuals. “He let me know that he knows who I am and he listened to me,” she said and
added, “professors would be amazed at what they could find out just by listening to students.”

Another way Mickey felt her chemistry lecture professor treated students as individuals is
by making eye-contact and walking around the classroom engaging with students as he taught.
She described feeling confident and capable in lecture and, although the pace seemed fast at
times, she felt her lecture professor made an effort to reach out to different types of students,
regardless of their race or gender, and keep everyone involved when he asked questions in class.
“He made eye contact with us frequently,” Mickey said, “which let us know he was gauging
whether or not we were up with him – if we were following what he was talking about.” She
described a sense of relief when she compared the way she felt about her laboratory course with
her lecture course saying, “lab may not be going too well, but at least I'm not coming in here all
confused - I feel like I'm doing some part of chemistry right.” Even after his lectures ended,
Mickey explained he would ask if anyone had any questions or any remarks which made her feel
that “he made an effort to meet our needs – he put the extra foot forward to make sure he wasn’t
just up there talking for an hour and some change, he made sure the information went into our
brains and stayed there.”

**Caring and Encouraging.** Mickey felt that another way her lecture instructor showed he cared
for students was the course materials he put together. He provided PowerPoint slides, course
notes, homework, and followed the textbook. He also often showed them that there was more
than one way to solve or set-up a problem. Mickey remarked, “There was not a time that I walked out of his class and didn’t understand what was said or was taught to me; even if something was said that I didn’t understand because he was moving fast, I could go back and figure it out for myself because I was given the resources to do that.” Mickey explained she was the type of student who enjoyed working problems because the repetition and practice gave her confidence and clarified the science content. Her lecture instructor provided multiple resources for his students to be successful in addition to being attentive to their needs in class. When Mickey shared with her lecture professor that she was going to withdraw from the laboratory course because she found working with her laboratory instructor nearly impossible, he provided the contact information for the Science Department Chair and encouraged her to contact him about the situation.

When Mickey talked about her science learning with her lecture professor, her demeanor was different than when she spoke about her chemistry laboratory experiences. Her words were faster, the delivery was brighter, and she was upbeat. The positive experiences flowed from her with more energy than did the negative experiences. Being positive seemed to be more in alignment with Mickey’s disposition in general. Her lecture instructor made it possible for Mickey to have a positive mindset about her ability to master science content while her laboratory instructor made her doubt she could be successful in science learning spaces.

**Advice to Black Women**

Mickey offered a great deal of advice to Black women who will be taking science courses especially those Black women who will enter science learning spaces filled with apprehension as she did. She explained Black women often enter science classes with a mindset of defeat and the feeling that other types of students are better in science than they are. “In our eyes,” she
explains, “I would say sometimes we look at science as if, you know, others are destined to succeed, we feel they are better than us in some subjects, like thinking that Asians are smarter, and if you always have that with you, it tends to derail your confidence.” She wanted other Black women to know that they are not alone and to seek out help as soon as possible. The resources and support she had through the TRIO program were invaluable to her in terms of the counseling provided by the coaches, academic support of the tutors, and camaraderie she felt with other TRIO students.

She explained knowing the type of learner you are, such as an auditory, visual, or kinesthetic learner, before taking a science class is important as is having an awareness of the type of professor with which you are most comfortable. Paying attention to the tone the professor uses towards students and the energy he or she presents on the first day is essential. Mickey explained,

Listen to the way the professor makes you feel on the very first day – the way I felt with [my lecture professor] was very different than the way I felt when I met [my laboratory instructor]. My lab instructor just talked and talked, looking straight ahead, not making eye contact, no engagement with us versus [my lecture professor] who I could tell was actually looking around and paying attention – you could tell he cared whether or not we were listening and he wanted us to understand what he had to say.

Mickey had a hunch that her laboratory professor might not be a good fit for her on the first day, but told herself “give him a chance, don’t be too judgmental.” She felt as if she stereotyped him unfairly when he first came in because he was a few minutes late, slightly disheveled, and seemed disorganized. She made note that he did not apologize for being late, but instead, he joked that he was getting old and said he could not find a parking place near the building. “You
know those times when you feel like there are two people on your shoulders telling you completely different things?” she asked. She laughed and said, “I listened to the one who told me to give him a chance a little too quickly, and she threw me off track – I should have listened to the one on the other shoulder when I knew it didn’t feel right for me!”

In addition to Mickey’s advice for Black women to follow their gut instincts about science professors, she recommended sitting in the front, middle section of the classroom because students who sit in that area can see and hear better and they are less likely to be distracted by the actions of other students. She added professors tend to look at the students in the front row more often than at the students in the back and on the sides of the classroom and it is easier to “stay in-tuned with the professor because you are right there, sitting face-to-face – professors can pick up on whether or not you understand if you are sitting closer to them.”

Finally, Mickey strongly recommended women use websites that provide student feedback such as ratemyprofessor.com and to speak with another student, preferably more than one, who has taken the science professor who is being considered. Mickey searched for her laboratory instructor on that website, and at the time she registered, but there was no listing for him. She said his noticeable absence from that website was concerning to her and a topic of conversation among her classmates while they waited outside for the instructor to arrive on the first day.

When I asked what meaning she attached to the instructor not being listed on the website, she pointed to her shoulder referring to the two figures sitting on her shoulders again, shook her head and said: “I should have listened to this one.”

Advice to Science Professors

When asked what she wants science professors to know about how to create supportive environments for Black women in science learning spaces, Mickey immediately responded,
Make your students feel *comfortable* – make them feel like no matter who they are or what their race or gender is – they have an open pathway to you…show me that you care and that you are paying attention to me, that I’m not just another student on your roster and please, *please* see me as an individual – don’t lump me into a category to make it easier for you to deal with me, let me know that you know who I am.

These sentiments were expressed in a strong, clear, and passionate voice. Because Mickey had these suggestions to science professors so readily accessible in her consciousness, I had the impression she spent a great deal of time thinking about her chemistry laboratory experience and what could have gone right, instead of the way it turned out for her. We sat in silence for a few moments before she added, “And listen to your students, be open to suggestions – when they tell you they don’t understand what you are saying, *believe them.*”

Mickey also stressed the importance of organization for science professors. “Students need to know that you care enough to prepare materials so that we *can* learn,” she said. “If we come into your lab and you have nothing written on the board, no materials prepared for us, no chemicals or whatever out for us, what effort have you made?” she asked. Mickey, on some level, associated science professor organization with caring. If a science professor makes an effort to be organized by writing an outline on the board, connecting lecture material with textbook material, and managing time spent in science learning spaces in a way that maximizes student interaction and learning, then that showed Mickey that the science professor cared about the students.

**Conclusion**
Mickey was passionate about becoming a nurse, but the challenges she encountered with her laboratory instructor were overwhelming and too difficult to overcome. She attempted two science courses and was successful in the lecture component, but due to an institutional policy which required students to withdraw from both science lecture and laboratory courses at the same time, Mickey did not complete either course. Although Mickey entered college science learning spaces with an eagerness to learn science and considered herself a “science person,” the interactions with her laboratory professor made her question her ability to complete the requirements to earn a degree in nursing, and she began to consider other degree options.

Mickey’s experiences in chemistry laboratory were appalling. Her instructor was openly racist, poorly prepared, arrogant, and unprofessional. His ability to act as a gatekeeper, with the power to disrupt Mickey’s science learning trajectory by needling at her self-confidence was apparent. He did this by making racist comments (references to slavery and the assumption Mickey would be a statistic by becoming a college dropout), telling students that if they don’t finish a test early, then they were not prepared, and his “my way or the highway” attitude when problems were solved correctly, but were not presented in the way he wanted. Fortunately, Mickey exercised her power by speaking with the Science Department Chairperson about her experiences and encouraged other students to do the same. Unfortunately, there is no system in place to keep track of complaints of this nature or make them available to students, so it is possible that systemic racism will continue to occur inside science learning spaces where professors are not challenged in a meaningful way about their beliefs and how those beliefs may affect their teaching.

Mickey believed there is a “target on your back as a Black woman” in male-dominated fields, so Black women “feel like we always have to prove something,” which gave Black
women a special strength that was unique to Black women as a result of their intersectionality. She felt that “determination and drive are the advantages of Black women in science” learning spaces. However, even with these psychological buffers in place, Mickey’s science professor was able to break her, at least temporarily. He derailed her confidence and made her question her ability to become a nurse. Due to the anxiety and stress she experienced in her laboratory course, Mickey sought counseling through the student counseling center to help her make sense of the interactions and reconcile her reality that “one person, [the laboratory instructor] had all the power and I didn’t have any.”

Mickey’s insights on colorism/shadeism and her observations that bi-racial and lighter-complexed Black women have different experiences than darker-complexed Black women inside science learning spaces was noteworthy. Based on the history of slavery, there is a preference for Black women with lighter skin (“darker-skinned people were not up in the Big house, we outside working because of our complexion – we are not as light, or as superior, or as wanted, as someone with fairer-skin”). Mickey believed Black women who have a lighter-complexion are more likely to have positive experiences inside science learning spaces than other Black women. Mickey is the third of five participants to acknowledge colorism/shadeism in science learning spaces. At the time this research was completed, Mickey was eager to begin chipping away at the science requirements needed for nursing school. She had just registered for classes and was looking forward to taking her chemistry lecture and laboratory courses from a different professor.

**BECK**

**Overview of College Science Experiences**
Beck was a Journalism major who completed a total of four science lecture and laboratory courses. She described generally positive experiences inside science learning spaces. Both of Beck’s science professors have been men younger than Beck. One professor was White, and the other was what Beck described as foreign. Although Beck spoke a great deal about racism in the U.S., she did not notice racism in either of her science professors, and she did not feel negatively stereotyped inside of these spaces.

Background

**Biographical Information.** Beck is a 58-year-old politically active writer who is lively, self-assured, and engaging. She is involved in campus political organizations, worked with the Associated Press covering the most recent general election at a polling site in a nearby county, and wants someday to become a motivational speaker. Beck is an avid reader, a trivia buff, and plans to travel to Curacao and Aruba when she graduates at the end of this semester. She keeps lists of the books she has read, the films she has watched, and the places she would like to visit. Her favorite book which she has re-read recently is *Nectar in a Sieve* by Kamala Markandaya which is set in India in the 1950s. She has already booked a place to stay in Curacao and is actively learning the predominant language of the islands, Papiamentu. Beck moved from New York to Georgia because “she didn’t want New York City to be the only place she called home” and she does not want America to be the only country in which she has lived. Beck was married for a brief time but is single with no children now. She has a wide variety of interests and loves to learn for the sake of learning. Beck believed research studies centering Black women are important because Black women are a “special group that nobody pays attention to.” She has been a part of a longitudinal Black women’s health study by Boston University for the past 20 years. She likes being involved in research studies because “being involved allows her voice to
be heard” and she “needs to know that her opinion counts.” Beck shared that having her opinion heard was important to her and that was the primary reason she was interested in being a part of this research.

Beck grew up in the Bronx, NY in the 1960s with both parents. After finishing high school, she attended Lehman College for a few semesters, the Fashion Institute of Technology in New York City, and worked for New York Telephone for several years. Her father was a preacher. “I had a sheltered life because my parents were very religious” she explained, “we did not have a TV in the house, so I spent my spare time reading encyclopedias.” She enjoyed reading from an early age, and she and her mother would visit the Book Mobile, similar to a mobile library, and read the daily newspaper together. Beck’s daily routine includes visiting the campus library to read newspapers. She prefers the New York Times and Wall Street Journal over newspapers like USA Today because “USA Today and [our local newspaper] are written in a way that targets people who don’t read well.” At the time of our first interview, she was reading *The New Jim Crow: Mass Incarceration in the Age of Colorblindness* by Michelle Alexander. Beck explained the book was about the war on drugs in America and how it largely targets young Black men, “It’s a racial thing, simple as that – Michelle Alexander spells it out so clearly.”

Beck is active on social media and often posts her views about race, racial differences, and racial identity. Over a two-day period, she shared and commented eight different times about *The Whiteness Project*, a documentary investigating how Americans who identify as “white” experience their ethnicity. In a recent public post she shared, “All my life I have been aware of the different names used to describe ‘us.’ Negro, Colored, Black, and African-American. Now it’s American of African Descent. When it comes to race in America, it is still a
complex issue.” Recently she has shared and commented on articles such as “History Insists on Covering Up the Intellectual Production of Black Women, Even in the 21st Century” and “The Third Rail: Race and American Public Transportation Advocacy.” She urged her followers to watch a TED talk titled “We Need to Talk about an Injustice” by a human rights attorney discussing the massive imbalance in the American justice system that falls along racial lines. In a social media post not long after our first interview, Beck asked, “Yeah, and, what are they going to do about it? And this is but a tip of the ‘big ole iceberg’!” about an article she shared about the U.S. Supreme Court upholding that racial bias must be addressed because “racial prejudice is antithetical to the functioning of the jury system.” Beck has faced racial discrimination in her search for housing, and she suspected it has also been a contributing factor to her being unemployed.

At the age of 53, Beck decided to return to school to get a better job. “I knew I had to go back to school because I wasn’t having any luck getting a job and I knew if I went back to school I could get a work-study, that would be some income and then other opportunities would open up for me, which I’m still waiting for,” she said. Beck described herself as part of America’s working poor population which she explained meant her income falls below the poverty line. After our initial greetings, the first topic we discussed was that she had entered my contact information into both of her phones, one of which is her “Obama phone.” “If you get food stamps, you are entitled to a free Obama phone,” she explained. She makes a point to use public transportation every day, even if it is just to ride somewhere for coffee because she buys a monthly pass and she does not want to waste the opportunity of using it. She visits the school library every day to read hard copies of the newspapers, sometimes removing them and returning them the next day. “I know I’m not supposed to, but I want to have the hardcopy because I find
that in the online version, not all of the articles are accessible in that format, so I usually come
down to [a library on campus] to read the Wall Street Journal and to [a different library on
campus] to read the New York Times.”

Reading current events and staying informed so that she “can have a meaningful
conversation with anyone of any color, gender, age, or occupation” is important to Beck. She explained that she felt comfortable having a conversation with anyone she meets under any circumstance. “I am not a feminist,” she said and Beck does not believe that woman are “scientifically equal to men, not Biblically anyway, and they shouldn’t be.” She has a strong belief about the way men should be and the roles they should have in society. The identities that Beck most strongly identified with were, “Black woman, American, bald, and straight.”

Beck referenced the interrelatedness of socioeconomic status to race multiple times
during our conversations and frequently connected the history of slavery in America to her and other Black Americans’ socioeconomic status. “I feel like Black men and Black women are equally on the bottom because of slavery, and we are still living like that…it’s never going to end you know, it’s deliberate,” she said. Beck added, “Some of us got to be rich, and some of us have to be poor, and they determined who is going to be poor after Bacon’s Rebellion in the 17th century when wealthy Whites offered poor Whites land and other freedoms to drive a wedge between poor Whites and poor Blacks.” She shared that she is currently watching a movie on YouTube called *Slavery and the Making of America* (six hours narrated by Morgan Freeman), and it described how White people could eventually get out of being poor, but that poor Black people do not have the same opportunities. “Poor Whites and poor Blacks have the same enemy” Beck explained, “but the Black people who try to do anything about it always get killed – Martin Luther King, Medgar Evers, Malcolm X, the Black Panther in Chicago – Fred
Hampton, they get taken out – they cannot live out their lives if they try to unite poor Whites and poor Black people…it keeps us separate and the Blacks are lower – what is an easier way to identify a slave than if they have dark skin like me?” Beck described how she becomes frustrated when she hears people talk about how things in America have changed, “what the fuck has changed?” she asked. “How come I don’t have a good job, and I’m not wealthy, at my age I shouldn’t be worried about a job – I should be able to live wherever I want to live and not have to struggle to survive – the racial thing is never going to end,” she said. Beck is set to complete her Associate of Arts degree in Journalism. She is currently taking the last two classes needed to meet the requirements for graduation and is looking forward to traveling and writing.

Relationship with Researcher. I did not know Beck before our first interview. We met at a trendy local coffeehouse which she chose on a Saturday morning. We exchanged emails, talked on the phone, and texted prior to meeting face-to-face, so I had an idea that she was energetic, straightforward, and friendly. Beck texted me 10 minutes before we were supposed to meet to let me know she was sitting outside on the patio and asked me if I knew what she looked like, I said “no,” and she said, “I’m the one with a bald head.”

Beck had strong opinions about a wide variety of topics. She easily and frequently recalled different books she has read and explained why she agreed or disagreed with various points of view using current events and news stories to emphasize her points. Beck prefers “people of color” or “Black” over “African American” because “when you say African American to me, in White people’s minds that means you are the lowest on the totem pole because your ancestors were slaves.” She comes across as resourceful, courageous, and streetwise. She arrived earlier than our scheduled meeting time so that she would have time to study for an upcoming criminal justice test that was the following week. Her criminal justice
class notes were spread out on the table when I arrived. She told me how much she was enjoying her criminal justice class and the instructor who, coincidentally, I have worked with professionally in the past. I knew first-hand that her criminal justice professor, a retired White male police officer, is comfortable making race-based assumptions and that he does not go out of his way to be politically correct. I was surprised that Beck described him as “funny” and “a real character” at the beginning of our first interview.

During our first interview, Beck had only positive comments about all of her college instructors, regardless of the subject or her interest in the class. This changed during our second interview when she half-joked that the same criminal justice professor could be a member of the Ku Klux Klan. Approximately four months passed between our first interview and our second interview. In that time, we had become better acquainted on various social media platforms and had communicated via email and text message about questions I had from our first interview. During our second interview, I asked Beck if she would have responded differently to any of my questions if I were a Black researcher and she immediately answered “Yes.” There were other differences between our first and second interviews. In the second interview, Beck shared more polarized views about racial differences, Whiteness, and use of “the race card.”

At the end of our first interview, Beck shared the contents of her Journey Book which was a journal-type notebook that contained her handwriting. She had already started writing down and memorizing important words so she could communicate in the Papiamentu language when she arrived in Curacao after graduation at the end of this semester. Our first interview lasted over 90 minutes, and we continued to talk as we walked out of the coffee shop towards our city’s public transit station. Our second interview took place on campus in a small classroom in the science building on a Friday. Beck chose the location for the second interview because she
was already planning on coming to campus to use the library. Our second interview lasted almost two hours.

**Racial Colorblindness**

Beck’s views about racial colorblindness, in general, diverged from her views about her science professors’ ability to be colorblind. Beck said of racial colorblindness:

> It means you look at a person and don’t see the fact that they are different or that they are whatever color they are. It is one of those lies that we want to believe – it is just a lie, and I don’t understand how people can claim that because the first thing we see in each other is color – people of color do not use the word colorblind…it’s mostly White people who use it, they act all doe-eyed and confused saying ‘I don’t see color’ - I hate that.

However, during our first interview when asked if she felt like her science professors were colorblind, she paused briefly and responded,

> I would have to say yes (pause), yes because I don't feel like what we were doing they had to, to not be (pause). You know that whole thing with colorblindness, it's just - people seem to think that they don't do it, but - ummm - you hear all the time about people losing their job or something happening, and it's just - I think that the people who can say that they are not colorblind - they're always in a position where they can ruin somebody's life - without thinking that is what they are doing, but they know it is wrong what they are doing - they know…”

Beck acknowledged people in power, those with authority over others can claim to be colorblind and continue operating with racist attitudes and assumptions and those attitudes and assumptions could ruin a person’s life. However, she did not align her science professors with people in such
powerful positions and made the assumption that both professors were colorblind because there was not a legitimate reason for them not to be. I probed Beck about this assumption later, and she stated again, “I would have to say that they are colorblind because I can’t see for what reason they wouldn’t be.”

In the second interview, I asked for clarification about how she can feel racial colorblindness is a lie and hold to the belief that her science professors were colorblind. She said,

[Professors X and Y] never claimed to be colorblind – it is damn near impossible to say you are colorblind in America because race is always there, we are a racially divided country and anyone who says anything different is either lying, ignorant, or straight-up crazy. I don’t believe either of them associated anything negative or bad with skin color, at least I didn’t get that impression – believe me, I know overt racism when I see it, now [my criminal justice professor] he is a different story, he makes race-based assumptions about Black people and doesn’t even try to hide it.

Beck has strong, but complicated views on race and power. Beck saw colorblindness as not associating or ascribing negative traits to people based on their skin color, not just not seeing color. To Beck, since she did not see evidence of either of her science professors associating negative traits to Black students, she assumed they were colorblind. She is familiar with a professor associating negative traits to Black students, but it was a White male criminal justice professor. It is noteworthy that Beck only shared this with me during her second interview.

Beck shared that Black people, and she assumed White people did too, want to know immediately when something bad happens if the person committing the offense is Black or
White. If something bad happens, she said she might say “yeah, this White lady” and she believed White people probably would say “yeah, this nigger did such as such.” At the time of our second interview, a high-traffic bridge had just been damaged, and a Black man was arrested for the incident. “As a group of people, Black people always want to know who did the bad thing – if it turns out to be a Black person, we are all like ‘aww fuck, that just means White people are going to be saying ‘those niggers burned down the bridge’…if something bad happens, the first thing everybody is going to think is that a Black person did it.” Beck also shared that when she watches forensic science and real-crime shows – “you know what I’m thinking when I’m watching? I hope the guy who did this is not Black – and when you find out he is, I’m like, ‘well fuck’…”

**Addressing Researcher Whiteness**

“Have you read the *History of White People* by Nell Painter?” Beck asked during our second interview. Beck had started a paper for her American Literature class on Whiteness, but then chose to change the topic because “it gets so complicated when you talk about the history of White people.” Beck summarized a book she read about how the Irish became White and compared the conditions of Black people under slavery to the conditions Irish immigrants faced in early 20th century America. “The Irish immigrants’ conditions were much worse than the slaves,” she said and added, “when it came to Irish people, they would say that it was just as good to kill an Irishman as it was to kill a nigger.” Beck distinguished herself from other Black people in some ways. For example, when she discussed the race card, she explained that some Black people “use the race card to get people to feel sorry for us, like ‘Oh, I’m Black, and I’m poor, and I grew up in a poor neighborhood, poor me’, I don’t have time for that” she said. She wanted me to know that she is “smarter than the average bear”, “that she is not one of those
dumb people who accuses every White person of being racist”, and that she is “not trying to hide her darkness although some Black women do” (then recommended that I watch Dark Skinned Girl on Netflix). She shared that some Black women, mostly younger students, will say that a professor does not like them, or that the professor is mean to them, “but really” Beck explained, “they are just trying to avoid hard work.” Beck is aware of racism/systemic oppressions and holds Whites mostly responsible, but also blames Black people on some level too. She seems to distance herself from other Black people at times as well as the history of slavery. Beck was proud when people asked her where she was from, “they don’t think I’m American” she said, “probably because I’m bald and confident, they think I am from somewhere else, and that is okay.” She went on to say, “If you are American they know that means you have roots in the African Slave Trade and they know somebody from your family came from Africa as a slave for you to be here in the first place.”

I am intensely aware of my Whiteness when I am with Beck. She is more knowledgeable and more informed than I am about racial differences, American history as it pertains to race, and the politics of race in the U.S. Beck frequently talked about slavery, economic oppression, and the negative lens through which White people view Black people in America. “I feel like it is never going to end for Black people” she explained, “we fight, fight, fight but still, here we are in the 21st century and if you are a Black person, it is still bad for you – even during slavery there were successful Black people, but just like today, Whites did their best to keep them oppressed.”

When I asked Beck if she would have responded differently to any of my questions if I were a Black researcher and she immediately answered “Yes.” She continued “I would be in it with both feet, and I wouldn’t hold anything back – we’d be like ‘and that White bitch, you know what that White bitch said to me’ and you know I would really, really get down to some stuff.”
She described how it would be different if I were a Black woman because I would have experienced some of the same things that she had experienced and it would be easier “to tell me more and to go deeper.” For example, she asked if I had ever gone into a store and had the women who work there act like they did not see me because they did not want to help me or assumed I could not afford to shop in their store. She added, “Or have a White woman not want to touch you when they are handing you back your change?” I admitted I had not experienced anything like that and began to understand what she meant. “About responding to you differently if you were Black – yeah, I would that is just because a Black woman would have experienced some of these things, and she would totally get it” she added, “it would be different, although I feel like I have been fairly honest with you and I guess it’s because I feel comfortable enough to say whatever I need to say.”

I recorded in the researcher journal after the interview that I wondered if I represented the nebulous White woman image to her in some way and realized I must on some level because I am a White woman. Although “white” is not one of my identities that comes to mind first, I assume that is how others likely classify me, especially my participants. I also wondered what “fairly honest with you” meant to Beck. I did ask if she would have shared anything different about her science instructors and how she experienced science learning on our campus and she responded “No, not really” as she shook her head side to side.

**Interactions with School Science**

Beck attended a vocational high school where “they didn’t stress academics as much, their goal was to teach us a trade.” She believed math and science go hand in hand and to her, math is scary, and she does not like it. “That is why I have always had anxiety with science; it’s the embedded math, you always have to go through the math” she explained. She strongly
disliked the memorization of formulas in math and related that to her high school science and math learning experiences as well. Beck believed that there was a racial component involved in learning math and that having a math phobia is a taught fear. “You know it has been said that Black people are not good at math or science” she shared. When probed about why a person’s skin tone would impact his or her proficiency in math or science, she immediately replied, “I don’t know, that is just the way it is.” After a fairly long pause, Beck added, “I think it is just a perception really, because if Black people were afforded the same education as White people from elementary through high school and college, then we would be just as proficient in math and science.” The only aspect Beck enjoyed about high school science was using test tubes and mixing chemicals together. “That part was okay I guess,” she said.

Beck has taken a total of four science classes and laboratory courses to fulfill the science requirement to graduate with an Associate of Arts degree in Journalism. Beck enjoyed college science classes and had mostly positive experiences with both of her male science professors. She took the Astronomy I and II sequence to fulfill the science requirement to earn her Bachelor’s degree in Journalism and chose astronomy because the other science courses had too much math embedded in the content. “My last math class was a bitch; I barely got a D…you could boil me in oil before I take a math class again,” she said describing her feelings about the last college math course she took. She described her first science professor, who was also her lab instructor for the course, as a foreigner with a thick accent. “He was kind of soft-spoken and nice” she explained, “I felt like he was too nice and some students took advantage of him, I feel like it’s a cultural reason for why they treated him the way they did – because they felt like they could because they considered him a foreigner.” When the other students, mostly Black males who sat in the back of the class, made fun of him she dismissed it as young guys being immature
and essentially just ignored them. His accent made it difficult for her to understand him, but she quickly explained that she learned in a college seminar course it is up to the student to make adjustments if there are challenges in class, such as an instructor with a heavy accent. She explained “you have to make the adjustment – not him, YOU need the degree, so that means you make adjustments,” so that’s what she did to succeed.

Beck’s science instructor for the second astronomy course, a White male younger than Beck, was her instructor for both the lecture and the co-requisite lab course. She described him as a quiet American who was not as harsh of a grader as the instructor she had for Astronomy I. “You can tell he’s extremely shy, he seemed to be almost fearful like someone is going to bite him or something” she explained. Her second science professor wrote the lab manual and parts of the way it was written frustrated Beck because “it only infers certain things, it doesn’t come right out and tell you, so sometimes I would get really frustrated in lab.”

Beck took notice of the differences between science learning in K-12 grades compared to college science learning. She explained doing “hands-on things in grade school science made it more exciting and memorable” than what she did in college science classes. She remembers her biology teacher in high school telling her she had done an “excellent job dissecting her frog” because “I’m kinda OCD about some stuff and I was really, really neat and organized with the dissection…she noticed that and told me so.” The science labs she took in college were more focused on using laptops and computer programs which she found less interesting and more tedious. “Most of the time in lab,” Beck explained “we’d just be working on the laptops and be like ‘Damn, when is this ever going to end?’” Beck explained that the strategies she used for most of her learning, including science learning, came from the college seminar course she was required to take during her first semester. The action plan she used in both astronomy lectures
was “see it, read it, say it, and write it,” the same strategy she implemented for preparing for her criminal justice test the first day we met.

**Views on Black Women in Science Learning Spaces**

As a Black woman in college science learning spaces, Beck says that she has never personally experienced racism or sexism. She explained “I can’t say that I’ve run up against anybody trying to, ummm, oppress me because I am a Black woman – not on our campus because I can speak up for myself, I don’t need anyone to speak for me, and I know how to say what I need to say.” She believed Black students, Black men more so than Black women, have the advantage of benefitting from government grants to support non-white STEM students and that Black men are helped more when there are actions taken to “level the playing field.” “There are more government funds to help African Americans – they target males, but really anybody could join, and so the advantage was that there are *funds* being given out for us to get extra tutoring, extra help in math and science classes because we know that is critical because there are not enough African Americans involved in math and science fields” she explained. Beck believed that Black women who are nursing majors and involved with TRIO because they are required to take so many science classes, have the advantage of TRIO tutors to help them. Other students who are not part of the TRIO program have to go to the campus tutoring center and wait for a tutor to become available. The majority of TRIO students on Beck’s campus, in her estimation, are Black or non-White females.

Beck pointed out that college science students who are not Black women have the advantage of having more science-oriented classes earlier in their education. “Predominantly white institution students just get more exposure to science earlier” Beck explained, “They are encouraged more so they may have more confidence than other students in those areas.” Beck
felt that this was especially true for grades 1-6 and said: “schools that are predominantly white, those kids just get more stuff in math and science.” Another advantage she noted was that students who are not Black women were probably more “financially comfortable,” specifically that they did not need to spend time searching and applying for scholarships to attend college as Black women. She doubted that most White women spent as much time as she has looking for financial help just to earn an Associate’s degree.

As part of her core curriculum requirements, it was necessary for Beck to select a two-course sequence in computational or natural sciences. She chose Astronomy because she was told by other TRIO women that Astronomy courses did not have much math content. Both courses required a lab component that must be taken as a co-requisite. She had two astronomy professors, a foreign-born male for the first lecture and lab course and a White male for the second lecture and lab course. Beck had mostly positive experiences in all her college science courses.

**Negative Experiences in Science Learning Spaces**

Beck’s challenges in college science learning spaces involved negotiating the embedded math content in her astronomy courses, pressure to finish her lab experiments in the allotted time, and to a lesser extent, her bids for recognition and interaction with her White male astronomy professor that were unacknowledged by him.

**Math content.** Beck found the math content in the two astronomy lab courses frustrating. Even though she had completed a math course beyond the required math pre-requisite for astronomy, the math content was challenging for her. When we discussed her science classes for the first time, the first topic Beck raised was the math content and how much she disliked it. “I loved astronomy, everything about it except the math part...we mostly worked
on the math in labs and it wasn’t just me who thought it made no sense,” she said. She explained that her first professor, a male whose nationality she was not sure about (just that he was “foreign”), did try to review the “some” of the math with them, but it did not help much because many of the students were disruptive when he was trying to teach and he spoke with an accent. “He was very soft-spoken and would not discipline the students who were talking or being disrespectful in his class, and his thick accent just made it worse,” she described. Most of the math in her astronomy labs involved learning and using numerical equivalents of extremely large numbers, percentages, unit conversions using dimensional analysis, and calculating distances. “When it starts coming to things to the tenth power, then the 14th power, then the cabillionth power, I just wanted to put my head down and forget this whole school thing,” she said lightheartedly. Since Beck entered the science course with a bias against math and lacked confidence in her ability to do math well, she described the math content in the astronomy courses as the most challenging part of college science.

**Pressure to complete labs and turn in the lab reports on the same day.** Lab Reports for both astronomy lab courses were due at the end of each lab class. The pressure to answer the question and perform all of the mathematical calculations in what Beck felt was a fairly short amount of time agitated her and made her feel pressure to rush just to have something to turn by the end of lab. They were allowed to work in groups, but sometimes the group dynamic made the negative feelings more intense. “I was always filled with anxiety in lab because I never thought I was going to be able to do what needed to be done in the allotted time” she explained. I asked if it would have relieved the pressure on her if the professor allowed students to turn in their lab reports at the next meeting. She explained that this would not be possible because the computer programs and simulations they used were only available in the astronomy lab. “Plus,”
she added, “we did everything in groups, and there is no way we could all get together outside of lab.” Beck’s astronomy lab classes met in the evenings, and most of the students in her class worked during the day. I asked Beck to talk more about the tension she felt and how she thought it affected her science learning. Beck paused for a few seconds and added “when I had the night-time lab class, my group was always, always, always the last group to leave. You know how [street] is and I had to wait outside for the bus, and it was always dark when we finished. Sometimes it would be cold and raining, and it was always late, but I still had to stand out there waiting for the bus, so that was really, really something that made me anxious – I always had anxiety because I would be concerned about having to wait for the bus and it doesn’t run as often late at night.” In addition to the academic challenges Beck faced in her astronomy lab classes, it was also necessary for her to negotiate structural impediments, such as waiting for the bus in the dark, as well.

**Unanswered bids for interaction.** Beck’s second astronomy professor, a White male, would often not engage with Beck when she would try to start conversations with him before class. The topic of the conversation most often was about a current event or news story she had read about that involved the solar system, planets, or astronomy. Beck set up an alert to receive news about astronomy and the solar system. “Every day when he would come to class I would always say ‘Hi,’ and if I saw something online that I thought was interesting, I would say ‘well did you hear about such and such?’ and most of the time he would say ‘no’ or ‘no, I have not heard about that’.” She thought it was “really odd” that a person whom she felt was passionate about astronomy and the universe had not heard the most recent news or relevant stories about the subjects. I asked if Beck thought he had not heard about or seen the information or if it seemed like he just did not want to talk to her about it. She thought about it for a few seconds
and replied “I guess I don’t really know – but I think he really hadn’t heard about it because every once in a while if it was something he did hear about, he would say that he did, but we still would not talk much about it.”

Engaging with her science professors and being seen as a good student was important to Beck. She explained that although the labs were less interesting, “in lecture classes, they both always had 100% of my attention, I always sat in front and took really good notes – I always asked questions because I have always been curious about the planets, Earth, and the solar system.” During the conversation about her professor’s lack of enthusiasm in starting a conversation with Beck about her news alerts, she added that “even though he may not keep up with current events and read the same stories I was reading, he always encouraged us to ask questions about his lecture, and I was always very engaged in what [Professor X] had to say.” By showing her professors that she had a genuine interest in astronomy outside of the required class material and that she was willing and active in seeking out additional information related to the course content, Beck was seeking acknowledgment to be seen as a curious, intelligent, and an above average student.

**Positive Experiences in Science Learning Spaces**

When I asked Beck to tell me about the interactions she had with the science professor whom she felt facilitated her science learning the most, she explained that both of her astronomy professors were “informative, engaging, passionate, and really appreciated her interest in the topic” so she feels that both professors were equally enthusiastic, encouraging, and helpful. Beck’s positive experiences in college science learning spaces were consistently positive because the passion of her instructors in astronomy lecture kept her interested and both professors encouraged and allowed students to ask questions. Although she did not enjoy the co-requisite
lab component for the courses, a positive aspect of the time she spent in lab was that both professors allowed the students to work in groups.

Science instructor passion. Beck appreciated the passion both of her instructors showed for astronomy. She explained that their passion made it easier to learn the material because they maintained her interest for the entire class period. “I didn’t just learn the material to pass the tests,” she said, “I really learned it, and sometimes when I would learn something fascinating in class, I would post it on [social media].” The example she provided when I asked was “Did you know that the sun is going to be around for another 4 billion years? But it is going to eventually burn out.” Although one of her science instructors, the foreign-born male, received harassment from some of the students who sat in the back of the class, Beck felt that he was able to mostly ignore the trouble-makers and remain enthusiastic during lecture classes. “He was a really nice guy, you know, I went to every single class except one because I got really sick… I didn’t let anything stop me from missing a class ever because he made it so interesting and I looked forward to going and learning new things.” I asked if Beck’s curiosity about astronomy and her love of learning could have given her the impression that both of her science professors were passionate. She considered that possibility for a few seconds then replied “I really don’t think so, but I can say that both [Professor X and Y], well Professor X more so, seemed to get really excited when he would talk about retrograde motion and if you can get excited about stuff like that, you really must have a passion for planets.” To Beck, science professor passion and enthusiasm for science was rooted in the way they spoke, their facial expressions and that they moved around the room, often using grand hand gestures, during class. She also felt that her second science professor, the White male, found pleasure in being able to break down concepts in ways that the students would understand. “He would try to explain things in more than one
way – some of the material could be very confusing, like retrograde motion,” she laughed, “but he would keep trying to make us understand it, and he would get excited when some of us did.”

**Encouraged student questions during lecture.** Both of Beck’s science professors made their PowerPoint lectures available to students by posting them online in a password protected repository for the college. Both also provided additional resources such as YouTube videos which they would sometimes watch and discuss in class. The videos and PowerPoint lectures were available to students in units of several chapters at a time which allowed Beck the opportunity to print and review the lectures and watch the videos prior to the professor showing them in class. “I would always go through the PowerPoints before and after each class and do whatever the professors said to do,” explained Beck “and sometimes I would have questions about them before class started.” She explained that both of her astronomy professors liked that she would sometimes have questions about the videos and ask questions during class. “I always felt like they were open to and really encouraged questions from us” and added, “in both lecture classes, students asked lots of questions, and they never seemed to mind – I think they liked that we were interested in what they were teaching.” I asked how having those interactions made her feel and she replied, “it made me feel like he really appreciated my genuine interest in the topic, that I wasn’t just doing it to get a good grade, I sat in the front you know, he could tell that I was really interested – not like the people who sat in the back, if you sit in the back everybody knows that you are up to no good.”

**Working in groups to complete lab assignments.** Beck struggled more in the lab component of both astronomy courses than the lecture portions. Some of this was due to her dislike and lack of confidence in her ability to do math well and some of it was due to the time constraints she faced each lab meeting because lab reports had to be turned in at the end of each
experiment. The one positive feature she found in the lab classes was that, in both courses, she
did not have to complete the work on her own. “The only thing that saved me in lab is that we
did them in groups,” she explained. I asked if she liked working in groups and she replied “only
when it comes to science – in [other classes] I hate group projects because so many people seem
like they don’t really want to work and they want everything to be easy, but science was a little
hard – especially the lab, the labs were hard.” Working as a member of a group took pressure off
of Beck to be the sole person responsible for completing the assignment, and she doubted she
would have been able to pass the lab courses if she had to do all of the work on her own. “There
was a lot of stuff we had to do in lab and we didn’t have that much time to do it,” she said. “We
would have a short pre-lab lecture then race to get a laptop for the group, then follow directions
like ‘ok, click on this program, do this, do that’ – sometimes it was easy, but most of the time it
was difficult because there were so many math calculations that had to be carried out – the
computers did most of it, but we had to figure out how to make the programs work.” Beck was
not convinced that she necessarily learned more by working in a group, and she rarely engaged
on a meaningful level with the material for lab, but she was certain that without the help of
classmates and the group work dynamic in lab, that she would not have passed the courses.

Advice to Black Women

Beck did not have much advice to offer Black women who will be taking science classes
and even less advice for science professors because she felt as if both of her professors “did
everything right.” The first bit of advice she offered to Black women was that “understand that it
is all up to you – you have got to make up your mind that it is not going to be easy.” She added
“they should know that school is not easy, but science is definitely not easy – if there is an
adjustment that has to be made, they need to know that they are the ones who need to adjust,
don’t expect it from your science professor, the professor doesn’t need the degree, you need the degree.” She would also tell new science students that learning is not just transmission of information from the professor to you, “you’ve got to go outside of class and work, work hard – I just don’t think people want to push themselves mentally much anymore.” This sentiment is in alignment with Beck’s overall disciplined approach to learning and individual accountability.

When I asked her specifically about advice to Black women taking science classes she had an addition. She said, “Black women – a lot of Black women suffer from fear of success.” I had heard the term but did not see how it applied to Black women and science learning. Beck replied “oh, it’s a problem – it’s almost like we don’t deserve it or we think we are undeserving of success…Black women have always been accused of helping everybody else and not concentrating on themselves.”

**Advice to Science Professors**

Beck did not have any advice to give to science professors, possibly because in the seminar class she took and referenced when we first met (when she was studying for her criminal justice test at the coffee shop) she learned that the responsibility for learning fell on the student, not the professor. She reminded me that although professors may have issues that make learning more challenging such as strong accents, being soft-spoken, or cultural differences, it is always the responsibility of the student to make adjustments. I challenged this by asking what a Black female student should do if she felt as if her science professor was making race- or gender-based assumptions about their ability. Beck replied,

Women may complain about the professor just because the work is hard and in order to justify that they may say ‘he doesn’t like me’ or ‘he is racist’ or ‘he is mean’…but really, to me, they are just trying to avoid the hard work, but if somebody is overtly in your face
and they are saying things that you know are racist, like I’ve said, students have told me some things before that professors have said and I was like ‘What? You didn’t say anything to him about it?’ I would not have let a professor get away with saying something racist and not confronting him about it.

Beck believed some faculty members have stereotypes and deficit thinking perspectives about Black women, “some of them think we are dumb and can’t learn, but I did not experience that, I did not experience that at all.” The stereotypes that exist for Black students, in Beck’s eyes, do not apply to her.

**Conclusion**

Although Beck was acutely aware of structural racism in the U.S., she did not feel as if either of her science professors treated students differently on the basis of race. She took a total of four science classes and had two science professors, a White male and a foreign-born male. As a requirement to earn an Associate’s degree in Journalism, Beck was only required to take a two-course science sequence in natural or computational sciences. She chose the astronomy course sequence because she believed astronomy would have the least embedded math content and she did not like or was not confident in her ability to do math. Although Beck was not a feminist and did not believe males and females are equals, she did not notice either of her science professors treating students differently on the basis of their gender or age.

Beck believed that both of her science professors were racially colorblind although she later explained that the idea of racial colorblindness was a lie because the first thing we notice about each other is color. Her basis for the claim that her science professors were colorblind was two-fold. First, she believed that the most harmful effects of claims of racial colorblindness come from people in power, or from people who are “in a position to ruin somebody’s life.”
Second, she pointed out that her science professors never claimed to be colorblind and she felt they were colorblind because they did not have a reason not to be colorblind in Beck’s opinion. This reasoning may point to the fact that, to Beck who only had to take a two-course sequence in any science she chose, science professors do not have much power or authority over their students. This is a tremendously different attitude towards science professors from allied health field majors who are required to take multiple, specific science courses in order to progress to their chosen specialty. If Beck wanted to change her science course sequence, she could with no penalty providing she made the change within a certain amount of time from the start of the semester.

Although Beck is extremely knowledgeable and action-oriented about racial and socioeconomic injustices, she did not experience or acknowledge any interpersonal dynamics inside of science learning spaces that related to her race, gender, or age. She cites multiple examples of documentaries, books, and articles about racism, the history of racism, and how racism affects multiple facets of American society, but nothing she mentioned was ever specific or personal. She wanted me to know that many of the Irish immigrants had a much more difficult time when they came to America than the slaves from Africa. We spent more than a few minutes discussing this during our second interview, and we ended that part of our conversation agreeing to disagree although she never backed down and remained passionate about that point. When Beck mentioned “the race card,” she explained that some Black people use it to get people to feel sorry for them and that some Black women, mostly younger students, will say that a professor does not like them or is mean to them to avoid hard work. She wants people to know that she is intelligent and “that she is not one of those dumb people who accuses every White person of being racist.” Some of her direct quotes, if read without knowing the race
or gender of the person whose voice was being represented, could easily be mistakenly attributed to a racist, misogynistic person from another century.

I am stymied by this juxtaposition of her racial radar always being activated and the lack of any personal or specific occurrences that could have been on even the slightest level race-based. It could be that Beck never felt negatively stereotyped in any way by either of her two science professors because she did not recognize it or think it was important to share or both professors truly were colorblind as she believed. She maintained that she knows overt racism when she sees it, so it could be an issue of degree or severity of racism that is important to Beck. Beck also seemed to separate herself from other Black women. For example, she said the following about racism on campus:

Maybe it’s not that the professors I’ve had aren’t racist, it could be that they are, but I think that by me having a strong personality and the fact that I speak clearly – when you speak to me, you can tell I’m smart and you can tell I ain’t crazy, and you know I know what I am talking about…you don’t have to strain to hear or understand me you know, but people that have complained about it - the students who have told me it is here, that they have experienced it and like I said, somebody may be racist, but they don’t treat me that way, then I am not going to say that they are - maybe they can just cover it up good around me.

What Beck seems to say here is that racism exists on campus and she knows that only because others have told her it exists. She had no first-hand knowledge or personal experiences with racism on campus or in her science learning spaces because, as Beck believed, others see her as intelligent, with a strong and clear speaking voice. The implication is that because she is intelligent and speaks clearly, Beck believes she does not fit into the stereotype that veils other
Black students in science learning spaces. At the time this research was completed, Beck had graduated earning an Associate’s degree in Journalism and was enjoying her time in Aruba according to her social media posts.

ALANNA

Overview of College Science Experiences

Alanna was an Elementary Education major who completed a total six science lecture and laboratory courses with four different instructors, two White males, and two White females. She had mostly positive experience inside science learning spaces. Although Alanna did notice racism in three of her science professors, she never felt racially stereotyped in a negative way by the professors.

Background

Biographical Information. Alanna is 32-years-old and married with two children. She enjoys nature, running, dancing, and most of all, family time with her kids. She described herself as a realist adding that she is down-to-earth, funny, and generally has a positive attitude. She tends to overlook the negativity of others, assuming the best if possible, and she works to encourage her kids to do the same. She described her childhood in Fairfax, VA as “not ideal,” both parents had drug problems, and she and her two siblings stuck together and essentially raised themselves. Her first passion was law enforcement, and she entered college immediately after high school to pursue a career in criminal justice. She had completed the necessary coursework to apply for the Police Academy, passed her fitness and background checks, and was set to begin training when Alanna became pregnant and decided to take a break from college. Her law enforcement mentor whom she admired greatly, a White male older than Alanna, was
frustrated and disappointed in Alanna and said to her “You ruined it - *one,* you are Black, *two* you are female and *three* you are pregnant and not married – how do you plan to have a career in law enforcement?” Although that took place over ten years ago, Alanna said she still thinks about being in law enforcement and is disappointed that “it wasn’t meant to be.” She keeps up with friends who are police officers, and it is sometimes the highlight of her day to hear about their adventures at work.

Alanna strongly identifies as a mother first, then a Black woman, then a student. She described her children, a ten-year-old boy, and a seven-year-old girl, as biracial, “but they are still Black” she added. At the time of our second interview, Alanna had just completed the requirements for an Associate of Science in Education degree and will transfer to a nearby 4-year college to complete her Bachelor’s degree in Early Childhood Education. “Teaching is something that is important to me;” she explained “I know it doesn’t pay much, but I want to be there for my kids…being a young, Black mom was tough, and it’s something I don’t ever want them to go through, so if I can be there for them when they go through school, that is my main focus now.” Science and math are two subjects that she is happy both of her children are interested in because Alanna strongly disliked math and was never encouraged to interact with science. Her son wants to be a paleontologist, and her daughter is interested in forensic science. Alanna plans to earn her Master’s degree in the field of education and eventually pursue a doctoral degree once her children are through high school.

**Relationship with Researcher.** Alanna and I had not met prior to our first interview which took place in the TRIO conference room. The TRIO conference room is located just outside of the TRIO office suite where the tutoring center and administrators are housed. The conference room has no windows and there is no window on the door. As Alanna walked in, I introduced myself
and thanked her for agreeing to participate. We went over the consent form and talked briefly about my interest in studying Black women in science learning spaces. She came across as serious, cautious, and somewhat reserved during our first interview. Alanna has very light skin and medium-length straight hair. She shared that after reading the recruitment letter, she assumed I was a Black researcher. “It never entered my mind that you could be White,” she said. She described walking into the room and pausing, thinking either she or I was in the wrong place. “It was like a Seinfeld moment,” she said referencing a pre-2000s sitcom that revolved around humorously awkward situations. She laughed and said “when I saw you I was thinking, wait, what? Where is the researcher I am supposed to be meeting?”

I started all interviews by telling participants if they had any questions for me at any time to please ask. I would answer anything they were curious about and nothing was off limits. Alanna immediately asked “What is your dissertation based on? Specifically. Why are you studying this topic?” I was thrown off balance by the precision and magnitude of the question. I had spent months working on that question, but for some reason had never thought about how I would answer if a participant asked so directly. After gathering my thoughts for about five seconds, I answered:

The dissertation is based on the experiences, both positive and negative, of Black women in science learning spaces like classrooms and labs. I want to hear about the things you’ve experienced and how your interactions with science professors have affected your science learning and how you feel about science classes. I’m interested in this topic because, well, I have a personal interest in learning more about this population because many of my students are Black women and some already seem to be defeated and discouraged before we even really get started, they seem to expect not to do well. Not all
Black women, but some. I’ve heard colleagues’ thoughts about why this is, but I would like to hear from the women – what are their experiences in college science classes? I’d like to start a conversation about it and ultimately use it to address claims of racial colorblindness in science learning spaces if the data warrant that.

With no prompting and only a brief pause after I finished, Alanna nodded her head and said, “Black women are stereotyped,” and then a few seconds later added, “Black people don’t claim to be colorblind.”

Although Alanna recognized that Black women are stereotyped, throughout both interviews she maintained that she witnessed Black women being treated differently by science professors, but she herself was not stereotyped negatively. She consistently referred to Black women as “Black women,” not using pronouns such as “we” or “us.” Her tendency was to give science professors the benefit of the doubt saying, they “never treated me like that, so I just don’t know,” and “I didn’t go more towards the negative, but I could see how some people could take it that way,” when we discussed some of the experiences and observations she shared. Another characteristic that made Alanna unique was that she did not make a negative comment without immediately following it with a positive comment. The following are examples:

- “It was kinda racists in a sense, but I don't think she meant it that way.”
- “He was not invested, but he really knew his information, maybe that is just his personality.”
- “He was completely disengaged and never made eye contact, but he seemed patient.”
- “She definitely would try to intimidate certain students, but maybe that was just because their questions frustrated her, I really don’t know why.”
When I pointed this out to Alanna, she seemed genuinely surprised. She shared that she was “trying hard not to be biased,” and that “I tend to see the good in people, even at home I tell the kids ‘if you focus on the negative, you get more negative.’” This is in alignment with the general tone of both interviews. After the first interview, I recorded in my researcher journal that I felt as if Alanna tended to arc towards political correctness and politeness which meant she could be sanitizing her experiences for me. I could not tell if this was because all of her science professors were White and I was White or if there was some other reason. When I asked her why she tended to give her White science professors the benefit of the doubt even though she acknowledged early in our first interview that “Black women are stereotyped,” and had shared that three of her four science professors were not racially colorblind, she replied, “it takes a lot for me to take offense to certain things I guess.” She added “Black women are, for me, maybe I am not looking at it as (pause) that…maybe I am too kind.” We continued:

Researcher: Could it be happening to you and you don't know it? How can you be aware of it, but still think "well, it’s happening to them, but not to me?"

Alanna: Wow, ummm (pause) that is something to think about - (longer pause) - ummm - could it be me deflecting it and not really wanting to see – I just don’t know.

Researcher: In our first interview, you said "yes it definitely exists, but I have never experienced it personally" – is that right?

Alanna: I do, I do, I do see it happening - oh my gosh, yes – umm - I don't know and I'm trying to think (pause) Wow - I don't think I have any experiences personally - the only thing that I will say - is that, there are certain science professors who were more lenient with Black women, and that is a stereotype - because if you are not holding Black women up to the same standard as
everybody else, you are assuming Black women are not as capable or need more help just to get by.

Again, Alanna refers to Black women as “Black women” not, “us” or “we.” Although the underlying assumption she believed her science professors had is problematic, she chose a racial stereotype that benefits Black women on some level.

**Racial Colorblindness**

In alignment with Alanna’s political correctness, when I asked, “What does racial colorblindness mean to you?” she replied, “it means that you don’t look at the person for their race, that you look at them for what is on the inside, for who they are – their character.” When I asked what she would think if a science professor told her he or she was racially colorblind, she laughed and immediately said: “That they are full of crap!” Alanna did not think being racially colorblind is something faculty, or anybody should strive for because it is not attainable. Being racially colorblind in science learning spaces would not change anything because even if a professor makes the claim, Alanna doubted that it would change their behavior or perceptions they have of students and their abilities. She again pointed out that when you hear the terms “colorblind” or “racial colorblindness” it is not being said by Black people. In keeping with her politeness, when I asked Alanna if she had anything more to add to the concept or ideology of colorblindness, she said “I guess if a person told me they were colorblind, they are trying to let me know that they don’t judge by color – either that or they are saying ‘I know you are Black, but I am colorblind’.” Her last comment is not in alignment with her first response which was it would mean they are “full of crap.” Since this last comment came at the end of our discussion about racial colorblindness coupled with Alanna’s consistent, courteous nature and her aspiration
not to be biased or offensive, I believe her first more candid and spontaneous response more likely reflects her thinking about colorblindness.

**Addressing Researcher Whiteness**

Not having the sense that Alanna felt comfortable enough with me to be completely open and honest about race and racial differences coupled with her reserved nature and desire not to be offensive, I did not have high aspirations of finding out how she would have described her science learning experiences or if she would have answered any of the questions differently if I had been a Black researcher. Because she tended to answer questions immediately and to give short, factual (not emotional), concise answers, I prefaced the question with “don’t answer this right away, think about it for a minute before you say anything – *how* would you have answered these questions differently if I were a Black researcher?”

Alanna paused briefly, then answered, “Hmm – Wow – now *I feel biased.*” She said that I broke that barrier somewhat when we met for the first time. When she came into the interview room and was clearly confused because she thought one of us was in the wrong place. She explained “When you said, ‘you thought I was going to be Black didn’t you?’ I was like ‘umm, yes and now this feels totally weird’ (laughs), our Seinfeld moment – with *that* you broke through a barrier, because most likely I would be much more reserved if you hadn’t said that, I mean, I am reserved, period, but I probably would have been more reserved.” I probed by asking if I really broke through a barrier or if I just made her a little more comfortable with talking about race with a White researcher. She said that I did make her more comfortable, but that yes, she would have likely shared things differently if I were Black. “I would have probably not had as many reservations, and now geez – that makes me seemed so biased – I can hear it as I am saying it,” she said. She added, “If you were Black, I would probably have shared things
differently, there would have been less to think about, you know, not wanting to be offensive.”

She explained she would have probably said things like “[Professor X], he is one of those weird White dudes who look like, like you don’t want to be caught in a dark alley with” or “[Professor Y], she is like a drunk ditzy White lady who everyone is rolling their eyes at, she is completely clueless.”

I made the assumption that Alanna was not trying to sanitize her thoughts about my Whiteness completely for two reasons. One, she paused before answering which was noteworthy because it was atypical of our general cadence which was for her to answer each question immediately and directly. Second, her candor about sharing the awkwardness of our first meeting. Furthermore, when I first used the phrase “aware of my Whiteness,” she interrupted me by laughing and repeated “Aware of your Whiteness – that is funny – I’ve never heard that before.” Since we were nearing the end of our last interview, I shared with her that I didn’t think a science professor, or anyone really, could address their biases or race-based assumptions until they confront or disassemble what it means to be White in America. I asked Alanna how she thought my Whiteness would impact this study and she replied, “I think it is important that someone is taking an interest in it - and your whiteness, well, you will have a different view - you hear the comments they make and you know these people - now you can see from both perspectives…now you can see what some of your colleagues may be doing wrong and nobody really addresses those things.” She added that because I will be able to relate to both sides now, it will benefit the study and hopefully the experiences I collect will “change it.” Again, Alanna said “take an interest in it,” not us, and she hoped the study would “change it,” not a word more offensive like racism, racial stereotyping, or the racism of having lower academic expectations or goals for Black women. She also said what your colleagues “may be
“doing wrong” after she stated early in the first interview that Black women are stereotyped in science learning spaces.

I believe my Whiteness had a fairly significant impact on what Alanna was willing to share with me. Our conversations felt comfortable enough considering we did not know each other, but guarded and incomplete at the same time. Most of the information she shared in her answers was given quickly and in a concise manner. I did not have the impression that she was being disingenuous in any way, but some of our interactions felt clumsy. I attributed the clumsiness somewhat to our inability to be completely comfortable talking about racial differences with each other and not being sure what was appropriate or inappropriate. For example, I wanted to ask her if she thought it was possible that the reason she recognized the stereotyping of other Black women by her science professors but she herself never felt stereotyped negatively could be due to the lightness of her complexion and her medium-length straight hair, but I did not ask because I was not sure if it was appropriate. I also had the same reaction to Alanna that she had about me when we first met. When she came into the TRIO conference room for the first time, my reaction was “where is the Black woman I am supposed to be interviewing?”

**Interactions with School Science**

Alanna was never strongly interested in science in high school. She believed some people are innately better at science and math than others, but the capability to succeed in these areas is not race-based. When asked what someone who is innately better in science looks like, she paused for a few seconds, laughed and said “Oh wow, this may be racist but, Asian, yes that is definitely racist, but when you asked that I immediately saw a little Chinese person in a lab coat being good in science.” “Male or female?” I asked, “I want to say male,” she replied.
She was not encouraged to do or learn science and tended to link science and math together. Since she did not enjoy math, she did not enjoy science much except for dissections in Biology and learning about plate tectonics and rocks in Earth Science. She felt more comfortable and was more interested in learning about biology and rocks than chemistry in high school because she felt those subjects had more to do with memorization and she is good at memorizing and recalling information, and they did not involve math. She explained that science to her is “a lot of facts, a lot of math, and a lot of things you have to understand before you can see how a concept works, it’s not just a step-by-step like history, it’s more conceptual, and you have to have the ability to see the whole picture for it to make sense.” She noted that some people find subjects like psychology and history difficult and concluded that each subject has its own challenges and she is just not someone who learned to enjoy science.

Alanna has completed six college-level science classes with four different White instructors: A chemistry lecture and lab, an environmental science lecture and lab, and two integrated science classes for early childhood education majors. One of the integrated science classes focused on Life/Earth Sciences and the second focused on Physical Sciences. Two of her instructors were White males, and two were White females. Although she did not enjoy chemistry in high school, she chose to take college chemistry because her husband, a Nursing major, was required to take it and they decided to take both the lecture and lab classes together. “Chemistry was really, really hard for me,” Alanna explained “because I already have a bias when it comes to Math,” and “I’m more of a go-with-the-flow versus a step-by-step person, and most of chemistry seems to be following certain steps and knowing formulas.” She felt anxious in chemistry class and lab because she was never confident in her ability.
Alanna believed three (two White females and a White male) of her four science professors paid attention to the race of students, and two (one White male and one White female) treated older, non-traditional students more favorably than younger students. Most of the nontraditional students in Alanna’s science classes were Black females. Alanna explained that although the three science professors “definitely classified students based on their race,” she was not sure if the differential treatment was intentional from one of the White female science professors. That professor routinely attempted to intimidate Black students when they asked questions in the class while encouraging and giving more complete answers to students who were not Black. “It just that when certain students, African American students, would ask her to explain something, you could see more frustration on her face and a lack of patience in the way she answered.” Alanna felt the way the instructor answered the questions was meant to intimidate the students into not interrupting her to ask questions. “I could see them being intimidated,” she said, but the instructor did not intimidate Alanna to the extent that she stopped asking questions. Alanna said, “I would just blurt out questions – I didn’t care – either she would answer me or she wouldn’t.” Although Alanna identifies as Black, this is another example of her noticing science professors treating Black students differently, but the treatment did not extend to her.

The differential treatment she noted from the other two science professors involved a more permissive, lenient attitude towards Black women. For example, allowing Black women time extensions past due dates and telling Black women they need to work hard, “because we need more people like you in science.” With the exception of math-intensive science like chemistry, Alanna’s personal interactions with college science and college science professors have been overwhelmingly positive.
Views on Black Women in Science Learning Spaces

Alanna felt that in science learning spaces, professors expected White students to perform on a higher academic level than Black students. “This is probably wrong to say,” said Alanna, “but I almost feel like when it comes to White students, science professors expect them to do well.” Since her science professors generally had higher expectations of White students than Black students, she sensed some of her science professors gave extra attention to Black students who showed they were trying and working hard. “This is where it is probably race-related,” explained Alanna, “since White students are expected to do well, there may be less effort put into helping them succeed…it did seem like the Black students who were working hard and doing well-received extra attention and encouragement.” She voiced the same opinion when asked about advantages Black women have in science learning spaces that other students do not. “Well this is probably not nice,” she said, “but since they are expecting you not to do well, they are more willing to help you.” Alanna explained that certain professors are almost too lenient with Black female students saying, “some allow you to come with some boohoo story about why you didn’t complete a task, and they may give more time and leniency to a Black woman than they would to someone else.” I ask if this has ever happened to her or if she just had a hunch it was likely to happen, and she shared that she did have one experience like this when she missed a deadline in Environmental Science for an article review. She asked for an extension, and her professor told her to have it to him by 5:00 on Friday and another student, a younger White female, asked later in the class and he told her that it was due today. Other than potential leniency extended to Black women in science classes, Alanna did not see any other advantages for Black women in science learning spaces.
The advantage students who are not Black and female have in science learning spaces according to Alanna is that they are more highly regarded by science professors. Having the advantage of the professors’ confidence in their success, “no question is a dumb question,” from those students, so their higher expectations lead them to treat non-Black, non-female students more as equals. The science professors are less likely to dismiss their curiosities or questions as not important when they ask questions in class or lab.

Alanna described two occurrences in the same science class which she felt were based on either a cultural misunderstanding or stereotyping of a Black female, she was not sure which. In one instance, the White male professor routinely grimaced in an overly exaggerated way when the student would come up to him to ask questions. Alanna said that the woman did not wear deodorant, and she had a slight body odor some days, but that the way the instructor acted, so obviously tense and repulsed, indicated to the other students that he did not want to interact with her, and she felt it was unkind of him to act in an unprofessional manner. The same professor awarded a Black female Muslim an award for the highest GPA in the course. The award is called the Student of the Semester Award and science faculty are encouraged to acknowledge whichever student they feel has been outstanding in some way during the semester. It is usually awarded to the student with the highest GPA in the class. Alanna said the professor called the student to the front of the class to present her with the award and said, “I wouldn’t have expected it, but you have the highest GPA in the class, thanks for your hard work.” She said she and some of her classmates were looking at each other like “What did he just say? Did he really just say that to her?” She described how the student who won the award walked back to her chair with the certificate not really knowing what to say or how to act. Alanna felt that since the White male professor had never said anything like that to her, she was not sure if he was referring to
being surprised because she was a Black woman or Muslim. “I really don’t know,” she said, “I could just be giving him the benefit of the doubt because he never treated me like that, so I just don’t know.”

**Negative Experiences in Science Learning Spaces**

Alanna had relatively few negative experiences herself in the six science classes and labs she has taken. Although she believed Black women were stereotyped as less capable and less likely to succeed in science classes, she did not feel as if she was personally stereotyped. She had a difficult time understanding why this was the case and it was one of the few questions she did not respond to with an immediate answer. Finally, she answered, “Wow, ummm (pause) that is something to think about - (longer pause) - ummm - could it be me deflecting it and not really wanting to see – I just don’t know.”

She described how one of her science professors, a White female about the same age as Alanna, would attempt to intimidate Black students into not asking questions during class, but Alanna did not feel intimidated and did ask questions. She believed this was somewhat due to her age because she was older than many of the students and had more obligations and life experiences, she was less likely to feel intimidated by the professor.

Alanna described two types of negative experiences, but they are not exclusive to Black women’s science learning: (1) two of her science professors lacked the ability to break down concepts in a way that students could understand; and (2) a professor’s detached, aloof demeanor made engaging with the science content in his classes more tedious than Alanna felt was necessary.
**Inability to break down scientific concepts or answer questions in a suitable manner.** Two of Alanna’s science professors lacked the ability to explain course material in a way that students could generally understand. One was a White male and the second was a White female. The same two professors “were harsher towards females than males for some reason,” when they would ask for clarification during lectures. The White female is the same professor whom Alanna described as intimidating and who attempted to shut-down Black students when they asked questions while encouraging and politely answering questions from White students. Alanna felt there was a missing link in her teaching because, “if you are giving a student an answer and they still do not understand what you are talking about, you should try a different route – she would definitely put in more of an effort with White students, but sometimes she would say to [all] of the students, ‘well, if you can’t understand that, I don’t know how else to explain it, maybe you should go to the tutoring center’.” The White male science professor would also show frustration with students, but his approach was to repeat the same explanation over, almost word for word, when someone would say they did not understand. Alanna said that eventually, students learned just to stop asking questions because he was not helpful and try to figure out what they were not being taught in class on their own.

**Detached, aloof demeanor of science professors.** One of Alanna’s science professors, a White male professor whom she had for two science classes and one lab, rarely made eye contact with students when teaching. “He always seemed to be either looking at the ceiling when he was lecturing or at something interesting at the back of the room,” she explained. Most of the students in the three classes she has with this professor were Black or Hispanic females, so Alanna supposed it could be that he had an issue with females in general or that females made him uncomfortable in some way. “I’m trying hard not to be biased,” she said, “but it could just
be that he did not like teaching women.” This professor would make comments such as, “you are not kids, you are college students” and, “look, I’m not here to babysit you,” which Alanna thought were “unnecessary.” Alanna made A’s in each of this professor’s classes, “most of us made A’s in the class, but I’m not really sure how, I don’t feel like I learned much from him…he was completely checked-out and his detachment alone was such a distraction,” she explained.

**Positive Experiences in Science Learning Spaces**

Alanna describes mostly positive experiences in her college science learning. Two positive experiences that supported Alanna’s science learning came from the same science professor, the White female whom she felt attempted to intimidate younger students of color. The two positive actions this professor took to facilitate Alanna’s science learning were: (1) she encouraged Alanna not to drop the class when Alanna became so frustrated she considered quitting and (2) the professor had a positive and helpful attitude when Alanna visited her multiple times in her office for extra help.

**Encouragement.** Alanna described a time when she was deeply discouraged and frustrated during a particular class. She felt like giving up and that she would simply not be able to learn the necessary material needed to pass the next exam. She explained how the professor was walking around the classroom and could sense that Alanna was flustered and distressed. “My professor came and sat down right beside me and said something like ‘come on, I know you can do this’ her noticing me and saying that really boosted me back up,” she recalled. She went on to say, “it quieted my own critical self-thinking telling me that I couldn’t do it – I had really torn myself apart and was strongly considering quitting the class and trying to take it again next semester.” The professor reminded Alanna of the good work she had done in class and on previous assignments which gave Alanna the confidence and drive she needed to continue.
Alanna did not think the extra attention was necessarily due to her being a Black woman. I asked if she believed the professor would have acted in the same way if the student were not a Black woman and Alanna replied, “Yeah, I think if she saw them trying, she would.”

Positive and helpful attitude during office hours. When Alanna visited the same White female professor in her office for help outside of class, she gave Alanna her undivided attention and was supportive and encouraging. When Alanna would enter her office, the professor would turn her computer screen off to show Alanna that she had the professor’s undivided attention. If Alanna was struggling and became frustrated over a problem the professor would say, “I know you can do this – I know you are a good student, you are diligent, and you can do this, just take your time and think through it.” These interactions affected her science learning by making her feel more capable. Alanna explained how this attention and encouragement made her feel:

She gave me more confidence, and I worked harder to understand even when I didn’t think I would be able to at first – I watched YouTube videos and used any online resource I could find because, one I wanted to be a good example for my kids, but also I didn’t want to disappoint her after all that she had done to help me. It was important to me that both my kids and [my professor] saw my effort.

Alanna passed the class with this professor, earning a C. The professor had taken the time to break down Alanna’s grades to explain what she needed to score on the final exam to make the grade she wanted. Unfortunately, Alanna missed her target grade by just one point. “That part sucked, just missing it by one point,” she laughed, “but I still passed her class and learned more than I thought I could.”
Advice to Black Women

Important learner characteristics for Black women in science learning spaces identified by Alanna were confidence, determination, and persistence. “Don’t give up, keep working even if it looks like you will not make it, you’ve got to stick with it” she advised. She believed science is just like any other subject a student may not be familiar with, “it is hard, but the more time you put into it, the greater understanding you will have…it may take you longer than it takes someone else, but that doesn’t mean you are not capable of doing it.”

Advice to Science Professors

Alanna’s advice to science professors was, “not to expect the worst – expect that Black women will be able to do just as well as anybody else in your class…so don’t handicap Black women with low expectations.” She explained the low expectations she felt most of her science professors had limited Black women and fed into their already present self-talk about their lack of ability in science and math. This connected to one of my personal interests in Black female science learners and why they seem to be already skeptical of their ability when they first come to my chemistry class. Alanna offered that many Black women feel as if they are unprepared to succeed in college science classes, so they go in already apprehensive about their abilities to do well. She said she could not speak to why other Black women felt this way, but for her, she said it was mostly her upbringing and previous experiences in school science. Mostly that she never really excelled in school science, probably due to the math content, and she was never encouraged to be interested in or to pursue it. The second piece of advice Alanna gave to science professors is to make an effort to connect the content to Black women’s culture. She explained, “once you have something that is personal that someone has an interest in, or you find a relatable interest, then you know, you can do much better with Black women.” I asked Alanna if Black
women were represented in any way in any of her science classes and she immediately replied, “No” then quickly added, “well, not that I can remember.”

Conclusions

Alanna has taken a total of six science classes with four different instructors. Two were White males, and two were White females. She had mostly positive experience inside each of the science learning spaces, and the negative experiences were not specific to Black females. The negative experiences were common complaints about college science instruction across the U.S. Alanna felt that three of the four science professors, “definitely classified students based on their race,” but was unsure if one of them, a White female, did this intentionally. The other White female openly differentiated students based on their race, but Alanna believed her intention was to support Black students by frequently making statements such as, “we need more people like you in science.” The third instructor whom Alanna felt had race-based assumptions treated a Black Muslim female student in an unkind way and allowed Alanna extra time to turn in an assignment, which Alanna assumed was because he felt that Black students needed special treatment to achieve success. Interestingly, Alanna’s advice to science professors was not to handicap Black women by having low expectations, but she acknowledged that sometimes the low expectations of the science professor caused the professor to be more lenient. Some professors seemed to offer more assistance to Black women, although in the case of Alanna’s White female chemistry instructor, she felt the extra assistance and encouragement would have been extended to any student who was working hard and making an effort.

Alanna felt that “Black women are stereotyped,” and she did not believe it was possible for a science professor, or anyone else, to be colorblind. She said she would think someone is “full of crap” if he or she claimed to be colorblind. Alanna also shared that she would have
answered some of the interview questions differently if I were a Black researcher. What is interesting about the science learning experiences Alanna shared with me is that, although she recognized colorblindness is unattainable, Black women are stereotyped, and that she had observed White science professors treating Black women differently from White students, none of the negative experiences she discussed happened to her personally. For example, the treatment of the White chemistry professor towards Black students in her class did not affect Alanna even though she is a Black student. The professor became visibly frustrated with the questions from some Black students, and she attempted to intimidate them into not interrupting her to ask questions. Alanna’s approach was that “she would just blurt out questions,” with the attitude of, “either she would answer me or she wouldn’t.” This is another example of Black students being treated differently than White students, but the negative treatment did not extend to Alanna.

The extra attention Alanna received in class from her White female chemistry instructor when she observed Alanna struggling was not due to her being a Black female in Alanna’s opinion. Alanna believed the professor would have acted in the same way towards any student the professor felt was trying hard. The professor’s extra help was based on Alanna’s effort, not because she was a Black female. On the other hand, the leniency she received from her White male environmental science professor when she needed a time extension on an assignment was confirmed by Alanna as being as race-based in her opinion because a White female student also asked for a time extension, but was denied. There are several other factors that could have contributed to the professor being lenient with Alanna, but not lenient with the White female. However, Alanna offered this as the only example of science professors expecting less or expecting Black women not to do well as well as White students. Some of the reasons for the
different responses from the White male environmental science instructor could have been that the White female student asked him after Alanna asked him and he did not want to have multiple late papers being turned in. The White female student may have been more conspicuous about asking for special treatment from the professor, and he did not want to appear to be biased or outwardly show preferential treatment. He also could have just been in a different mindset when the White girl asked for the extension and did not feel like being lenient for any number of other reasons. What is important is that this is the only example Alanna referenced to support her belief that “since they are expecting you not to do well, they are more willing to help you,” but the majority of experiences she shared with me do not strongly align with this.

Alanna’s tendencies towards being positive, following critical comments with generous assumptions, politeness, and political correctness cannot be ignored. I believe these tendencies played a role in the data that was collected, but not in the overall way she described her science learning experiences. I do not have the sense that Alanna was misleading me about her experiences or observations, just that she either did not strongly associate with the other Black women in her science classes or she was not recognized as a Black woman by her science professors based on the lightness of her complexion. I mistakenly assumed Alanna was not Black, so it is possible that other professors made this assumption as well. At the time this research was completed, Alanna had graduated with an Associate’s degree in Elementary Education.

**SWEETS**

_Overview of Science Learning Experiences_
Sweets was a nursing major who has taken a total of six science courses with five different professors. She has had both positive and negative experiences in science learning spaces. She noticed racism in some of her professors and felt negatively stereotyped in those science learning spaces. She believed some of her science professors treated students differently depending on their race and, to a lesser extent, their gender and age. Sweets strongly based the quality of her science learning experiences on the personality and style of the professors. Overall, Sweets said her learning experiences with science professors were, “about 50:50 – 50% good and 50% bad.”

**Background**

**Biographical Information.** Sweets described herself as caring, understanding, and outgoing, although she quickly added that she enjoys being by herself and her alone time too. “Everyone calls me ‘the mother of the pack’” she said, “I’m fun to be around, and I love to take care of people.” Sweets is 39-years-old, church-going, family-oriented, and dreams of becoming a nurse one day. Her two children live at home, a 4-year-old boy and an 18-year-old girl, and her husband travels during most of the week. She moved to Georgia from New York approximately nine years ago. She worked in hospitals and clinics in both New York and Georgia as a Certified Medical Assistant and shared in a benign way “I never knew racism until I moved to Georgia – if there were racists in New York, they kept it to themselves - but down here…down here, people can be blatant with it.”

Sweets identifies as Black, not African-American, and although she was born in America, her culture is Jamaican. Throughout our conversations, when asked about her experiences as a Black woman in science learning spaces, she frequently included the intersection of her age, injecting phrases such as “especially grown Black women” and “older Black women more so
than younger Black women.” “Mature Black women tend to be more observant and notice patterns that the younger students don’t see – we notice patterns in communication and how professors speak to certain students one way and others in a different way” she explained. She attributed this difference, to some extent, on the intense fascination younger students have with technology and being plugged into their electronic devices while older students have more interest in what is happening around them, “the older students are more hands-on, we are used to looking and seeing and observing - younger students just don’t take in as much of their surroundings” Sweets said.

**Relationship with Researcher.** Sweets was a chemistry student in my Chemistry II lecture class and laboratory course. She successfully completed both courses the semester before our first interview took place. She sat in the middle section towards the front, and although she did not participate a great deal in class discussions on a routine basis, I had the impression she was engaged and attentive but preferred to process the information in a quiet, personal way. From what I remember, she did not begin to speak in class until after the first of four tests and when she did, her comments and questions seemed well-thought-out but tentative. In both the lecture class and laboratory, she stuck close to her friend Andrew, and although Sweets was cordial and friendly to everyone, she seemed reserved and somewhat unaffected by the energy of the students around her. When Sweets described herself as “outgoing,” I was surprised. She was amused when I questioned her about it, and she explained that in the institutional setting of a college classroom, she chose to be more professional. Sweets and I have had many friendly conversations since our formal relationship of student-science professor ended at the end of last semester, and the more I get to know Sweets, I can easily understand why she would describe herself in that way. Sweets invited me to her home for breakfast on a Friday morning, and we
had the opportunity to get to know each other more personally under more relaxed and informal circumstances. After she cooked and we ate breakfast, we sat down for the interview at her kitchen table. Our first interview lasted over two hours. Our second interview took place in my office on campus over a barbeque chicken dish she made for both of us to share. In between interviews throughout the spring 2017 semester, Sweets and I have become closer. We text message often about her family, our gardens, her statistics class, and frequently connect on social media. I have learned that when she becomes passionate about a topic, Sweets tends to slip into a heavy Jamaican accent which she did in our discussion about the concept of racial colorblindness. Our second interview felt more like two friends talking over lunch than our first interview did. Our second interview lasted just over 90 minutes.

**Interactions with School Science**

Sweets loved science in high school more than any other subject and considered herself a science person. “A science person can come in all shapes and sizes,” Sweets said, “it doesn’t matter what color you are, but some people do have advantages in science…I do think White students receive more encouragement.” She enjoyed the “hands-on” aspect of science and thought of science learning as an adventure, “there is so much more to science than what is in a textbook” she said. Learning science in college is different because there is so much more new material to cover each class, she explained, and sometimes it is more difficult seeing past the PowerPoint lectures and making connections from the science being taught to real life experiences. Sweets goes to science classes and laboratories expecting to learn something new, and that optimistic approach has allowed her to maintain a mostly positive attitude when it comes to college science learning.
Sweets chose her science courses because each course is a requirement in the Pre-Nursing program of study. She chose her professors based on recommendations from other TRIO members and which professors still had seats available at the time she registered. Sweets has attempted six science courses, two chemistry classes and one biology class, each with the co-requisite laboratory courses. She failed one of her biology courses and is in the process or re-taking it this semester with a different instructor. To Sweets, success in science class is not just based on the grade she earns, but “when you can retain the information and do the work on your own.” When I asked her to tell me about the experiences she has had in science classes, she quickly responded, “it depends on the professor.” I asked her to elaborate, and she explained:

You have some professors who are caring and want you to learn and then again you have some professors who are just giving you the information and think that you should just be able to grasp it or figure it out on your own. You can't ask some professors any questions because it's either they have an attitude with you or they kind of shun you and don’t want you to participate, you just go to class to get your grade and go learn it on your own.

She added that not all science professors are like this. She has had experiences with science professors who made her feel supported and eager to go to class. “Sometimes you want to go to class, you want to do the homework, you want to learn” she explains “some make you want to try your best even though sometimes you may fail or have some shortcomings, it still pushes you to want to be there.” About the science courses Sweets was less eager to attend, I asked if it was the subject matter or the professor that made her feel that way and she immediately answered “the style of the professor.”

**Views on Black Women in Science Learning Spaces**
Sweets struggled to come up with advantages Black women have in science learning spaces. Her first response was “that is a really tough question (five-second pause) I don’t see any advantages for Black women in science classes.” Her eventual response to the advantages Black women have was personal and centered mature Black women, not just Black women in general:

That is a really tough one…I think we are more organized and know that we have to get certain things done and we have higher expectations - more than a younger student that is there because their parents want them to go to school - we want it, …we want to be there because we, we as Black women are trying to, well me as a mother, I am trying to show my daughter that it can be done even at my age, I’m doing it with all of the additional responsibilities…so I think that is an advantage for mature Black women in classes - that we want to be there, we are expectant, we are open-minded - life on a whole has given us a better outlook on how to behave, how to conduct, how to proceed, how to receive the professor and the lecture - how to understand it a little bit more because we have more life experiences to incorporate with it.

Sweets acknowledged that the advantages she felt existed for mature Black women were probably also true for mature White women, but that many of her classmates in science classes were non-traditional aged Black women returning to school either for a second career or because they did not have the opportunity to attend college immediately after high school. She could only recall having mature White women in three of her six science classes, maybe a total of five or six altogether, and said that none of them interacted much with her. “Not that they were unfriendly” Sweets explained, she just tended to stay with the friends she already had in those science learning spaces which happened to be other mature Black women.
Students who were not Black women had advantages that were easier for Sweets to describe. She quickly answered, “they get more attention…and a little more leniency too, you know?” When I asked her why, she said “I think because maybe our college seems to be predominantly Black and when the White students or Asian students are in their classes, they try to push them more. They get more attention from the science professors, you see them getting extra boosts, much more help and encouragement goes to them than to the African American students.” Sweets saw her science professors being more responsive and helpful in general to younger Asian and White students than to adult Black women in science learning spaces too. “We had differences in ages and so forth, most of the Asians or White students were younger, and they come out of high school already knowing some things, the professors act like we should all know what they learned in high school, but older students may not have even been taught some of the things that the younger students come in to class already knowing.” Sweets believed that science professors should start with the basics, especially for introductory or survey classes, and the younger students were privileged either because they already knew more or the professors assumed they knew more than the older students. “They assumed the younger students were more capable of learning than we were so they encouraged them more,” said Sweets. At the time of the second interview, Sweets had almost completed six face-to-face college science courses with five different professors. Of the five, she used her experiences with two as examples of positive learning experiences (a White female and a Black male) and two as examples of negative science learning experiences (a White male and an older White female).

**Racial Colorblindness**

The only curse word I have ever heard Sweets say was in response to a question about racial colorblindness and the word was “Bullshit.” She has a contradictory opinion about the
concept depending on the race of the person who says it. She believed if a White person said that he or she was colorblind, it meant they are definitely racist. “They are saying just the opposite” she quickly snapped, “it is an easy way to express who they really are – if they say ‘yeah, I’m colorblind,’ then you know they are definitely not.” If a White person were truly colorblind Sweets contended, then that word would not be part of his or her consciousness or thought process. I asked if she thought it was possible for a person to truly be colorblind, to see each other without noticing our skin colors? Surprisingly Sweets replied, “I don’t see color.” I looked at her incredulously, not believing what she just said. “Wait, so a Black person can say it and mean it but a White person can’t?” I asked. She replied:

No. That’s not right – I’ll tell you why. I am not from the south, so everybody to me seems the same for the most part – it wasn’t something that was taught to me like there was no White people over here and Black people over there until I came down here. It wasn’t taught to me that it was important to differentiate Black and White…to me it was that we were all together as human beings. I know you are a White person, but I don’t see you as a White person.

This sentiment dovetails with two personal stories she had previously shared. One story was of her not experiencing racism until she moved to Georgia from New York and that down here, she explained, “people can be blatant with it” and “here, there are people who don’t even want to have a conversation about it, so much so that they won’t even look you in the eyes.” In the first interview, she explained how at the hospital where she worked as a Medical Assistant when she moved to Georgia, she was the person who talked to everyone including the White doctors, even though her training supervisor instructed her not to interact with the doctors unless they were speaking directly to her. The second is her deeply religious nature. Sweets strongly identifies
as a Christian. She strives to be Christ-like and see the good in people, all people. As this discussion continued, she said: “I am not saying I am colorblind, I guess I am saying that I love all color then.” I came to understand that what she was saying made sense, on some level, but the idea of racial colorblindness and what it means when someone says it depends in large part on who is saying it as well as who they are saying it to. I asked Sweets what, if any, reaction she would have if a science professor told her she or he were colorblind. She immediately answered “I would leave their class... I have a low tolerance for any kind of discrimination.” So, to Sweets, if a person tells her he or she is colorblind, it means he or she has race-based assumptions but does not want to admit or address those assumptions. I asked if this reasoning was correct and Sweets reaffirmed, “Yes. The first thing I think of if a White person says they don’t see color – DING, DING, DING it’s a lightbulb, a warning.” There are still some discrepancies though in her negotiation of racial colorblindness.

Her explanation of why she as a Black person can say she does not see color, but a White person cannot make the same claim is based on the history of Black Americans in this country and the ongoing tension between black and white people which seems, in her opinion, to be getting much worse in light of the most recent presidential election of Donald Trump. We both expressed shock and sadness about how expressions of white supremacy have become more aggressive and blatant during and following the presidential election. We discussed a recent exchange she had on social media following the University of Chicago’s webcast of former president Obama encouraging future leaders to work hard and stay focused on positive change. When Sweets discussed this, she slipped into her Jamaican accent and began speaking more rapidly and passionately. “Obama was being so encouraging and positive – his whole message was about uplifting people,” she said. “Then these White people, these White people, I’m sorry,
but these White people were the nastiest, they were saying the nastiest most horrible things about him,” she said, visibly upset by the sorts of things that were being directed at Obama on social media. She explained how she tried to calmly tell them via Facebook live comments that if they don’t like the man, all they have to do is to turn off their Facebook Live feed and they would be done, but “the trash talk, they were so hateful, so ugly about him and it was the White people being like that, then they turned to personally attacking me, it was so ugly” she said. Sweets’s notion of not seeing color raises discrepancies in her ability to consistently see all people as human beings instead of categorizing them into categories of Black and White. Sweets was clear that it was White people who were attacking President Obama and White people who then turned to attacking her when she defended him. This led to questions about my Whiteness and how the fact that I am a White researcher may affect the content Black participants are willing to share. “Well they were White…I’m not saying all White people are like that, but the negativity, the hatred, it was coming from White people.”

**Addressing Researcher Whiteness**

During our discussion about racial colorblindness, Sweets said that although she knows I am White, she does not see me as a White person. Because I have come to know Sweets in what feels like a deeply personal way over the past six months or so, I believe her, but explain that I am hopeful others will trust me enough to share their experiences in the ways that she has. She admitted that if I had not been her professor a year ago, “maybe I kinda wouldn’t say everything to you that I have.” She went on to explain there are two other reasons why a Black woman may not share negative experiences with me and only focus on positive experiences. One, “if she doesn’t really know you, then she may not tell you everything because she doesn’t know you”
and two, “if the woman has fair skin, then she probably doesn’t get it as much as someone who has darker skin.”

Sweets believed that because I am White, I have the ability to confirm biases other White people have, biases and stereotypes that are felt by Black people, but just out of their reach so they cannot be addressed unless they are exposed by other White people. For example, she said, “you are capable of confirming things we cannot confirm, things that we just suspect, but can’t uncover ourselves.” She explained that since White people do not generally talk about the stereotypes they have, they are sometimes difficult to detect right away, but “if you stay around them long enough, the stereotypes will come out in their words and actions.” Sweets believed that although a Black student may suspect racial bias based on the way a White professor interacts with her or him, another White professor, specifically me due to my institutional positionality as a science faculty member, can more easily confirm the suspicions. I agreed that my insider knowledge of other science faculty members could give me access to their biases, and in fact, it has which was one of the reasons I wanted to pursue this line of research.

In my researcher journal, I reflected on this conversation with Sweets and how much I wanted to confirm her suspicions. I wanted to tell her that she was not imagining the negative stereotyping of Black students and of mature Black women in science classes which I only imagined did lead to the types of differential treatment she described. I wrote,

I wanted to expose faculty members who I am certain have negative race-based assumptions about Black students because I have heard them make very clear, offensive, derogatory statements about the way students dress, their t-shirt slogans, their hair, how they don’t care, they don’t try, how they speak, their bad attitudes, and when these students don’t succeed in their classes, it always seems to be the fault of the student in
their eyes. They bear absolutely no responsibility for the poor performance of students in their classes. I hear these same science professors say that they are colorblind. I wanted to tell Sweets she is right, her feelings are valid, and she is not imaging things, but I don’t, and I am frustrated that I don’t know what to do. My brain was flooded with things to say, things I wanted to share, but I just looked at her and nodded in agreement. I felt like a coward.

I felt that by not sharing these beliefs with Sweets, I was betraying her friendship and on some level, her trust. I could confirm her suspicions but was aware that was not the right time to have this discussion. She was openly sharing with me, and I was not reciprocal which felt misleading and unfair.

**Negative Experiences in Science Learning Spaces**

Sweets attributed her negative experiences in science learning spaces to the following: (1) she noticed differential treatment of Black students compared to White and Asian students, (2) she felt she was being viewed through the lens of negative stereotypes, and (3) she believed the content was made unnecessarily difficult because two of her science professors lack teaching skills or did not make an effort to teach effectively.

**Differential treatment.** Sweets observed science professors treating students differently depending on the race of the student. In all her science learning spaces, the Black students were mostly Black women. Sweets described differential treatment by science professors in that they were “more open and receptive to other nationalities than to Black students.” Science professors were friendlier with White students, and they tended to break down what they were saying into smaller chunks when White students asked questions. She observed the professors spending
more time engaging with White students which she measured in terms of making eye contact with White students more than with Black students. Sweets noted that some of her science professors were more receptive to Asian students when they asked questions in class than to Black students. She found that some professors were “short-tempered or had a short attention span” with older Black women in their class compared to White and Asian students and that sometimes the professors would simply ignore questions from Black students. “Sometimes we have to call the professor’s name three or four times just to get their attention and try to get our questions answered,” she said, “at least if I called you in lab you would usually say ‘give me a second, I’m helping this person right now’, but the other two lab professors, they generally just ignore us, then forget about us” she said.

Sweets provided multiple examples of differential treatment that favored White and Asian students by science professors. One involved a biology laboratory instructor, a White female, who allowed a White student to go to the library to print a lab report that was due, but the same laboratory instructor did not allow a Black student to leave and do the same thing later in the semester, telling the Black student in front of the class that she could go print the lab report that was due, but there would be points deducted from the grade for it being late. By the manner in which she shared this story with me, although she was not the student who was chastised in front of the class, I could tell she was deeply affected by it happening to someone else, the injustice of it stung. After a few moments of silence, she added “some students looked around at each other like, ‘did that just happen?’, and so it wasn’t just me who noticed it.”

In another example, she described a White male science lab instructor who would routinely give Black students a harder time when they asked questions saying, “Didn’t you read your prelab questions before coming to class?” She reenacted how she and others would
frantically search through their papers, “stumbling going through the pages in the lab experiment feeling stupid,” but when White or Asian students would ask a question, the same professor “didn’t have a problem giving them the answers and encouraging them, telling them they were doing a good job.” Sweets shared with me how Black students would signal each other when they noticed this differential treatment and that their actions were so subtle, she doubted the science professor noticed they were communicating about him and his unfair behavior. She gave two examples of their silent communication. In the first signal, she looked at me with a cocked head and lightly tapped just under her lower eyelid signaling, “Did you just see that?” The other signal was similar, but she held her index finger to her earlobe signaling, “Did you just hear that?” She said these signals between herself and other Black students, mostly women, were common in both lab courses.

**Negotiation of negative stereotypes.** Sweets talked about two different stereotypes she felt that the same two science professors had about Black women. One was that Black women have bad or sassy attitudes; the other stereotype was that “Black women do not have the capability of being smart.” Based on the way two of her science professors responded to Black women in their classes, Sweets believed the professors thought the women were trying to challenge them or make them look bad in front of other students. She explained that Black women are often accused of raising their voices or being angry when in fact, they are just speaking in their normal tone and interacting the way they generally interact with others. She noted that if a professor does not know or socialize with any Black women outside of the Black women in their classes, he or she probably would not be familiar with how Black women speak, so she can see how this misunderstanding could occur, but it is still a stereotype with which she and other Black women must negotiate in science learning spaces, especially laboratories which
tend to be more noisy environments than classrooms. “We don’t mean anything by it,” Sweets explained, “some of us are just loud...we may sound stern, but that is just how we speak.”

The second stereotype Sweets sensed from science professors was that Black women were not as capable of learning as other science students. She said this was evident from the way they interacted with and answered the questions of Black women compared to the ways they interacted with other students. She interpreted by the manner in which the science professors answered questions in science learning spaces that “they don’t want to be bothered by us,” because “they give cut and dried answers or information to us when we ask while they take greater time with other races to explain whatever they want to know.” She attributed the differential treatment to science professors having higher expectations for White and Asian students than for Black students. When asked if she felt other professors outside of science faculty stereotyped Black women in this way, Sweets immediately answered “No.” After a five second pause, I asked if she had anything to add, and she said “They, the other professors I’ve had here, tend to go all in with regards to explanations, they wanted all of us to learn it, who we were didn’t seem to matter and they treated us all the same way I felt.” After reviewing her case, Sweets added exceptions to this, pointing out that math professors are similar to science professors in her opinion and she had some of the same negative experiences with her math professors.

Sweets described the pressure of being forced to deal with negative stereotypes while also being expected to learn science at the same time. She explained, it as “a teardown on your emotions and confidence, it shatters you and sometimes makes you feel like you are less of a person...when you get shot down in class, it makes you feel dumb, and you just want to pack up and leave.” She asked if I had looked up the course drop/withdrawal rates of the two professors
she had negative experiences with and I told her I had not. She felt sure they both have higher drop rates and student absences from class than normal because students who feel that way in class do not want to be there, so they just quit and try again with a different professor the next semester.

In contrast, Sweets described how a White female lecture instructor showed her that she did not have higher expectations from any one group of students and offered her example as a way that the two negative experience science instructors could have abated her feelings, at least somewhat, of being stereotyped as an incapable science student. She explained that the White female professor made her feel as if all of the students in the class had the potential to do well by posting the class average as well as the breakdown of grades for each assessment on the board after it was graded. Sweets said that science professor “proved that stereotype wrong in our class because we had a lot of high grades – several students made As and Bs and there weren’t many White or Asians in there – mostly Black, Somalian, Thai, and Ethiopian students.” By making the grades and class average available to the students, Sweets was able to see where she was in relation to the performance of the other students in the class and since many students were successfully passing the tests and many of the students in the class were also Black women, that stereotype was not present in that particular science learning space.

**Science content is made unnecessarily hard.** Sweets’s favorite subject in high school was science, and she considered herself a science person. She did not believe that mastery of the science content in her courses is unattainable or that the amount of material is unfairly or prohibitively substantial. Sweets felt that science professors can make the course material unnecessarily difficult because they lack teaching skills or they do not make an effort to teach effectively. “Teaching takes more of an effort than just reading PowerPoint slides or talking,”
she explained and described what it felt like to be in a science class where the professor made little to no effort to connect with the students. “There are those professors that don’t make you want to be there, you really don’t want to go,” she explained, “you just go because you know if you don’t go, there will be repercussions.” She spoke thoughtfully and passionately and imitated a science professor in a loud, droning, authoritarian voice, “Okay this is A, this is B, this is C, this is what you need to memorize – if you don’t understand, then go to the tutoring center.” She found the sink or swim mentality of some science faculty frustrating. “It all depends on their style of teaching,” she said, “there are some who don’t care if you are listening or learning, they act like they can barely tolerate their job and really couldn’t care less if you were in class or not.” I asked what it was like for her to be sitting in a science class like that and after a guttural moan she replied,

You dread going to class, you dread doing your homework, it’s horrible...during class you find yourself thinking ‘when is this going to be over?’ And it’s like you are drowning – I don’t want to say ‘death’ because that is such a strong word, but that is how it feels sometimes...you don’t want to be there, but you have to be there because you need that science class and they know you need it, so you are stuck.

Not all of Sweets’s science learning experiences have been negative. “You can tell the difference in a professor who is just doing the job for a paycheck and a professor who loves what they do – they have completely different styles of teaching,” she explained.

**The Positive Experiences in Science Learning Spaces**

Sweets’s positive experiences in science learning spaces centered on her interpretation of whether the professor enjoyed teaching and whether she felt she had an open line of
communication with the professor. Two of her five science professors fit into this category, a White female, and a Black male. If the professor did enjoy teaching, which to Sweets meant preparing materials for students, spending time interacting with students in classes and laboratories, making an effort to offer multiple ways of explaining difficult concepts and being open to answering questions from all students, then she considered the time with that professor to be positive. When asked for an example of how it was possible to tell if a science professor enjoyed teaching, Sweets thought for a moment then was visibly excited and spoke with enthusiasm as she recalled a chemistry laboratory experiment. She described an experiment which focused on the synthesis of a class of organic compounds called esters. Esterification reactions are fairly straightforward, requiring only a short amount of time to react and just three reagents. Esters are known for having pleasant, fruity odors, and three of the esters Sweets remembered making in the laboratory, smelled like citrus fruit, wintergreen, and banana candy.

“Who would know that when you combine two liquids that don’t smell very good at all, you could get another fragrance?” she recalled, “the smell of the banana ester smelled more like banana candy than a real banana and the instructor seemed so excited that many of us noticed that.” She explained how the laboratory instructor wanted to hear from everyone, what each of them thought and why. “Being encouraged to speak and being asked what we thought instead of what the answer was,” was meaningful to Sweets and she interpreted the instructor’s enthusiasm, high energy, and obvious desire to interact with and hear from the students during the laboratory as evidence that the chemistry professor enjoyed teaching. She pointed out that a laboratory instructor who was “just showing up for a paycheck…one who tolerates their job instead of enjoying it” would be more likely to sit in one place during the laboratory experiment, not interact much with students, and only speak when a student came up to ask a specific question.
Sweets’s positive experiences were not necessarily based on the grade(s) she earned in the classes, but how much effort she believed the professor put into teaching and how much she of the information she retained. Sweets acknowledged she did not apply herself as much possible to either science class when she was taking the half-semester accelerated biology class and the semester-long chemistry class at the same time because she frequently found herself overwhelmed and unable to navigate the rigors of both classes and laboratories, but she blamed this mostly on herself and to a small extent on the volume of science material she was attempting to master in six-weeks. It was necessary for her to re-take the half-semester accelerated biology course the following semester. She explained the science professors who enjoy teaching are “encouraging and make you want to stay tuned-in in class and know more about what they are talking about; the grades are important, but they aren’t everything…you leave class knowing more than you did when you went in.” She described having a positive learning experience from a professor who created chapter summaries for content-intensive chapters and made those available to students in addition to the PowerPoint lectures that were discussed in class, pointing out that the professor was not required to do that, but chose to make an effort to offer multiple ways of explaining difficult concepts in order to help the students succeed.

Sweets believed that communication is important in all facets of life, but communication between Black women and their professors is especially important. I pushed Sweets to explain what she meant by that, and after about a five-second pause she replied,

We are communicators – we learn more when we talk, talking means more to us than just reading or seeing something…when a professor makes an effort to talk to us, like asking us if we are following or if we understand. ‘Is everybody with me? Are you getting this?’
Communication like that in class is just as important as how they communicate with us outside of class.

Sweets’s positive experiences regarding communication with her science professors overlapped with her interpretation of how much they enjoyed teaching in general. She described the science professors with which she had positive learning experiences as having both characteristics. “I loved their passion for science and how they were able to bring it over and translate that to us in class,” she said, then added, “there was never a dull moment in their classes – it was that simple, they kept things lively and upbeat.” She believed that if a science professor walked around during a lab session and interacted with students instead of sitting in one place, then that professor cared about student learning. “The ones who really care about us learning” she explained, “never stayed in one place too long, they walk around and help everybody…the ones who don’t care just sit in one place at the front of the room and do their own thing until we finish.”

**Advice to Black Women**

To other Black women who will be taking science courses, Sweets recommended they take time before entering a science class to figure out how they learn best. “You’ve got to be able to go to a professor and ask for what you need if you are not getting in in class,” she explained. Using herself as an example in my Chemistry II class, Sweets recalled she approached me early in the semester to ask for online sources she could use to supplement what we were learning in lecture. At the time, she was taking my semester-long Chemistry II course; she was enrolled in half-semester accelerated biology course which was taking a great deal of her time and energy, leaving less time for her to focus on the chemistry class. Because I did not allow students to record the lectures, she found herself needing more than what I was providing
in class and online to master the content, so she asked for additional material, especially websites and videos that would help. She explained that Black women need to know how they learn best and be prepared to speak with their professors to ask for help when they need it, adding that being as specific as possible about what is needed is more productive than just asking for help in a general sense. Sweets added she learns especially well when she can be “hands-on” with material such as molecular models sets in chemistry and open laboratory sessions (supplemental laboratory sessions that are not required) in biology laboratory courses and other Black women may discover that as well. “Always ask your science professors about additional resources,” she explained, having the opportunity to, “put my hands and eyes on things and hear lectures more than once, doing it over at my own pace, that really helped me understand.”

Sweets also recommended that Black women come to science classes with an open mind. She explained that some Black women who do not like science will already have the mindset that science classes will be boring and difficult. “They will look at science classes as hurdles they must clear to move forward in school, not see that science can be interesting and connected to real life,” she said. She laughed and admitted that keeping a positive attitude can be difficult, especially when you have a professor who is unenthusiastic and does not seem to enjoy teaching, but those are the environments where keeping an open mind is most crucial she explained. “Go in open and go in with a clean slate each day” because “it will not always be fun and it will not always make sense, but it is still something you will have to do to get to where you want to be.”

To the Black women who look at science and science learning with anxiety, she gave the same advice. Many Black women are apprehensive about taking college science courses because they believe the learning environment will be competitive and unwelcoming and the professors will be detached and unapproachable. She recommended, “come with an expectation to add
something new to what you know, because every day you learn science, it is something new...every time you do a lab it is something new,” and added, “just come with your mind open to receiving and don’t just think ‘it’s gonna be hard’ and ‘I can’t learn this’ – that is the way a lot of Black women come into science, they say ‘it’s too hard’ and ‘I don’t want to do it’.

Finally, she advised Black women to plan on finding additional sources and ways of understanding the science content because often the science professors only lecture during class and even if they provide their PowerPoint lectures and notes to students, she found that often that material provided was not sufficient for her to feel like she understood what she was expected to know. “Seek out others to study with,” she explained, “different professors provide different materials and what might not work for one student, could work for you.” She found that by studying with other students who were taking the same science class with a different professor, she was able to learn from their professor’s prepared materials such as chapter summaries and PowerPoint presentations, because, “every professor has their own way of saying things their own style of teaching.” Sweets shared that science laboratory classes and the tutoring center are good places to meet other science students who have different professors.

Advice to Science Professors

Sweets appreciated science professors who were organized, transparent, and respected the students’ time by starting and finishing classes and laboratory courses on time. Sweets’s advice to science professors was simple and straightforward. “Be understanding – besides being a science professor, be human,” she pleaded. After a long pause, she explained she was not trying to make excuses for Black women, but that a lot of Black women were single mothers and child-related issues are a fact of life for most Black women. She appreciated science professors who made an attempt to be understanding and flexible, but also recognized that it is not always
possible to make allowances for the same student over and over again. When describing what it meant for a science professor to be “transparent,” Sweets explained that it was helpful for her to know how she performed on an exam in comparison to her classmates, for example how many As, Bs, Cs, Ds and Fs there were and for the science professor to go over the correct answers in class as soon as possible, allowing students to ask questions if clarification was needed. She explained that knowing the breakdown of letter grades in the class for a test allowed her to have a reasonable understanding of where she stood in comparison to the rest of the class in terms of how well she grasped the material. Sometimes knowing where she ranked encouraged her to study more, realizing that if the majority of the class is doing well on the tests, then she should be able to do well too. Finally, Sweets advised science professors to offer students more than one way to learn critical material pointing out that only sharing their PowerPoint lectures is often not enough for a deep understanding for her. She especially appreciated online videos because they provided her the opportunity to watch someone explain an important concept over and over again until she felt as if she understood it.

Conclusion

Sweets has completed six face-to-face college science courses with five different professors. Of the five, she used four to describe her science learning experiences. Of the four science professors, two were included in her positive experiences (a White female and a Black male), and two were included in her negative experiences (a different White female, and a White male). Her negative experiences were: (1) she noticed differential treatment of Black students compared to White and Asian students, (2) she felt she and other Black women were being viewed through the lens of negative stereotypes, and (3) she believes the science content was made unnecessarily difficult because some of her science professors lack teaching skills or did
not make an effort to teach effectively. The stereotypes Sweets described two of her science professors having were that Black women had negative or bad attitudes and Black women did not have the capability of being smart. She did not feel that professors outside of science faculty had these stereotypes about Black women. The impact of feeling stereotyped and differential treatment of Black women by professors had a detrimental effect on Sweets’s science learning.

Sweets’s positive experiences with science faculty, those that impacted her science learning in a positive way, involved her perception of whether or not the science professors enjoyed teaching and whether or not she felt she could communicate openly with the professor. Ways that she described she could tell if the professor enjoyed teaching were that he or she prepared quality learning materials for students, spent time interacting with students in classes and labs, made an effort to offer multiple ways of explaining difficult concepts (such as video links and molecular models), and being open to answering questions from all students, not just certain students, while in classes and labs.

Generally, Sweets equated positive learning experiences with the attitude or disposition of the science professor. If the professor was lively and enthusiastic, on some level Sweets equated this with caring and felt the professor cared about her success in the class. For example, if the professor was lively, upbeat, and active during class, Sweets believed the science professor cared about her success, and she enjoyed being in their classrooms.

Sweets took pride in the fact that she did not quit even though the circumstances were challenging and being in the class often was frustrating and was a waste of time. She did not pass one of these classes and is in the process of re-taking the biology course with a different professor who is a Black male. Sweets said the difference between her current professor and the previous professor was the “difference between night and day” to her. She currently has a high
B average in the course and although the class is not easy, she does not dread going and is
grateful for the professor’s positive, helpful attitude. At the time this research was completed,
Sweets was in the process of completing the requirements to earn an Associate’s degree in
Nursing.

5 DISCUSSION

The purpose of the study was to describe the experiences of Black women inside college
science learning spaces using a critical race theory perspective. The research questions were:

1) How do Black women science learners describe their experiences with science faculty?
2) How do these experiences influence their science learning?
3) What type of learner characteristics do Black women perceive as important to be
   successful in college science learning spaces?
4) What type of science professor characteristics are most helpful to Black women in
   college science learning spaces?

This chapter consists of a summary of the study, the findings organized to answer the research
questions, and a discussion of the study as it relates to the tenets of critical race theory. The
chapter concludes with limitations of the study, implications, and recommendations for future
research.

Summary of Study

My approach to the study was to gather the narratives of Black women who had taken at
least one face-to-face college science class within the past year. Most of the women had
completed at least four college science classes, and none were science majors. The choice to
focus on the experiences of non-science majors (non-STEM majors) adds to the limited amount
of research-based literature centering the experiences of Black women science learners who are not represented in either “women in STEM” or “minorities in STEM” science education literature.

Although a CRT framework was used to collect, analyze, and organize the findings, I did not approach the study with the assumption that the women experienced racism inside of science learning spaces. It was more important to provide a platform for their stories to be heard and their experiences documented. This study was designed to understand and share the experiences of Black women in college science learning spaces. CRT has a foundation in storytelling, which is a method of giving voice. Ladson-Billings and Tate (1997) contend, ”The 'voice' component of critical race theory provides a way to communicate the experience and realities of the oppressed” (p. 59). Harper (2012) further emphasizes, “if minoritized persons were invited to explicitly name what they have experienced, it will become clear to researchers and others that racism is indeed worthy of more serious empirical examination and documentation” (p. 15). The primary goal was to understand the women’s realities through their rich stories and descriptions.

The cases were written to provide an understanding of each woman’s experiences, both positive and negative, inside of science learning spaces and how those experiences influenced her science learning trajectory. Stereotyping, cultural misunderstandings, and how the women situate Black women inside science learning spaces, for example, advantages and disadvantages of being a Black woman in a science class, were discussed. The women explained the learner characteristics they felt were important for Black women to be successful in science learning spaces by offering advice to other Black women who will be taking college science classes. Each woman also offered advice to college science professors. Finally, each participant shared
what she thought about the claim of “racial colorblindness” and the impact that researcher Whiteness could have on a study that centers the experiences of Black women.

In the following section, I situate the findings from my research study in the current literature. I integrate the findings with the research presented in the Introduction, and Literature Review, Chapters 1 and 2, respectively. I also include new literature, where appropriate, to support the findings where necessary. Table 2 below provides an overview of the participants’ reasons for taking their science classes and views on topics discussed during this study.

Table 2
Overview of Participant Views

<table>
<thead>
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<th>Research Question One</th>
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<td>How do Black women science learners describe their experiences with science faculty? Due to their race-based, differential treatment the women perceived science professors as obstacles to entry into the allied health field. Women who did not have to take specific science courses as part of their degree requirements did not experience science faculty in the same way.</td>
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Multiple studies speak directly to the distinctive challenges Black women face in colleges and universities in the U.S. due to their intersectionality which include gender and racial discrimination, negative stereotyping, being judged negatively, and cultural misunderstandings (Coker, 2003; Johnson-Bailey, 2002; Johnson-Bailey & Cervero, 1996; Sealey-Ruiz, 2013; Thomas, 2001). Seymour and Hewitt (1997) described the STEM climate for women as “chilly” to address how women were treated differently from men in these environments. Carlone and Johnson (2007) show examples of subtle racism and sexism in science learning spaces and describe how some women are able to succeed despite sometimes “unpleasant and culturally asynchronous conditions” (Carlone & Johnson, 2007, p. 1211) in college science environments. In other studies, researchers have examined the experiences of women of color in science learning spaces and found they face discrimination from faculty to varying degrees (Justin-Johnson, 2004; Ong, 2005, Ong et al., 2011). Seymour and Hewitt (1997) found broad challenges faced by students of color in college science classes which include internalization of stereotypes, perceptions of racism, and inadequate support from science faculty (p. 329).

Johnson (2007), working from the Seymour and Hewitt (1997) study, found unsupportive faculty to be a challenge for women of color as well. Brand, Glasson, and Green (2006) examined the experiences of five Black students (three males, two females) in science and mathematics classrooms and found students struggled with negative stereotypes and negative perceptions they believed guided the thoughts of their science and mathematics instructors. The students in the Brand Brand et al. (2006) study struggled in different ways to distinguish themselves from negative stereotypes and grappled to prevent the stereotypes from affecting their confidence and self-esteem. The students also felt their instructors portrayed science and mathematics as subjects that only smart people can succeed in.
The experiences of the women in this study support the findings of previous studies. Science professors limited the success of these women in three ways: (1) differential treatment of Black women, (2) displaying negative or deficit-view stereotypes of Black women, and (3) demonstrating a “my way or the highway” attitude which made the professors seem unsupportive and uncaring.

**Differential treatment.** Differential treatment of Black women in science learning spaces was described by all three women who were taking required science courses for nursing school. Each of described multiple examples of differential treatment which ranged from professors being more open, receptive and friendly to students who were not Black women to a professor who made a slave joke by mimicking in a high-pitched woman’s voice, “oh Massa, don’t beat me, Massa, please don’t beat me Massa” when he announced to his class of mostly Black women that he was giving a quiz. In general, the women felt science professors were nicer and more respectful to Caucasian and Asian students than to Black students.

Sweets explained, “science professors were friendlier with White students, and they tended to break down what they were saying into smaller chunks when White students asked questions.” She observed the professors spending more time engaging with White students which she measured in terms of making eye contact with White students more so than with Black students. She found that some professors were “short-tempered or had a short attention span” with older Black women in her class compared to White and Asian students and that sometimes the professors would simply ignore questions from Black students. “Sometimes we have to call the professor’s name three or four times just to get their attention and try to get our questions answered,” she said.
The women interpreted the manner in which the science professors answered questions in science learning spaces that “they don’t want to be bothered by us,” because “they give cut and dried answers or information to us when we ask while they take greater time with other races to explain whatever they want to know.” They attributed the differential treatment to science professors having higher expectations for White and Asian students than for Black students. Kim described she noticed differential treatment when her science professor allowed a White student to shut down a conversation she initiated with the professor about why the professor changed her testing format from online to in-class after the majority of the class, which was mostly Black women, did well on the test. Kim strongly believed her science professor changed the testing format as a gatekeeping measure. Kim explained, “I think to keep us back...it goes back to our history, where White people want other White people to get ahead of a Black person, we have to work harder to get to the same place.” The participants felt that the experiences of Black women in science learning spaces were different from the experiences of White women and Black men.

The participants in this study found their science professors treated them differently than Black men. For example, Kim believed Black men receive better treatment from science professors because they are more highly valued in the nursing field. Mickey, Beck, and Kim felt Black men had fewer domestic responsibilities and therefore handling the rigors of science classes was less problematic for Black men than for Black women. Beck believed Black men had an advantage in science and mathematics pursuits because federal funding and other incentives that were meant to support minorities, in her opinion, were directed towards Black males. Finally, Mickey believed that because science was thought to be a male-dominated field, Black women in science classes had a target on their backs. She explained:
You know you have to work to outdo everyone because the target is on your back as a Black woman. You know you have to prove that you can be a Black woman in sometimes a male-dominated category and you have to prove that you can do it without letting your kids or a man or all those other people who stereotype you affect your progress. You also have to face the fact that not only are you Black but that you are also a woman so it's like, you are competing with boys, and you are competing with the race of those boys, and you are competing with those other girls in the class who don't have that same pressures that you have because they are of a different race.

A component of both Black feminist thought and intersectionality is that due to overlapping oppressions and positionality in U.S. society, Black women are treated differently from Black men. The findings from this study support these assertions.

**Negative Stereotypes.** The participants described negative stereotypes they felt their science professors had about Black women science learners. Two of these stereotypes were that “Black women do not have the capability of being smart” and Black women have bad or sassy attitudes which gives the impression that they do not care or are not invested in learning. Beck believed some faculty members have deficit thinking perspectives about Black women, “some of them think we are dumb and can’t learn…” The recurring theme the women voiced was that science professors did not expect Black women to perform as well as White women or Black men and their actions and attitudes towards Black women illustrated this deficit-view. The women generally felt as if they were stereotyped and pre-judged from the time they walk into the classroom by their science professors as being less smart, less capable, and less willing to work. They indicated that this was more of a sense or a feeling because professors who have a bias
against Black women do not speak about it openly, but as Sweets explained, “if you stay around them long enough, the stereotypes will come out in their words and actions.”

Three women felt racial stereotypes were worse for Black women who have a darker complexion. Mickey believed that she was racially stereotyped in a negative way more so than other Black women in the class because she has very dark skin compared to bi-racial women and Black women with a lighter complexion. She felt because of the favorability of lighter-skinned Black women, those women would likely have different experiences in science learning spaces. Sweets and Kim also discussed colorism/shadism explaining that darker-complexioned women are likely to have more negative experiences inside science learning spaces due to the country’s history of slavery and the racial hierarchy that developed from that era. Johnson-Bailey and Cervero (1996) briefly mention colorism in their study addressing challenges and coping strategies of Black women who return to college but do nothing more than describe it as “intraracial discrimination based on a preference for lighter skin shades” (p. 149).

Alanna was the only participant who believed she benefitted from negative stereotypes. Alanna felt in science learning spaces; professors expected White students to perform on a higher academic level than Black students. “This is probably wrong to say,” said Alanna, “but I almost feel like when it comes to White students, science professors expect them to do well.” Since her science professors generally had higher expectations of White students than Black students, she sensed some of her science professors gave extra attention to Black women who showed they were trying and working hard. “This is where it is probably race-related,” explained Alanna, “since White students are expected to do well, there may be less effort put into helping them succeed…it did seem like the Black students who were working hard and doing well-received extra attention and encouragement.” She voiced the same opinion when asked about advantages
Black women have in science learning spaces that other students do not. “Well this is probably not nice,” she said, “but since they are expecting you not to do well, they are more willing to help you.”

Most of the participants in this study believed the negative stereotypes that were ascribed to them as a result of their intersectionality placed them at a disadvantage in science learning spaces. This finding supports Brand et al. (2006) study about the influence of sociocultural factors on science and mathematics learning of African American students. It also supports the findings from Seymour and Hewitt (1997), Carlone and Johnson (2007), and Ko et al. (2013) who describe specifically the experiences of women of color in science learning spaces and how they are confronted with negative stereotypes.

**My Way or the Highway attitude.** The participants felt science professors made learning science more difficult than necessary by having uncaring attitudes and less-friendly classroom environments than professors who teach other subjects. They also believed some science professors abuse their institutional authority because they are aware students need the science courses to access nursing school. One woman explained:

I think some science professors make things more difficult than they have to be… I think the professors, knowing that we need those science courses they know they have the upper hand and control over your grades… they know that they have that leeway and control in that area knowing that you need it. Because if you compare the English and the other regular classes like History or Psychology, those teachers not as hard or as difficult personality wise – they just more laid back, I think they more easily help you versus the science professors who know you need to pass their class or you can’t go to nursing school.
It was a common occurrence for the women to hear their science professors say how difficult science classes were and that not everyone is supposed to pass. One of the science professors kept reminding students that if they were to fail the course, the failing grade would remain on their college transcript for the rest of their lives.

Mickey’s science professor refused to give her credit for an assignment, even though the answers were correct and verified by her tutor and lecture instructor because she did not answer the question the way he wanted it answered, so she did not receive credit for working the problems. Mickey explained, “He had that attitude, it just seemed like his personality where if it doesn’t go his way or someone disagrees with him, he just doesn’t care because he is in charge and it’s his class – so it’s his way or no way.” Many of the science professors specifically stated in class that “science courses are meant to weed people out” and have told students that science is more difficult than any other subject they will take in college and a lot of students will not pass their course. One participant asked, “Why does it have to be like that? Why do they want us not to pass? That just doesn’t make any sense to me…”

The women’s experiences revealed science professors were more likely than other professors to be condescending, unfriendly, and less interactive with their students. They saw science learning spaces as places where there was no room for personal expression or variation of course content based on student interest compared to courses such as Psychology, English, Public Speaking, or History. Because the women were encouraged in many of their non-science courses to write papers, have class discussions, and investigate topics they found interesting, they formed more authentic and reliable relationships with professors in non-science courses. Kim explained that when something questionable happened in class or a comment was made that could have been considered biased, she was more likely to give the benefit of the doubt to a
professor whom she had come to know more personally than a science professor. The majority of her experiences with science professors left her feeling as if she could not relate to them (they had nothing in common) and that they preferred a more formal, distant relationship with the majority of their students.

The “my way or the highway” attitudes of some science professors was not limited to their attitudes in class. It extended to the way science faculty grade assignments. Some felt science professors abused their authority by being less transparent in their grading processes because, compared to professors in other classes like English or Public Speaking, they give very little or no explanation about incorrect or insufficient answers and do not provide feedback about how to improve one’s performance. Additionally, because many of the science professors used relatively few assessments to calculate the course grade, the women realized if they performed poorly on just one assessment, it might not be possible to earn an A or a B in the class. Kim believed that if science professors genuinely wanted to see more students succeed, then professors would not set the courses up in such a way that if a student fails one test, she fails the entire course. She explained,

Don’t have us put all of our eggs in one basket – give us quizzes, give us homework, give us more opportunities to actually engage with the material instead of just giving us tests that count for such a high percentage of our grade…they know we need those science classes and they make it hard as hell for you to get it and pass it – I don’t think it has to be that hard, why they gotta make it that way – one midterm and one final exam, that don’t even make sense if you really trying to help us learn the material.

Because science professors have a great deal of power, in part because they are seen as gatekeepers into certain careers, their “my way or the highway” attitude was especially difficult
for the women to negotiate. The “you have to go through me to get to nursing and what I say goes” attitude can act as an insurmountable barrier for Black women in college science classes.

Students who lack confidence in their ability to succeed may also lack the willingness to engage in their courses Rocca (2010). Similarly, feelings of intimidation and inadequacy may prohibit students from participating in class, particularly when the intimidation is tied to a lack of understanding of course content (Fassinger, 1995; Weaver & Qi, 2005). These psychological factors may well promote or prohibit students’ academic engagement in introductory science courses.

**Research Question Two**

*How do these experiences influence their science learning trajectories?* The science learning trajectories of the women who needed specific science courses to enter allied health fields were either slowed down or derailed by their experiences with science professors. The science trajectories of other women were generally not negatively affected by their experiences with science professors.

Carlone and Johnson (2007) point to the social and structural environment of college as the main source of women of color’s attrition in undergraduate STEM education. Required introductory science courses needed for matriculation into a major field of study have been called gatekeeper courses (Eagan & Jaeger, 2008; Tobias, 1992). Gatekeeper courses are designed to weed out students who cannot perform at the expectations of faculty (Seymour and Hewitt, 1997). Poor performance in gatekeeper courses discourages students psychologically by deflating their self-confidence in their ability to succeed academically (Seymour & Hewitt).
The women in this study described how their interactions with science professors generated feelings of discouragement, powerlessness, and frustration which ultimately either derailed or slowed down their science learning trajectory. Race-based differential treatment, deficit stereotypes, and unsupportive attitudes of science professors negatively affected the women’s science learning trajectories. For example, two women stopped attending required science courses due to insurmountable barriers created by their science professors.

Due to the blatant negative racial stereotyping and his “my way or the highway” attitude, the actions of Mickey’s chemistry laboratory instructor caused her to withdraw from his class which meant she also was required to withdraw from the co-requisite chemistry lecture course. Since Mickey had successfully completed all the non-science courses required for her degree, this is where her academic career stopped. When she ended the relationship with her science laboratory instructor, she effectively ended her academic career as well. Before college science, Mickey’s interactions with school science had been positive. She entered college enjoying science and considered herself a science person. Mikey’s science learning trajectory was derailed by her chemistry laboratory professor. Due to the anxiety and stress of what she experienced in the laboratory course, Mickey sought counseling through the student counseling center to help her deal with and make sense of her experiences. “It was not good – I had anxiety, I was depressed, and I was discouraged…. the whole experience showed me that one person, [the laboratory instructor] had all the power and I didn’t have any,” she explained.

Kim’s science learning trajectory was slowed down by a science professor whom she felt was racist and she mistrusted. Because Kim believed complaints to the Department Chair would not be productive, she felt discouraged and powerless. She eventually stopped attending and failed the course. Her suspicions of racial stereotyping stemmed from the professor changing
the format of testing and being dishonest about the reason for doing so. She felt her suspicions were confirmed when the professor allowed a White student to effectively shut down the class conversation about changing the format which left Kim feeling belittled, unheard, and frustrated. Although Kim did not consider herself a science person and struggled in science, she felt that professors set the courses up in ways that did not support student success.

Sweets too expressed feelings of discouragement and frustration inside science learning spaces due to interactions with science faculty, but she was able to persist for the most part. The differential treatment of Black students and deficit views of her professors was discouraging and impacted her science learning trajectory in a negative way. Sweets described the pressure of being forced to deal with negative stereotypes while also being expected to learn science at the same time. She explained, it as “a tear down on your emotions and confidence, it shatters you and sometimes makes you feel like you are less of a person...when you get shut down in class, it makes you feel dumb, and you just want to pack up and leave.” Sweets shared how Black women would signal each other when they noticed differential treatment or racial stereotyping. She found support and companionship with other Black women in her science classes which seemed to strengthen her in ways the other participants did not describe. Each of the women taking science classes for access to nursing school described the double impact of frustration and discouragement which resulted in feelings of powerlessness inside their science learning spaces. When they could not see a realistic, attainable path to success in these science courses, the women lost their motivation and confidence which impacted their college careers in different ways.

These results support findings from previous studies. The students in Seymour and Hewitt’s study (1997) saw the culture of weed-out courses as non-productive, questioned
whether or not this was a reliable way to identify strong students, and instilled the idea that failure was a normal part of science learning (p. 130). Brand, Glasson, and Green (2006) found racial stereotypes had a negative impact on student learning. In alignment with Black feminist thought, some of the women relied on support from other Black women when they felt powerless and frustrated. The way Sweets signaled to other Black women when they noticed differential treatment was an example of this. She gave two examples of their silent communication. In the first signal, she looked at me with a cocked head and lightly tapped just under her lower eyelid signaling, “Did you just see that?” The other signal was similar, but she held her index finger to her earlobe signaling, “Did you just hear that?” She said these signals between herself and other Black students, mostly women, were common in both lab courses. The way Sweets signaled to other Black women is in alignment with Black feminist thought. It indicated to other Black women the actions of the professor did not go unnoticed in subtle ways that were not meant for the consumption of other students or the professor. Hill Collins (2009) explains Black women “have long explored this private, hidden space of Black women’s consciousness, the ‘inside’ ideas that allow Black women to cope with and, in many cases, transcend the confines of intersecting oppressions of race, class, gender, and sexuality” (p. 108).

When these results are viewed through an intersectionality lens, it is clear that the women believe their experiences with science professors and the resulting trajectory of their science learning is directly related to their womanness and their Blackness. Of the three women who aspired to enter the allied health field, Mickey was completely derailed by her experiences and Kim was derailed, but was able to re-take classes to get back on track. Sweets persisted but found it necessary to extend her time taking college-coursework so she could devote more time and energy to passing her science courses. Faculty behaviors that set the classroom context also
contribute to students’ academic engagement. Many scholars, including Chickering and Gamson (1999) and Ewell and Jones (1996), have documented the strong association between faculty-student interactions and increased student learning and engagement.

**Research Question Three**

*What advice do Black women have for other Black women about how to be successful in science learning spaces?* Advice to other Black women fell into two categories, emotional advice about mental toughness and practical advice about science learning.

Johnson-Bailey and Cervero (1996) describe three emotional coping strategies of Black women in college science learning spaces used to navigate racism: silence, negotiation, and resistance. Coker (2003) found silence, compromise, excellence, and confrontation were coping strategies and sources of strength for Black women in these spaces. The women in this study described using one or more of these coping strategies in their science learning spaces.

Mickey pointed out that because Black women often feel as if they have a target on their back and must prove themselves capable more so than other students, they have to develop a unique drive and determination to survive science learning spaces. This strength to preserve in challenging circumstances was also expressed by other participants. The participants noted that although many Black women enter science learning spaces lacking confidence in their abilities, they should not let that type of thinking derail their confidence. One woman said, “it may take you longer than it takes someone else, but that doesn’t mean you are not capable of doing it.”

Important characteristics for Black women in science learning spaces were confidence,
determination, and persistence. “Don’t give up, keep working even if it looks like you will not make it, you’ve got to stick with it” Alanna advised. Kim’s advice to Black women who will be taking science classes is that, if you are struggling and feel that it is impossible to pass the class, it is critical to stick with it. She said emphatically, “you can do it, but you’ve got to stay focused and don’t get discouraged, don’t allow fear to overtake you - stick with it and don’t let no one tell you that you can’t do it.” Another participant expressed the importance of taking personal responsibility for science learning. She said, “understand that it is all up to you – you have got to make up your mind that it is not going to be easy.” The same woman added “they should know that science is definitely not easy – if there is an adjustment that has to be made, they need to know that they are the ones who need to adjust, don’t expect it from your science professor, the professor doesn’t need the degree, you need the degree.” She would also tell new science students that learning is not just transmission of information from the professor to you, “you’ve got to go outside of class and work, work hard” if you want to get through it.

The practical advice about science learning was to meet with a potential science professor before signing up for his or her class, talk to other Black women about their experiences, consult free online websites such as ratemyprofessor.com to get a feel for the way a professor treats his or her students, and to find a syllabus from a prospective science professor online to evaluate his or her expectations. Sweets strongly recommended that women figure out how they learn best before taking any science class, so they know what to ask for from a professor if they need help. For example, she explained that she learns best from videos and podcasts because she can slow the speed and listen as many times as necessary for her to feel comfortable with the science content. She added being as specific as possible about what is needed when a student approaches a science professor is more productive than just asking for help in a general sense.
Some aspects of the advice the women offered can be applied to any science student. However, some of their advice applies only to Black women. This too illuminates their intersectionality and supports Black feminist thought. The basis of Black feminist thought is Black women have a distinctive set of experiences that inform their realities which are different from the realities of people who are not Black women. A goal of Black feminist thought is to empower Black women, and the contribution of Black women’s advice to other Black women is central to this goal.

**Research Question Four**

*What type of science professor characteristics are most helpful to Black women in college science learning spaces?* The women expressed in various ways that a science professor’s willingness to see them as individuals instead of viewing them through the haze of stereotypes was the most helpful characteristic. Secondly and along the same vein, they advised science professors not to assume they are less capable than other students.

Faculty have been noted as playing an essential role in the overall experiences of all female students of color. Bensimon (2005) and Oritz and Boyer (2003) have concluded that faculty beliefs, practices, and attitudes can diminish or boost outcomes for students, especially underrepresented racial minorities.

In an effort to understand the experiences of successful women of color in science, Carlone and Johnson (2007) found recognition by others to be the most helpful characteristic determining the women’s science learning trajectories. It was critical to the success of these women to be recognized by others as “someone with talent and potential in science” (p. 1197). They also found the consequences of negative recognition, “cases where the women were
recognized not as competent science students but as women of color incapable of learning and doing science” (p. 1202), led the women to feel invisible and bitter.

The women felt most supported by science faculty who valued rapport building with students, offered them an open line of communication, and professors who were friendly and respectful. Feldman (2007) used evidence from student evaluations to examine exemplary practices and found students benefitted from instructors who motivate students to do their best, are friendly and show respect for students.

The women in this study felt most supported by science faculty who valued rapport building with students, offered them an open line of communication, and professors who make an effort to be organized, consistent, and friendly. Mickey asked of science professors:

Make your students feel *comfortable* – make them feel like no matter who they are or what their race or gender is – they have an open pathway to you…show me that you care and that you are paying attention to me, that I’m not just another student on your roster and please, *please* see me as an individual – don’t lump me into a category to make it easier for you to deal with me, let me know that you know who I am.

Another woman asked professors “not to expect the worst – expect that Black women will be able to do just as well as anybody else in your class…so don’t handicap Black women with low expectations.” She explained the low expectations she felt most of her science professors had limited Black women and fed into their already present self-talk about their lack of ability in science and math.

The women believed science professors could be more effective teaching Black women if they would take the time to get to know their students as much as possible and be willing to build
a rapport with them, even if it seems as if they have nothing in common with their students. One woman explained that science professors who take the time to get to class early and talk to students about their weekend or engage students in discussions that do not necessarily involve science would be a way for professors to build rapport with students. “Even if it’s not about science, damn, just show us you are human and have a life,” one woman said. The women felt that if science professors would be more interactive and personal, then students would likely feel comfortable approaching them to ask for help. The overarching advice to science professors was simple and straightforward, “Be understanding – besides being a science professor, be human,” one woman asked. Regarding practical advice for science professors, the women learned best from professors who were organized, transparent in their grading, and respected students’ time by starting and finishing classes and laboratories on time.

**Racial Colorblindness**

Although racial colorblindness was not addressed in the original research questions, addressing this ideology and how the participants viewed claims of colorblindness became salient. Some of the participants asked what led me to pursue this study. I shared that if the experiences of the women I interviewed revealed any of them felt racially stereotyped, then I would use their experiences to encourage science faculty to examine their beliefs and assumptions about Black students. Every woman, regardless of whether she was aspiring to enter an allied health field, shared she felt professors judge students negatively based on their race. This led me to consider how the professors would respond and I made the assumption that claims of racial colorblindness would be plausible. This led me to discussions of racial colorblindness with my participants.
Lopez (2014) describes colorblindness as “the dominant etiquette around race” (p. 77). Bonilla-Silva (2003) calls racial colorblindness “racism lite” (p. 3). Science professors who claim to be racially colorblind can contribute to racism by ignoring or minimizing systemic racial barriers that are in place for students of color inside their teaching spaces. It absolves professors of the responsibility of acknowledging racial inequities, and it acts as a workaround allowing them to avoid critical self-reflection on how they treat and interact with students of color.

Of the five women who participated in this study, only one, Kim, believed achieving racial colorblindness was possible. Sweets described the idea that someone could be colorblind as “Bullshit” and felt if a White person said he or she was colorblind, then “they were definitely racist.” Beck saw colorblindness as not associating or ascribing negative traits to people based on their skin color, not just not seeing skin color. Alanna had a similar view in that she felt it meant that a person who claims colorblindness is judging someone based on their character, not their skin color. Although when I asked what she would think if a science professor told her he or she was racially colorblind, she laughed and immediately said, “That they are full of crap!”

Regarding a science professor’s ability to be racially colorblind, Mickey does not believe it is possible. “I just wouldn’t believe they were being truthful - there is no such thing as colorblind,” she said, then added, “you have to see people how they are, not how you want to see them – everybody is not equal, everybody is not colorless – you have to be realistic, not everyone is equal in our culture, and that has its basis in skin-color.” Mickey is the only participant who addressed colorism in relation to colorblindness. She explained, “There is bias within our own culture about skin color – we are not even colorblind within our own race,” she said. “With Black people,” Mickey explained, “they say ‘well I’m light-skinned’ or ‘I’m dark-skinned’ and I’m like at the end of the day you are still black, you are a person of color no matter
how you want to slice it.” Mickey also provided examples of more favorable treatment in a science laboratory of a bi-racial friend and how the bi-racial friend was able to switch identities based on her light-complexion making it possible for her to interact differently with White students than she did with Black students.

Discussion of Research Findings in Relation to CRT

CRT is a set of interrelated beliefs about the significance of race and racism in the U.S. It served as the theoretical lens for analysis and interpretation. In this section, each of the tenets of CRT will be addressed in relation to this study.

1. **The centrality of race and racism.** CRT views racism as an inherent and permanent fixture in society (Ladson-Billings & Tate, 1995). One of the frameworks used for this study was Black feminist thought. The findings from this study show that racism was present in the college science learning spaces of these women. The women felt their science professors noticed race and treated students differently on the basis of their skin color. Although negative stereotyping and differential treatment of Black women by science professors impacted their science learning in different ways, the centrality of race to their science learning experiences has been established.

2. **Challenging the dominant racial ideology.** CRT as it applies to educational research challenges claims of objectivity, race-neutrality, meritocracy, and racial colorblindness in learning spaces. The women in this study strongly believed that if a science professor claimed to be racially colorblind, he or she was at the least, being disingenuous. Most felt it was impossible for anyone to be racially colorblind. Bonilla-Silvia (2006) explains, the colorblind ideology
associated with racist attitudes, denials of racism, and negative attitudes towards anti-racist policies. The participants felt claiming to be colorblind equated skin color with something negative and by claiming not to see it, aside from being ridiculous, minimizes the importance race plays in their every day and science learning experiences.

3. **Commitment to social justice.** CRT seeks to advance educational equity and promote empowerment. A goal of critical race scholarship is to understand racism in all forms so that what is learned is used for social justice, empowerment, and positive social change. Being committed to social justice goes beyond acting to expose inequality, it requires an exploration of possible solutions to the problems that were identified. In this study, racism was found to negatively affect the science learning trajectories of women taking science classes as a pre-requisite for nursing school. To uphold the CRT tenet of commitment to social justice, recommendations for action for science faculty and department chairpersons are discussed below.

Another way this study is tied to social justice is the underlying motivation from which this research was borne. I am a White female college science instructor. As a result of my employment, I have had interactions with both Black women science learners whom I have had the opportunity to get to know as their science instructor and with my colleagues in the Science Department. As a White instructor, I have been situated in multiple interactions and conversations where deficit views of Black students are spoken of freely. Comments have been made about the way Black students act, speak, and conduct themselves in science learning spaces. Most of the colleagues sharing these observations have been White, but not all of them. Although it is clear from these experiences that some of my colleagues racially stereotype Black students, especially Black women, I doubted any of them would self-identify as a racist. I
wondered how these racial biases, whether they were conscious or unconscious, affected the science learning experiences of their Black female students. Race can be a difficult, painful, and awkward topic to discuss across racial lines. One of the goals of this research is to challenge White professors to become aware of their racial biases and show the damaging effect those biases can have on their students’ science learning.

4. **Valuing experiential knowledge.** CRT recognizes that the experiential knowledge of people of color is legitimate, appropriate, and critical to understanding, analyzing and teaching about racial subordination. In this study, the experiences of Black women as told by Black women are used as evidence to document discrimination and differential treatment inside science learning.

5. **Racism situated in both historical and contemporary contexts.** A lens used in the analysis for this study was Black feminist thought. Black feminist thought was borne from the history of slavery in the U.S., and it recognizes how slavery has shaped societal positionality of Black women in the U.S. (Collins, 2002, p. 4). Participants referenced slavery for the basis of stereotypes. They discussed the slave mentality and how they believed some people, both Black and White, are holding on to that mentality. One of the science professors in this study mimicked female slaves in class. The women who discussed colorism used slavery as the historical context for the preferential treatment of women who have a lighter-complexion.

**Limitations**

This study has limitations, which is true of all research, but measures were put in place to minimize them. Case studies have an inherent limitation, in that they cannot be generalized to a broader context, so the findings apply to only the women in this study and cannot be generalized to other Black women taking college science classes. As Yin (2009) stated, looking at multiple
cases helped make the study more robust, and five women were included in this study. Additionally, I enlisted the assistance of a peer to review my research and pose hard questions about my methods and interpretations.

As a White researcher interpreting data from Black participants, I may have misunderstood or misinterpreted the meaning and contexts of some of their stories. To minimize this limitation, I used member checking to ensure that the participants agreed with the findings and interpretations. I also explicitly asked each of the women how she would have answered the questions differently if I were a Black researcher. The women indicated they would have told me the stories in a different way or used different terms, but the fact that I was a White researcher made them provide more information, not less because they recognized I might not have the ability extract the complexity of the meanings. Because I was White, they provided more information to assist my understanding which served to minimize this limitation.

Another limitation could be that I did not recruit only women who explicitly stated they had experienced racism in college science learning spaces. Although the foundational tenet of CRT is that racism is a permanent fixture in the U.S, I did not recruit participants on the basis of whether or not they had experienced racial bias or felt racially stereotyped in science learning spaces. Kinzie (2007) states “critical theory rejects the idea that neutrality is a necessary condition of inquiry” (p. 87). If I had limited participants to only women who had experienced racism, there would likely be more evidence of racism in science learning spaces. Since the framework for the study is CRT, that could be considered a limitation of the study. Additionally, although qualitative research enables researchers to gain rich data from participants, it relies on participants to give complete, honest, and accurate answers. Therefore, the data are based on the
participants’ perceptions and my ability as a researcher to give accurate meaning to their perceptions.

**Implications and Recommendations**

The implications of this research will be presented as recommendations to science professors and science department chairpersons.

*Recommendations to Science Professors*

1) We should critically evaluate our teaching practices. Ask for anonymous feedback, let students know they can come talk to you, put your department chairperson’s contact information on your syllabus, and be willing to be accountable. Scholars of critical race theory (Delgado & Stefancic, 2000; Ladson-Billings & Tate, 1995) analyze education through a racial lens, interrogating the ways that racism impacts the educational experiences of communities of color.

2) We should educate ourselves about various forms of racism and develop a critical race consciousness (Crowley & Smith, 2015). Understand the how stereotypes are critical to the maintenance of racism and to work to grasp the implications of passive racism (Tatum, 2003) and dysconscious racism (King, 1991). Studies of pre-service and K-12 teachers reveal various forms of racism as well as a variety of strategies educators use to evade critical analysis of their involvement in deficit thinking and racial stereotyping (Crowley & Smith, 2015; Haviland, 2008; Picower, 2009).

3) Do not claim “racial colorblindness” to dodge a critical analysis of participation in racism. Colorblind discourse evades discussions of the contours of racism and minimizes the legacy of racism through discourses of meritocracy and equality (Leonardo, 2002).
The women in this study felt if a professor claimed to be racially colorblind, it was a cover for problematic racial views. They believed that being racially colorblind was impossible.

**Recommendations to Science Department Chairpersons**

1) Review syllabi to confirm each faculty member includes a statement of non-discrimination. Title VI of the Civil Rights Act of 1964 protects students from discrimination. The Office for Civil Rights, an arm of the U.S. Department of Education, enforces these laws. Any college that receives federal financial assistance from the U.S. Department of Education is required to protect students. A combined non-discrimination notice should contain two basic elements: (1) a statement of non-discrimination that specifies the basis for non-discrimination; and (2) identification by name or title, address, and telephone number of the employee or employees responsible for coordinating the compliance efforts.

2) Encourage professional development that enriches faculty understanding of systemic racism, culturally responsive teaching practices, and anti-racist teaching practices.

3) Have an awareness that some of the faculty you manage may not be capable of seeing past racial stereotypes which could cause them to misidentify the object in need of change. They may need the assistance of the Department Chair to shift the object of change from “these types of students are not capable” to “the professor needs to improve his or her teaching practices.”

4) Create a safe space for faculty to talk about race. We cannot solve a problem without talking about it.
This study plays an important part in exposing the ways in which science professors affect the science learning trajectories of Black women. Although the intentions of the science professors are not known, it is reasonable to assume that many of the professors did not enter a career in college science teaching to limit the success of Black women by treating them in a less-supportive way or by discouraging Black women from completing their classes. Regardless of our intentions, what we say and do inside our classrooms conveys more to students than we realize. Educating ourselves about the implications of our actions, whether they are conscious or unconscious, is important to improving the success of Black women in our science learning spaces.

**Future Research**

More narrative evidence is needed from minority students in science learning spaces. While studies centering a CRT perspective provide the opportunity to have a deeper understanding of how racism affects student learning, in science education, these studies overwhelmingly center STEM- and science-majors. STEM- and science-majors differ from the participants in this study in that many are already high-achieving science students. However, most college students are required to successfully complete science courses in order to earn a Bachelor’s degree. Future research should include the science learning experiences of non-STEM and non-science majors to produce literature that will benefit these students as well as science faculty who will be teaching them.

Some of the women’s experiences gathered for this study were alarming and disturbing. Although every college and university that receives federal funding is required by the Department of Education to adhere to a non-discrimination policy, the results of this research show that is not the case. Future research could be directed towards determining how effective
Title VI of the Civil Rights Act of 1964 has been in protecting minorities of all types from discrimination. Also, how do science faculty uphold or enact their commitment to non-discrimination in their classes and laboratories?

Multiple studies have been conducted on preservice and K-12 educators that reveal racial bias, deficit-view stereotyping, and avoidance strategies employed to deflect the appearance of race-based thinking (Crowley & Smith, Haviland, Milner, Picower). Similar research should be conducted centering college science faculty which could uncover similar unconscious biases that may affect the way we interact with students. Finally, a tenet of CRT is to challenge or express skepticism toward claims of racial colorblindness. The women in this study believed racial colorblindness was not possible and if a professor claimed to be colorblind, that professor was likely a racist. However, the colorblind ideology is present in college learning spaces because it upholds the idea that race should not be acknowledged or considered inside our classrooms; essentially if we see or acknowledge race, we may be considered racist. A study exploring how science professors engage with claims of racial colorblindness could lead to productive self-analysis benefitting both science professors and our students.
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APPENDIX

Interview Guide for Interview 1

PARTICIPANT HISTORY

- Tell me about yourself.
  - How would you describe yourself?
  - How would your friends describe you?
- What made you choose your major?
- How many face-to-face college science classes and labs have you taken?
- What made you choose the college science classes you took?
- What does a “science person” look like?
- How would you describe your overall experiences in science learning spaces?

EXPERIENCES IN SCIENCE LEARNING SPACES

- Do you consider yourself a “science person”? Why or why not?
- What was science learning like for you in high school?
- Take a moment and think about each of your college science classes. Would you describe how you felt when you were in each of the spaces?
- Did you feel like any of your science professors noticed or paid attention to race? Gender? Age?
- Did you notice or feel any sort of stereotyping while you were in science classes or labs?
- Has race or gender ever come up in your science class or lab?
- Have you ever been a part of or witnessed a student-science professor interaction that was based on a cultural misunderstanding?
- Think about the interactions you have had with the science professors who have helped you the most. Tell me what those were like.
- Think about the interactions you have had with the science professors who have helped you the least. Tell me what those were like.
- How did those interactions make you feel?
- How/In what ways did those interactions influence your science learning?
• Do you think a White student or a male student would have had the same experiences as you? Why or why not?

BLACK WOMEN IN SCIENCE LEARNING SPACES
• What are the advantages of being a Black woman in science learning spaces?
• What advantages do students who are not Black woman have?
• What types of learner characteristics do you think are important for Black women in science learning spaces?
• What advice would you give to other Black women who will be taking college science classes?
• What advice would you give to science professors?
• How do you think college science professors are different from professors in other subjects?

CLOSING
• What questions do you want to ask me?
• Will you let me interview you again after I interview the other participants?
• What is the best way to contact you if I have questions?
• What is the best way to give you the case narrative I write so you can review it for accuracy?
**Interview Guide for Interview 2**

**DISCUSSION OF INDIVIDUAL EXPERIENCES**
- How can I improve the case narrative you read?
- Is there anything you want me to add or remove?
- Do you have any questions for me?

**RACIAL COLORBLINDNESS**
- What does “racial colorblindness” mean to you?
- If someone tells you they are colorblind, what does that mean?
- What would you think if a science professor told you he or she was racially colorblind?
- Were any of your science professors racially colorblind?
- How could you tell?
- Do you think it is possible to be racially colorblind? Why or why not?

**RESEARCHER WHITENESS**
- How would you have changed any of the things we’ve discussed/you’ve shared if I were a Black researcher?
- How would you have answered these questions differently if I were a Black researcher?
- [To participants who knew me prior to becoming participants:] What about the Black women I’m interviewing who don’t know me like you do – what do you think they might have done differently if I were a Black researcher?
- What might you have explained differently if I were Black?
- What impact do you think me being White will have on this study?

**CLOSING**
- What questions do you want to ask me?
- What is the best way to give you the new sections I’ll add to your case for you to review?
- Is it okay if I contact you if I have any more questions?