# THE UNDER-REPRESENTATION OF AFRICAN AMERICAN WOMEN IN THE STEM FIELDS WITHIN THE ACADEMY: A HISTORICAL PROFILE AND CURRENT PERCEPTIONS

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

African American and African Studies—Doctor of Philosophy

2016

**ABSTRACT**

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This research project seeks to discover the reasons behind the underrepresentation of African American women (AAW) in higher education, particularly in the Science Technology Engineering and Mathematics fields. Why is there underrepresentation of AAW in the STEM fields? Research evidence has demonstrated that AAW face social disparities such as race, gender, and class in the academy. A lack of adequate mentoring and financial resources to support their research efforts are related to these disparities and present fundamental challenges for them. To conduct the inquiry about the barriers AAW have to overcome to achieve success in STEM disciplines, a qualitative research method was used to "attend to social, historical, and temporal context. The findings of these studies are tentatively applied; that is, they may be applicable in diverse situations based on comparability of other contexts" (Mariano, 1995, p. 464). The researcher collected data by

conducting in-depth interviews with five participants, using an open-ended conversational format to facilitate the development of trust, rapport, and maximum elicitation of stories from the participants. The results suggest that AAW overcome barriers to successful STEM careers through their family and social ties, mentoring relationships as well as their religious practices.

This dissertation is in dedication to my dear grandmother, Ms. Cynthia “Gams” Howard for teaching me that “the truth never has to defend itself.” May you rest in heavenly peace and continue to be my guiding light. I love you and miss you so much. ‘Now we have our Ph.D.,’ tassel turned left!

**ACKNOWLEDGEMENTS**

I would to thank my dear mother, Mrs. Faith Howard-Johnson for seeing me as a special gift to this world and encouraging me to never give up on the things my heart truly desires. Thank you Grandma J for seeing me as a shining star and encouraging me by calling me your "Dr. Granddaughter." Many thanks to my dear mentor of 20 years, Dr. Don Viapree who has guided me over endless hurdles while equipping me with mental strategies to maintain my peace of mind in the midst of all storms. Ms. Mary Smith, my dear great-aunt, I thank you for all of your constant prayers, unconditional love, and words of wisdom. Special thanks to my cousin, Quallie Johnson who assisted me greatly in my final stages of this dissertation. Many thanks to Mrs. Dawne Botke-Coe for helping me to draw closer to my own light and to embrace my powers unapologetically.

To my Spartan family, thank you for your words of encouragement while simultaneously pushing me into my greatest potential: to my co-chairs Dr. Lee June and Dr. Rita Kiki Edozie thank you believing in me; for grooming me into higher levels of academic excellence. Additionally, thank you to my committee members, Dr. Gloria Smith and Dr. Karen Williams for the advice,

encouragement, and support. Thank you to Ms. Anne Graves for always lending a helping hand and keeping me alert and focused, Dr. Julius Jackson, thank you for seeing the scholar in me and assisting with my intellectual growth. Dr. Judi Brown Clarke, I cannot thank you enough for the 'golden nuggets' you extended to me, to Dr. Robbie J. Stewart thank you for seeing me (affirming me), Mr. Steve A. Smith, thank for guiding me through each step of the IRB processes and Dr. Reitu Mabokela, I appreciate your contributions to my initial research and your efforts in strategically getting me through my comprehensive exams. And also, I would like to give a special thanks to all of the research participants, Dr. Natalie Batamanian, Dr. Patricia Kenschaft, Dr. Frederick D. Chichester, Mrs. Octavia Cabey, Dr. Pamela Scott-Johnson and Dr. Aisha Steplight-Johnson for helping me reach the ultimate goal of the completion of this dissertation; thank you for your endless support I am forever grateful to you all; "teamwork makes the dream work." As I transition into the new divinely orchestrated journeys set before me, I will soar higher with courageous wings to increase the number of African American women with Ph.D.'s. Forever "lifting as climb!"

**TABLE OF CONTENTS**

LIST OF TABLES

# *CHAPTER 1: INTRODUCTION*

## *Statement of Purpose*

Four decades after the "women's liberation movement" in the US, the question still remains: why are African American women (AAW) outnumbered and outranked in the Science, Technology, Engineering and Mathematical fields (STEM) and in particular by their White male counterparts? Research makes evident, that it is because of external and internal barriers as well as a mixture of the two. Some researchers including Benjamin (1997), Jordan (2006), and Moses (1997) have pointed to the stereotypical notions which are commonly used within the American society as a strategy to justify and assign women to their "proper place" below and subordinate to men. Other researchers, such as Tickels (2006), Ceh and Blair-Loy (2010), have claimed that their lagging behind in such fields of study is due to their lack of discipline or even their dearth of interests to advance professionally. I hypothesize that combinations of both external and internal barriers have created blockages that aid to the invisibility of AAW in the academy. Therefore, this research seeks to define those

internal and external barriers more precisely as well as their effects on AAW's persistence and prospects towards occupational success. The specific purpose of this research is to both examine historical factors while unveiling the current perceptive reasoning behind the under-representation of AAW in the STEM fields within institutions of higher education. Additionally, I intend to investigate whether AAW have gravitated towards spirituality to seek guided answers from a higher power. That is, the study considers whether spirituality enables them to combat the politically orchestrated strategies of ongoing career sabotage exercised by the White power structures.

It is traditionally understood, that in order for a woman to advance beyond her "non-threatening" position, she must fight in order to gain recognition. Must an AAW be vastly superior in comparison to her male counterparts? Or even after gaining positions of authority and leadership roles in the academy, does she need to outperform and be both more gracious and astute than her male colleagues? Rather than focusing exclusively on external barriers, this research will also highlight the importance those internal

barriers that may account for significant losses of talented AAW in master's or doctoral programs as well as the degree carrying AAW in the academy. The majority of the literature suggests that the under-representation of AAW in STEM is related to external barriers. However, I believe that internal barriers are also potentially significant obstacles to the advancement of AAW in STEM. The internal barriers are the inner self doubts and lacking the discipline to propel toward the finish line. Hence, many give up before they put forth the needed efforts towards achievement. To speak to this factor, I refer to statistical data.

In 1993, the *National Science Foundation* (NSF) established the Program for Women and Girls, which is housed in their Division of Human Resource Development in the Directorate for Education and Human Resources (EHR). As the largest public funding source for research on the participation of girls and women in STEM, NSF began advancing in research projects to improve the representation of girls and women in STEM. Thus, NSF serves as a key resource to bring together previously conducted

research on STEM while emphasizing the work that still remains undone.

In particular, NSF (1998) notes the bias towards AAW in STEM in stating that, "women aren't encouraged to pursue science. People often think women aren't logical or analytical". In (2001) the NSF informed us that Black, Latina, and American Indian women made up less than 2% of employed scientists with doctoral degrees. According to the NSF (2004), women represented 46 percent of the total workforce in America, but only 25 percent of the workforce in the fields of science and engineering. Other data collected by NSF in 2006 showed that women earned more than half of all Bachelor's degrees (58 percent). Women also held more than half of all science and engineering undergraduate degrees (51 percent), but with notable variation among fields. Women earned more than half of the Bachelor's degrees in psychology (77 percent), biological sciences (62 percent), and social sciences (54 percent) and almost half (45 percent) in math. However, in certain STEM fields, women remain largely under-represented. Women received only 20 percent of computer science degrees, 21 percent of physics degrees, and 20 percent of engineering

degrees. Due to continued attrition throughout graduate school as well as other factors that deter women from entering STEM careers, women make up almost half (49 percent) of the Nation's workforce, but only 25 percent of the STEM workforce. Consequently, this gender gap has lessened opportunities for its US women of color, and in particular, African American women.

It is also important to highlight those internal barriers that may account for the significant losses talented AAW in master's or doctoral programs as well as the academy have experienced firsthand. The predominate body of literature typically suggest that the underrepresentation of AAW in STEM is related to external barriers. However, I believe that internal barriers are also potentially significant obstacles to the advancement of AAW in STEM.

It is necessary, therefore, to examine the experiences of talented AAW in postsecondary learning and work environments in order to inform actionable solutions to improve their rate of success in the academy. While the phenomenon of underrepresentation for AAW in STEM may start

during the early school years, it continues over time within colleges and universities. For example, although women among African American, Latina/o, and American Indian undergraduates are more likely than men in their sub-group to complete college degrees within six years, those aspiring to major in STEM fields at college entry were significantly less likely than their under-represented minority male counterparts to be retained in STEM (Hurtado et al., 2012). However, for those women who persist to graduate school and complete a degree, the outlook for a career in academia is brimming with challenges.

In a paper commissioned for the *National Academy of Sciences* proceedings, using data from the NSF, Ginther and Kahn (2012) found that AAW represent only 2.3 percent of the tenured or tenure track faculty and 5.1 percent of non-tenure-track faculty, although, they only make up 4.5 percent of the U.S. population. Moreover, among Ph.D. recipients, AAW have a lower likelihood of reaching the rank of full professor with tenure than their male and White counterparts. This structural underrepresentation affects the climate for diversity on two levels in an institution: it directly affects the behaviors and

interactions with others in a campus context, and on a psychological level, it shapes the perceptions that others hold of women of color, as well as their own perceptions of the learning and work environment (Hurtado et al., 2008).

In offering another source of information on the under-representation of AAW pursuing STEM based degrees; I refer to the American Institutes for Research (AIR) researchers who gathered statistical information on STEM PhD recipients from a sample of 2,713 using the NSF's Survey of Earned Doctorates between 2005 and 2010. Some of their findings are outlined as follows:

- More than a third of black STEM PhD holders earned their undergraduate degrees at HBCU's, but 88 percent of this group went on to earn their graduate degrees at predominately white institutions.
- Nearly 40 percent of black STEM PhD recipients identified as first-generation college students. Eleven percent of first-generation college students attended only HBCU's on their pathway to a STEM doctorate.
- Among black STEM PhD's women (14 percent) are more likely than their male peers (11 percent) to earn a doctorate at an HBCU (www.air.org; accessed on 10/26/14).

However, among women who earned undergraduate degrees in 2010, only 8 percent of Black women earned degrees in a

STEM field, compared to 10 percent of White women, according to the *National Science Foundation*.

Dr. Laurie O'Brien of Tulane University expresses in an American Psychological Association publication (2014) that:

> If black women start out in college more interested in STEM than white women, but are less likely to complete college with a STEM degree, this suggests that black women may face some barriers, such as race-based stereotypes (www.apa.org accessed: 4/7/2015).

Research suggests that AAW face a "double bind" for having two identities that are especially undervalued in STEM contexts: that of being female and a racial minority (Ginther and Kahn, 2012; Liefshitz, 2011; 86). Instead of a double disadvantage, some researchers have found that the intersection of both gender and race is reflected in women of color's unique perceptions of the workplace in academia (Aguirre et al., 1993) and that their professional experiences in STEM are qualitatively different than that of men and of White women (Liefshitz, 2011).

This heavily relates to W.E.B. DuBois' coined phrase "double-consciousness." DuBois states in his frequently referenced book *The Souls of Black Folk* that:

> It is a peculiar sensation, this double-consciousness, this sense of always looking at one's self through the eyes of others, of measuring one's soul by the tape of a world that looks on in amused contempt and pity. One ever feels his two-ness, an American, a Negro; two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder (2-3).

For historically the two identities of being Black and a woman is highly undervalued in this patriarchal Westernized society and thus, the AAW has been marked as an uninvited guest in the STEM fields. Therefore, this study will incorporate intersectionality as a theoretical framework to expose the multi-layered effects of both the internal and external marginalization's experienced by AAW in STEM.

By implementing intersectionality as a tool, a broad context can be critically examined thus, opening the doorway to understanding the systemic oppression within the institutional environment. Also, through investigative analysis the multi-layered effects of both the internal and external marginalization's experienced by AAW in STEM will expose the unending hostilities of power and privilege within the academy.

In recognizing the various forms of discrimination as overlapping biased acts, intersectionality serves as a

useful tool in analyzing and addressing these human rights violations. Intersectionality specifically speaks to the "cold hard truth" similarly to what Gary Lemons exactly articulates (1998) in his article titled "To Be Black, Male and Feminist" when he queries, "Is our attainment of patriarchal power through the oppression of women any less insidious than white people's perpetuation of a system of racial oppression to dehumanize us?" He then follows with an even bolder assertion, stating:

> Many of us have become so obsessed with fighting racism as a battle for the right to be patriarchal men that we have been willing to deploy the same strategies to disempower black women as white supremacists have employed to institutionalism racism (56).

This quote attests to the subjugation Black women experience by both the White male cultural system as well as within Black male chauvinism. It also attests that not all Black men carry this same narcissistic mindset thus, giving us hope to establishing more unity amongst Black men and women. It is through the tireless efforts of AAW trailblazers that Black women have audaciously developed a voice in spaces they were once deliberately muted.

Through the unceasing scholarly work of hooks, Beverly Guy-Sheftall, Johnetta Cole, Patricia Hill Collins, Hortense Spillers, E. Frances White and the likes of other valiant scholars, there have been many torch carriers working towards the empowerment of Black women; intellectually and professionally. One forerunner of such bravery is the early works of unsung heroine, Anna Julia Cooper. Led by such an unwavering and liberating spirit, Anna Julia Cooper emerged a force to be reckoned within the 1890's. As a Black feminist educator, scholar, and activist, Cooper was noted for attributing courtesies to and declaring the worthiness of the Black woman in society. Writing about the matchless position of the Black woman, Cooper expresses that she "confronted a woman question and a race problem" (Lemert, 112).

Speaking beyond the "double-jeopardy" which Cooper previously eludes to, Jacqueline Grant in *White Women's Christ and Black Women's Jesus: Feminist Christology and Womanist Response* states (1989), that there is in fact a "tridimensional character of Black women's life i.e., its vulnerability to racism, classism and sexism" (209). (Note, this triple marginality in which Grant speaks to is a part

of her very own “fighting words”). Hence this has and continues to be the work of AAW in and outside of the academy, in particularly, within fields of STEM. Their contributions have been many although their recognition historically has been slighted.

While it is true that AAW have been underappreciated by both the White oppressive male as well as her fellow White female colleagues for far too long. However, in her heroism the AAW has navigated strategically through life locating her space, obtaining credit rightfully due to her, and establishing egalitarian relationships without compromise. Choosing to use every life breathing moment to untie the grips of sexist and racist oppression from around her neck; she bravely exhaled while disallowing her voice to no longer be suffocated. For example, she has made her way through doors that were once bolted shut systematically due to her biological make up.

***Statement of the Problem***

After years of great debate, the question still remains a major topic of discussion, why does the under-representation of AAW in the STEM programs remain

unresolved. Research has demonstrated that despite the discriminatory attacks on AAW in the sciences, they still manage to earn degrees. According to *Royal Society of Chemistry* surveys (in 2000 and 2008), "the greatest attrition [for AAW] occurs during the transition from PhD to [independent] research" (Robinson, 273). Even though, attitudes towards women in science have improved, there is still minimum visibility and thus, low numbers in career advancement in STEM fields. Additionally, this reflects social markers such as racism and sexism, which ultimately has induced stereotypical notions of AAW. This "divide and conquer" tactic has obscured AAW abilities to transition from PhD to independent research. Also, it has led to their repeated experiences of unfair treatment due to such damaging biases.

***Research Questions***

After first conducting an overview of prominent historical AAW in the STEM field, the central research question of this study is why there remains an under-representation of AAW in the STEM fields. This study, a

qualitative one, will also address the following research procedural sub-questions:

1. What contextual and intervening conditions influence the under-representation of AAW? What is the current status of research on the involvement of AAW in STEM?

2. What causes the transitional shift of success from doctoral student to a professional researcher?

3. How does the institution play a part in the under-representation of AAW?

The above-mentioned sub-questions are necessary because as Creswell explains (2007):

> [I]n grounded theory, the steps involve identifying a central phenomenon, the casual conditions, the intervening conditions, and the strategies and consequences. By writing procedural sub-questions, authors can mirror the procedures they intend to use in one of the five approaches to inquiry and foreshadow their choice approach (110).

Similarly, Faulkner and Valerio (1995) approach explains the usefulness of the sub-questions:

> The sub-questions follow the paradigm for developing a theoretical model. The questions seek to explore each of the interview coding steps and include: What are the general categories to emerge in open coding? What

> central phenomenon emerges? What are its causal conditions? What specific interaction issues and larger conditions have been influential? What are the resulting associated strategies and outcomes? (3).

Therefore, some guiding questions include: Do AAW's have a role in their own invisibility when it comes to, for example, decisions regarding their own educational and occupational development. Perhaps they do not take enough risks to distinguish themselves in order to advance in the academy or their careers. Therefore, one might examine whether or not there are resolute steps towards AAW surpassing satisfactory achievements within the STEM fields? Why do AAW have a lower "return on the investments" when represented by the amount of higher education institutions? Despite the greater availability of resources such as financial support for advanced study and mentoring, why do AAW continue to be significantly underrepresented in STEM fields in higher education?

Thus, my objectives are twofold: First, I intend to conduct a historical review of AAW's entrance and presence in the STEM fields. Secondly, I will examine AAW's perceptions of the reasons for their own success or lack of success as well as the low numbers of AAW in the STEM

fields as a means of gathering data about the current status of barriers to the success of AAW in STEM in the academy. A goal of this study is to produce the type of description that will help to illuminate the various barriers they experience. However, since the researcher does not belong to any STEM organizations or academic departments, I have implemented Creswell's advice (1998) that qualitative investigators should not conduct research "in one's own backyard" (114).

***Significance of Study***

Dr. Ludmila Monika Moskal (2000) suggests that understanding the experiences of female scientists and engineers can initiate improvement in the work and educational environment and increase female participation. Obiomon and Sadiku (2007) state, that "solutions to overcoming their barriers lie primarily in awareness, understanding, and training of women of color and the administrators, faculty, and STEM management involved in advancing their status"(1). Therefore, Obiomon and Sadiku (2007) further explains that, "Despite the existence of these obstacles, research reveals that African American women enhance the value of the STEM [fields]" (1). Jordan

concurs, noting that, in fact, AAW "contribute a unique blend of culture, strength, courage, character, outstanding skills, and analytical abilities to STEM environments (28). MacLachlan raises the following inquiry, "Is the quality of their life better than those of the women of 1975 who had to struggle with so much?"(8). She then responds by stating,

> [I]t is very hard to say. The struggle is still there, racism and sexism still is at work, even if less obvious than in the past. But the experience of [the women mentioned above] show clearly that with support, such barriers can be dealt with, if not yet fully overcome (8).

To surmount barriers, AAW in the technologically intensive fields must maintain positive attitudes, utilize the support of family friends, engage supportive workplace culture, be passionate and competent in what they accomplish, engage supportive mentors and role models, embrace a supportive educational culture, and exercise extreme commitment and faith (Tickles, 2006).

***Outline of Dissertation***

This dissertation contains five chapters and the appendixes. Chapter one, includes an introduction of the

research which provides a summary of the primary focus and the themes. The study itself is a comparative analysis looking at the historical content of AAW and their entry into the higher education sectors specifically, in the STEM fields. Additionally, it articulates the rationale for the study, the rationale for using qualitative research methods, statement of the problem, and the research questions. Lastly, in this chapter, I included a summary of all the chapters within the dissertation.

Chapter two presents a comprehensive review of the literature. The third chapter describes the major theoretical concerns of the study and the methodological approach pertaining to the research at hand. It describes how participants were selected, the forms of data collection, how data were analyzed and the potential ethical issues.

Chapter four presents and highlights the results of each interview. In this chapter, each interview is described, along with the themes that emerge from each interview. The themes are accompanied with quotes. In chapter five, the results of the cross-analyses accompanied

with quotes representing different perspectives. It discusses the results of the study, the implications for theory development, practice, future research, the strengths and limitations of the study, and a conclusion. There is also an appendix section that includes copies of the informed consent forms, interview protocols and the survey.

## CHAPTER 2: *REVIEW OF THE LITERATURE*

### *"3 Strikes" of Oppression: Racism, Sexism, & Classism*

Caught between the conclusion of the *Civil Rights Movement* and the emergence of the *Black Power Movement*, during the *Second Wave* of the *Feminist Movement*, AAW were hemmed against walls of historical struggles. On one hand, "White privilege" which was systematically created by the White power structure instigated the racial disparities AAW experienced during the *Women's Rights Movement*. Whereas, male chauvinism from the same Westernized oppression activated internalized racism and sexism amongst Blacks. Thus, the evolution of the Black Feminism Movement materialized "to address the ways sexism, racism, and classism influence the lives of Black women whose needs were ignored" (www.mit.edu). With great hopes of escaping the multiple levels of oppression, which marked them invisible, Black women scholars and writers began to speak out via literary scholarship. Novelist, Toni Cade brought truth to power when she published her anthology, *The Black Woman* in 1970 which encompassed a combination of poems, articles, and prose tackling concerns of Black women, where

she plainly states "this invisibility […] goes beyond anything that either Black men or white women experience" (22). Next was the highly acclaimed literary scholar, bell hooks who gave us *Ain't I a Woman: Black Women and Feminism (1981).* In this literary masterpiece, hooks highlights the dual oppression of the Black woman's experience and her invisibility, stating:

> No other group in America has so had their identity socialized out of the existence as a black woman. We are rarely recognized as a group separate and distinct from black men, or as a present part of the larger group of "women" in this culture. When black people are talked about, sexism militates against the acknowledgement of the interests of black women; when women are talked about racism militates against recognition of black female interests (7).

This excerpt speaks to the displacement of AAW within the White feminist and Civil Rights movements thus, living under an inescapable "double jeopardy" due to both racial and gender oppression; thus, she must find her own way. Similar to hooks', in 1983, Barbara Smith uses literature to unify the voices of AAW when she presents us with another anthology, *Home Girls*. In this prolific collection, Smith speaks of the effects of class and sexuality as it relates to the oppression of AAW. She asserts "Until Black feminism, very few people besides Black women actually

cared about or took seriously the demoralization of being female and colored and poor and hated" (xxxvi). In the same year (1983), Angela Davis gifted us with her pioneering literary text, *Women, Race and Class,* which opened a wider lens to our scope thus, inviting us into concerns of classism from a Black feminism perspective. Davis supports "equal footing" for both the Black man and the Black woman, seeing the home as a space to build a stronger establishment towards partnership. Davis writes:

> Precisely through performing the drudgery which has long been a central expression of the socially conditioned inferiority of women, the Black woman in chains could help to lay the foundation for some degree of autonomy, both for herself and her men (175).

Davis highlights the foundational gifts AAW contribute despite their fixed positions of "second class citizens," whereas Alice Walker addresses the stereotypical notions of Black women. In Walker's *Living by the Word* (1989), she brings forth the concept of a "double-headed" captivity which are formulated from multi-layered experiences of oppression. In lengthy detail she walks us through a panoramic vision:

> Early this morning I dreamed of a two-headed woman […]. While one head talked, the other seemed to doze. I was

> so astonished! For what I realized in the dream is that two-headedness was at one time an actual physical condition and that two-headed people were considered wise. Perhaps this accounts for the adage "Two heads are better than one." What I think this means is that two-headed people, like blacks, lesbians, Indians, 'witches,' have been suppressed, and, in their case, suppressed out of existence (1-2).

Similarly to Walker a year prior (1988), Sociologist Deborah K. King's article "Multiple Jeopardy, Multiple Consciousness: The Context of a Black Feminist Ideology," delves into the simultaneous forms of oppression, asserting:

> The triple jeopardy of racism, sexism, and classism is now widely accepted and used as the conceptualization of black women's status. However, while advancing our understanding beyond the erasure of black women within the confined of the race-sex analogy, it does not yet convey the dynamics of multiple forms of discrimination (46-47).

Although in 1988, King's point of reference did not examine the multitude of discriminatory acts exercised against AAW. In 1990, the revolutionary works of Patricia Hill Collins, birthed the *Black Feminist w*here she undertook a further investigation of the inequalities exercised towards AAW from a career advancement standpoint. Collins asserts:

> While Black women historians, writers and social scientists have long existed, until recently these women have not held positions of power in universities,

> professional associations, publishing concerns, broadcast media, and other social institutions of knowledge validation. Black women's exclusion from positions of power within mainstream institutions has led to the elevation of white male ideas and interests and the corresponding suppression of Black women's ideas and interests in traditional scholarship (7).

In examining AAW's placement in history, "we have also been outraged by the ways in which it has made us visible, when it has chosen to see us" (Carby, 1997; 110).

Academic employment is an area of particular concern because faculty educate and impact students. However, there remains to be a dearth of role models which lead to the underrepresentation of AAW in STEM. Thereby, the salary differences and low status continues to plague. As a result, of bias and discriminatory hiring and advancement this leads to slower advancement of AAW in academic science. To bring clarity to the above-mentioned factors, the systematic oppression within the U.S. labor market will be visited to bring attention to such workforce injustices.

**"Minority Report": Labor Injustices**

Historically, in the workforce of the U.S. labor market women have experienced "pervasive stereotypes devaluing their professionalism" (Ridgeway, 1997; 65) which has led to the ill-fated yet common, "unequal access to male-dominated networks" (Ceh and Blair-Loy 2001; Davies-Netzely 1998). Therefore, women continually experience gendered structural barriers constraining their career advancement. Lee (2002) explores further:

> Women and racial minorities are thought to face particular disadvantages in managerial and professional settings. Persistent and even widening gaps in earnings, slower rates of promotion, and truncated career ladders suggest that a glass ceiling exists for women and racial minorities (695).

The *US Department of Labor* (1991) defines the glass ceiling as "those artificial barriers based on attitudinal or organizational bias that prevent qualified individuals from advancing upward in their organization into management-level positions" (U.S. Department of Labor. (1991). *Report on the Glass Ceiling Initiative.* Washington, D.C.: G.P.O.).

According to Bolzendahl and Myers (2004), women's employment activates awareness of structural barriers because it (1) exposes them to discriminatory treatment,

which leads them to acknowledge gender inequality; (2) falsifies myths about women's capabilities, which undermines individualistic explanations of inequality; and (3) exposes them to networks of nontraditional women who are likely to expose structural explanations of inequality.

Knowles and Prewitt (1969), inform us of the influential powers institutions possess, by stating "[I]nstitutions have great power to reward and penalize […] [t]hey reward by providing career opportunities for some people and foreclosing them for others" (5). Thus, women are often held at higher standards to prove their competence than similar men and are often denied credit for their success. When women display undeniable competence and authority in the workplace, they face another hazard: stigmatization for excelling at tasks viewed as masculine. Competent and powerful women are more than likely to be seen as dislikable and untrustworthy and therefore become less influential than similarly acting men (Heilman 2002; Ridgeway 1997; Ceh and Blair-Loy 2010).

Lee (2002) found that, White women and minorities traditionally have been segregated in the peripheral sector of dual labor market (697). He goes on to express,

"Competition for preferred jobs meant the construction of institutional barriers that excluded particular groups from the core sector and resulted in segregation of powerless workers in a limited secondary labor market" (697).

Similar dynamics as above-mentioned affect AAW in higher education as well. In particular, AAW in the academy have experienced all too often this "secondary treatment," and have been "virtually invisible" in research literature throughout history. For instance, Yolanda Moses (1997) author of "Black Women in the Academe," observes "the subtle and not so subtle ways that race and gender stereotypes [are] combined to create a double obstacle for black women" (23). Moses has examined the professional climate issues of the affirmative action dilemma stating that African American women have been placed under the "token" syndrome while balancing competing obligations.

Similarly, in *Sisters of the Academy,* Williams states (2001) that "[Black women have] been targeted as being simply affirmative action cases with little regard for the skills and intellect that they bring to campus" (94). In *Ph.D. Stories: Conversations with my Sisters*, Dowdy (2008)

speaks on being the "token" Black: "You will be hired and then find out that you are to fill the position of the only Black, only female, only published writer on your topic, and sometimes remain the only person of color in the building where you work" (4). Moses examines the mistreatment of AAW and the perception that they are less qualified noting, "My appointment was seen as an affirmative action hire. People did not expect me to be successful. But I was [and some] were actually rude enough to tell me so---thinking it was a compliment" (25). This is a prime example of the differential treatment exercised amongst AAW in the workplace. The tainted images of AAW stems from the historical misconceived notions. Saliwe M. Kawewe's (1997) in "Black Women in Diverse Academic Settings," conveys the following message regarding the misconceived notions of AAW:

> While some of the misconceptions and stereotypes are culturally biased, others are based on misunderstanding that arises from affirmative action compliance. For example, one false assumption is that any award, recognition, honor or promotion of black females is due to their special status of being black and female. [W]hat this implies is that being black and female is a passport for receiving preferential treatment. It further suggests that when universities recruit the

> black woman, they neither review nor value her credentials, past experiences, or potential for meeting high academic standards (264).

The above-mentioned excerpts hone in on Mabokela and Green's edited works *Sisters in the Academy (2001),* where one contributing 'sister-scholar' shares her story of the repeated mistreatments and alienation experienced by AAW in educational institutions. Williams (2001) shares experiences of her sisters by stating, "While their race and gender make them so visible on the outside, when they are devalued, ignored and disrespected, they are sometimes left feeling invisible inside" (94).

Samuel and Wane (2005) concur that AAW are underrepresented within academic walls. They state, "marginalization of minority women that is produced in the social world is reproduced in academe" (79). Akanke Omorayo who previously served as the program coordinator of the University of Michigan's Women of Color in the Academy Project (WOCAP) shares, "One of the more pressing complaints I hear from women of color faculty today is that no one takes their work seriously, or at best, it's viewed as a kind of public relations tool." Citing the scholarly works of Fanon, Friere and Scott, Boukari noted:

> Suppressing the knowledge produced by any oppressed group makes it easier for the dominant group to rule, because the seeming absence of an independent consciousness in the oppressed can be taken to mean that subordinate groups willingly collaborate in their own victimization" (Fanon 1963; Friere 1970; Scott 1985).

Safoura A. Boukari (2001) points out that there is a "continual multifaceted oppression and discrimination in predominately white institutions" (2). Bailey (who identifies as an African American woman) adds, "Invisibility and indifference of this environment bind us in an intimate and sorrowful way" (113). Derald Wing Sue, a Professor of Psychology and Education at Columbia University's Teacher's College observes (2008) that:

> [T]oday's racism is not the same as the overt racism of the past. The way that people of color are put behind now is mainly by a general failure to help. Assistance does not require handling people with kid gloves; it simply means taking work and scholarship by faculty of color seriously enough to challenge and support scholarship in a way that presupposes the possibility of success (26).

It is highly misleading to say, without further explanation, that AAW experience one form of oppression, as Blacks (the same thing Black men experience) and that they experience another form of oppression, as women (the same

thing White women experience). While it is true that…institutions that are described as sexist affect both Black and White women, they are affected by other forms of oppression as well (Spelman, 1988; 122). Turner addresses an additional unfortunate factor (2002), that the lives of faculty AAW are often invisible, "hidden within studies that look at the experiences of women faculty and within studies that examine the lives of faculty of color. AAW fit both categories, experience multiple marginality and their stories are often masked within these contexts" (75-76).

**"The Cat and Mouse Games" of Tenure for AAW**

"Institutional politics play an important role in the lives of academics, particularly academic women, because they often do not recognize that advancing in the academy is like playing a game" (Cooper, 2006; 12). According to Aisenburg and Harrington (1998), in order to play the game one has to know the formal and informal rules. They suggest that there is one primary rule unbeknownst to most women: the tenure game is one of politics, not merit. The women in their study believed that opposite--that merit, and not politics was the key (Cooper, 12). Women called themselves

"naïve" and they mean that they did not--or still do not--know how to play the academic game, but they also mean that they rejected--or still reject--the idea that playing the games to advance themselves is necessary. They believed--and still want to believe--that people advance themselves in the academic profession primarily through merit. And by merit they mean true merit that includes quality of mind and moral commitment as well as performance in writing and teaching. Further they believe that true merit will somehow be evident and recognized by professional authorities without self-advertisement. "They eschew academic politics--the technique of gaining the notice and support of important people---assuming that such game playing is, if anything, self-defeating because it is the opposite of merit and integrity" (393-394).

It is a known factor amongst the academic community that those who are not abreast on "playing the game" do not survive. For example, they may be subject to not obtaining a promotion for tenure and we all know that is the ultimate achievement for professoriate. Thus, another "unwritten rule" and very key to one's survival is developing relationships. Beyond one's teaching, research, and service

duties, a big category towards achieving tenure is collegiality. The consequence in "failing to participate in these activities could be detrimental to a faculty member's bid for tenure" (Benjamin, 1997; Braskamp & Ory, 1994; Park, 1996). As Cooper so straightforwardly puts it (2006) these rules, written and unwritten, formal and informal, are in place because there has to be some mechanism for deciding who gets tenure. She continues by specifying the costly investment placed on tenured faculty, "Tenure is an expensive and long term commitment on the part of an academic institution" (13). Gee and Norton (1999) state "While women are earning more doctorates, their chances of landing full-time tenure-track positions are shrinking" (165).

In The *Sister' Network*, an interviewee named Inez speaks to the unwritten rules of tenure. She states, when Cooper asks (2006):

> How can you inquire about the unwritten rules if you don't know they exist?": You are absolutely right. I think it is the natures of the research university, any university, because it is upon you to find out immediately, when you walk in the door, what you have to do to get tenure. You have to go and seek out that information. You have to get those timelines and figure it out. That is the lesson I learned. No one is going

> to help you. In some ways I knew that. In other ways, it is hard to sustain that you have to be proactive all the time (54).

Similarly, Christine Stanley in the "Summary and Key Recommendation" chapter of *Faculty of Color: Teaching in Predominately White Colleges and Universities*, offers some sound advice in key areas that would be of great benefit to female faculty who are in pursuit of career advancement in the academy. Stanley (2006) expresses for faculty, to expect racism [and] sexism. […]. Also, to understand that while excellence is expected of you, mediocrity is acceptable for others. [Understand that you] will always be placed in a mode to "overprove" yourself" (372). Additionally, she recommends faculty in pursuit of tenure to:

> [First and foremost, get] to know the culture of your institution. Even if there is no formal orientation or mentoring program, look for opportunities to learn how the organization works and what it values, then make informed choices. [Secondly to] know the rules for promotion and tenure in the department and institution, understand what is expected, what benchmarks are used to assess progress, and have them in writing in the contract, if possible. Get oral promises from the chair and dean in writing. Find out the informal, unwritten rules, practices, and customs relevant to the promotion and tenure process (2006, 367).

Although it is evident women within the academy share some similarities of marginality, it is very necessary to mention that not all women, in particular AAW, experience the same forms of mistreatment. Hence, in Rodriquez's article "On the Declining Interest in Race," she reminds us (1988) to speak categorically about all women is to deny the existence of real racial and ethnic difference. To speak of White women and minority women, on the other hand, is to affirm the natural bond that exists as women, while acknowledging the differences that also exist as a result of race and ethnicity (24). For example, some women felt that the feminist movement was only concerned with the problems of bourgeois, well-educated, White women. hooks (1984) illustrated this border-crossing when she states:

> The condescension they [white women] directed at black women was one of the means they employed to remind us that the women's movement was 'theirs' that we were able to participate because they allowed it, even encouraged it; after all, we were needed to legitimate the process. They did not see us as equals. They did not treat us as equals. And though they expected us to provide firsthand accounts of black experiences, they felt it was their role to decide if these experiences were authentic (11).

Hence, research has reported Black women to be more strongly identified with their race than with their gender. The rationale for this is the biological factor that Black women come in all shades and therefore, immediately they are judged by the color of their skin; a "birth mark" which is unable to be hidden. Historically, color has always been a marker for alienation and elimination for Blacks; which is referred to as "colorism." Colorism is a divisive and destructive legacy of American racism; [it] is a social hierarchal system of preferences based on skin color within an ethnic or racial group (Russell, Wilson, & Hall, 1992). According to Collins (1990):

> The academy provides a chilly environment for Black women students, faculty, and administrators. The environment of the academy for the most part, is unreceptive, unsupportive, and lacks in understanding and sensitivity to issues that affect Black women (38).

According to Collins (1990), "race, class, and gender may not be the most fundamental or important systems of oppression, but they have most profoundly affected African American women" (227). Interlocking systems of domination refer to the fact that systems of oppression class, gender, race, and sexual orientation are interdependent (Patton, 189). The "outsider-within" position (Collins, 1986) is

often an appropriate descriptor and phrase for women in general and non-Euro American women in particular who work in academe. The "outsider-within" descriptor aptly denotes and calls attention to the continued prevalence of interlocking systems of domination in academia and the multiple ways dominance is enacted on university campuses (Patton and Mclure 1994; 185).

***Intellectual Isolation***

For instance, people of color tend to buy into a White structured notion of the inferiority complex, which leads them to question their mental capabilities. "Many [minority] students of color cannot perceive themselves as scientists, even after positive experiences in mathematics, computer, and science activities" (Johnson and Parrott, 1993, 27). Then there is a gender disparity, where one feels isolated and unwanted due to their biological make up. This is also supported by the American society which is known to be understood as "a man's world" therefore, women do not belong in certain environments and are expected to stay in their "proper place" that is for women. Not only are women pushed out of male-dominating positions, if in

fact they dare to pursue such opportunities their sexuality is called into question. Eager to see women robotically controlled under the thumbs of patriarchal mindsets, their male counterparts are often praised for the intellectual advancements.

Despite all evidence to the contrary (Lindberg, Hyde, and Hirsch, 2008), popular perceptions of boys' higher mathematical abilities make girls less confident of their ability (Catsambis, 1994; Jacobs & Simpkins, 2005) and may convince them that being good in math is un-feminine. In college, women have lower retention rates than men in STEM fields, partly due to classroom climates and dynamics that discourage their interest (Dingel, 2006; Fencl & Scheel, 2006) and to fewer opportunities for mentoring (Herzig, 2006). As female and minority scientists who enter academia are concentrated in less prestigious institutions (Long & Fox, 1995), the most promising female and minority students are less likely to encounter them as teachers. If they enter STEM occupations, women expect to "meet with discomfort, isolation and even harassment" (Cockburn, 199) and tend to face more barriers from "discrimination,

stereotypes, industry culture…and a lack of female role models" (Wynarczyk, 2007; 945).

Patterson reported on the "adversities of racism and economic hardships" faced by the 58 Black women to earn natural science doctorates between 1876 and 1969 (Patterson, 34). These tangible obstacles were accompanied by a sense of difference from both the scientific community and the home community" (Malcolm, Hall, and Brown 1976; 216) and the "loneliness, frustration, and self-doubt that often result from discrimination and the relative isolation of women in science and engineering" (Ambrose et al., 44). Evelyn Hammonds described the changing combinations of poor preparation, racism, and sexism that plagued her through her physics studies in the 1970s, first at Spelman and Morehouse, then Georgia Tech, and finally at MIT (Sands, 1993). MacLachlan asserts:

> The majority of studies do not deal with minority women in science and if they do, rarely pay attention to the structural conditions surrounding scientific Ph.D. training which can give rise to many difficulties for all persons (1).

Yes, there have been many trying times for AAW in pursuit of academic career advancement in STEM fields.

However, with the emergence of Historically Black College and Universities (HBCU's) doorways have granted peaks of hope.

***Significance of HBCU's***

Rising from the second Morrill Act of 1890, HBCU's:

> Missions have been committed to providing access to higher education for the marginalized and disadvantaged of our society. And today these institutions continue to be significant in educating African Americans and other underrepresented minority students, particularly in the areas of science and engineering (Mack, Rankins and Winston, 2011: 149-150).

Studies at the beginning of the new millennium (in 2000), indicated 40% of African Americans graduating with a bachelor's degree in biological sciences graduated from an HBCU (Cronkite and Frankel 2000; National Science Foundation, 2002). Furthermore, HBCUs were responsible for 40% of the bachelor's degrees awarded to African Americans in other STEM fields, including physics, chemistry, astronomy, environment sciences and mathematics" (Cronkite and Frankel, 2000; National Science Foundation, 2002). While these studies have established trends on the role that HBCUs have played in generating the pool of African Americans with degrees in STEM areas, most of these studies

relied on data collected in the 1990s. Although they compromise only 3% of U.S. institutions of higher education, HBCU's in 2008 awarded 20% of the baccalaureate degrees earned by Blacks in science and engineering. There are "over 40% of the top 49 baccalaureate institutions of Black science and engineering doctorate recipients" (NSF, 2011). From this it is evident that HBCU's have contributed meaningfully to addressing the void of qualified STEM educators and researchers (Allen and Jewell, 2002).

> In a study period of 2001-2009:
>
> The top three HBCUs issuing degrees to African American engineers were North Carolina A & T State University, Morgan State University, and Florida A & M University, which North Carolina A & T State University conferring almost twice as many engineering degrees as the other two institutions. Xavier University of Louisiana dominated in the field of biomedical science, granting almost twice as many degrees to African Americans than the second and third place producers, Howard University and Jackson State University. Two private, gender-specific institutions in Atlanta, Morehouse College (men) and Spelman College (women) were the top producers of math majors. For the final STEM major considered in the analysis, physical science, Xavier University of Louisiana was the top producer. Almost three times as many graduates matriculated from Xavier as the second and third top producers, Florida A & M University and Howard University (Owens, Shelton, Bloom and Cavil, 41-42).

Mack et al quotes Warren (2000) stating a known factor that "HBCU's were among the first institutions to allow women access to higher education (158).

Stereotypes that associate STEM with men and masculinity are one of the key culprits that contribute to the gender disparity in STEM participation (e.g., Kiefer & Sekaquapetwa, 2007b; Nosek et al., 2002; Nosek and Smyth, 2011). Additionally, associating STEM with men and masculine traits such as independence greatly contributes to the gender gap within the field. Furthermore, gender-STEM stereotypes can decrease expectations of success and valuing of STEM among girls and women, while increasing expectations of success and valuing of STEM among boys and men (Eccles, 2007). However, the ethnic prominence hypothesis suggests that race-based stereotypes, especially on college campus, may be more salient for African American women than gender-based stereotypes (Levin, Sinclair, Veniegas & Taylor, 2002). Thus, for African American women, raced-based stereotypes may be more likely than gender-based stereotypes to lead to attrition in STEM fields (O'Brien, Blodorn, Adams, Garcia and Hammer, 2015).

From the above-mentioned research; it is evident that AAW's are marginalized by societal ideologies. However, what are their own personal beliefs about themselves? Do they experience some form of internal conflict? What are the critical factors that have influenced and hindered their professional mobility and levels of success? Do structural barriers alone account for the underrepresentation of AAW's within the academy at lower rates than White women and men overall? Therefore, my proposed research will add to the existing literature in hopes to develop not only a clearer understanding as to why AAW are underrepresented in STEM but, additionally to create and maintain new strategies towards increasing their presence and visibility.

Bystydzienski and Bird inform us that "Colleges that have been the most successful in encouraging minority women scientists are women's colleges and historically black colleges and universities (HBCU's)" (2006; p.138). Especially women HBCU's, which have "diverse faculties and give confidence to women science" (Jordan, 1999)

Recent studies suggest that one of the greatest influences and determinants of academic success in STEM disciplines, especially for women students, is access to same-gender role models (Bettinger & Long, 152-157). Research indicates "that effective mentoring provides faculty […] with tools that are essential to negotiating success (Evans & Cokley, 2008; Jordon-Zachary, 2004; Perna Lundy-Wagner, Drezner, Gasman, Yoon, Bose, and Gary, 2009; 157). Mack et al (2011) speak of the necessity for AAW to have "culturally competent mentoring [which] requires honoring cultural complexities of the target audience, demonstrating an awareness of social pressures and influences, and emphasizing personal connectedness" (157). Recent evidence suggests that blended integration of these components of mentoring is not only successful in retaining underrepresented minority students in the STEM disciplines and contributing to their persistence toward science careers (Mack & Taylor, 2008), but could also be equally as effective in addressing the underrepresentation of Black women in the STEM disciplines (Mack et al; 2011, 157). All too often AAW are left behind in the trenches, forced to fend for themselves with very little guidance within

academe. In facing such unique circumstances which tend to stagnate their academic and professional success within the academy mentorship is crucial.

Mentorship has served as a key role in passing the baton of success along to the next generation. Therefore, the stories of AAW pioneers in STEM fields have inspired future successors greatly. These pioneers have contributed professional mobility during tumultuous times, paving the way for the expansion of AAW visibility in the STEM fields. Some of these pioneers will be discussed below.

***African American Women STEM Pioneers***

Historically, HBCU's are known for grooming AAW leadership pioneers positions of influence, power, and prestige. Highlighting AAW stories is pertinent to generational promotion as well as sustainability of their continual presence in the STEM fields. Despite the gender and racial prejudices exercised against them, AAW emerged to set stepping stones to make the doorway of STEM fields a bit less trying to pry open. For example, AAW like Jane Cooke Wright, Shirley A. Jackson are a few trailblazers that have opened doors in STEM.

Jane Cooke Wright who was born to a famous surgeon, Dr. Louis Tompkins (he was the first Black doctor to be appointed to Harlem Hospital's staff); in time he became the hospital's director of surgery and, later, president of its medial board; there was clearly no doubt that Jane was destined for greatness (Yount, 1991; 69). Jane's pathway in the medical field was very similar to her father's professional pursuits for she too became "the first" of many trailblazing accomplishments. For one, she became:

> The first black doctor to head a public inter-racial hospital […]; then the first black surgeon to work in the New York City police department, and first black surgeon to be admitted to the American College of Surgeons (Yount, 1991; 69).

Honored with a plethora of awards for her work in cancer chemotherapy she discovered "that examining cancer cells grown in tissue culture could help to predict which drugs would be the most effective against cancer. These cells are from the cervix, or neck of the uterus" (Yount, 1991; 74). Wright contributed greatly to this research field. Graduating from Massachusetts prominent Smith College in 1942, Jane then went on to obtain her MD with honors from New York Medical College in 1945. Joining pioneering forces in the medical field by collaborating with his foundation

in 1949, “for several years father and daughter did research on cancer drugs together” (Yount, 1991; 71). However, in 1952 upon Louis Wright’s death, Jane “took over her father’s position as head of the Cancer Research Foundation [and in] 1955 she joined the faculty of New York University, where she eventually became associate professor of research surgery” (Yount, 1991; 72). Throughout the years Wright would continue her cancer research until 1961, when she took a break “to visit the East African countries of Kenya and Tanganyika (now Tanzania) as part of a medical team sponsored by the African Research Foundation” (Yount, 1991; 72).

Challenging herself to soar even higher, in July of 1967, Wright entered New York’s Medical College which led her to not only become a professor of surgery but an associate dean as well. This is a rarity; to see triumphs in both the medical and academic sectors which granted her “the highest post in medical administration obtained by a black woman” (Yount, 1991; 73). She proclaims, “Coming back gave me a marvelous feeling” (73). Interestingly enough, the hardships that AAW commonly faced were not even a second thought for Wright for as Yount quotes:

> [B]eing either black or a woman has not held back her career. She is also proud that she was able to combine full-time medical research with raising a family [… and] she could not imagine a better way of life (77).

Similarly put, Bystydzienski and Bird quotes Collins (1987) statement that "African American women continue to have high rates of labor force participation and do not perceive work and family roles as conflicting" (125).

Another AAW pioneer in the sciences, was "Dr. Shirley Jackson [who] became the first African American woman ever to receive a doctoral degree from the Massachusetts Institute of Technology (MIT). Her field of study was particle physics" (Hayden, 1992; 150). Known as a leading American scientist, Jackson, was a "theoretical physicist at AT&T Bell Laboratories in New Jersey [and in], 1991 she became a professor of physics at Rutgers University" (Hayden, 1992; 150). In particular, her research tailored around electron behaviors; where she studied "a group of substances that are known as semiconductors [which encompass a] movement of electrons [and certain] to be conductors of electricity and light" (Hayden, 1992; 152). However, before her many accolades of accomplishments, Ebony magazine (1974) asserts, Jackson was born with the

confidence of champions. Upon her entry into college she was proactive about "lifting as she climbed" by working with MIT's Black Student Union (BSU). It was then, back in June of 1968, when Jackson aligned herself with fellow cohorts with a collective cause to overcome her first milestone with a determined mind to see an expansion of African American students. Hayden shares (1992):

> As a co-founder of the BSU at MIT, she was concerned that during her four years at college, the number of African American students had not increased. Only six or so black students were admitted to MIT each year (159).

Additionally, Hayden conveys, "Jackson was committed to changing this enrollment problem, but she knew that it would not be easy. Blacks and women were essentially nonexistent in the science and engineering fields back then" (159). Jackson's leadership of bravery, "marked the beginning of MIT's active recruitment of minority students" (159).

An accomplished data analyst and mathematician, Valerie Thomas was another hope for encouraging AAW to pursue STEM; "she was one of only two women in her class majoring in physics" while attending Morgan State University (Hayden,

138). Although she was discouraged by sexist stereotypical notions stating that her research fields of interests "were not for girls" (138). Thomas kept her focus forward with a determined mind to excel in computer science. Additionally, Thomas was a computer programmer as well; her designs served as a key element to "research related to a supernova explosion, Halley's Comet, ozone hole studies, and Voyager satellite encounters with the planets Uranus and Neptune" (142).

In revisiting Jane Cooke Wright's other impacts in the world of science, one in particularly, included her entrance into the vanguard of AAW inventors. Hayden (1992) details Wright's groundbreaking contributions to the field of computer science:

> As project manager for Space Physics Analysis Network (SPAN) in the late 1980's, [she] helped to develop revolutionary new tool for scientific research […]. This network has enabled users in the United States, Canada, South America, and Europe to communicate with each other and to do collaborate in compiling research data. SPAN was a major advance in helping scientists who use satellite data to research on world climates, the sun, astrophysics, oceanography, and earth science (142).

The curiosity of her beautiful mind led her invention to a "three-dimensional illusion television system for

transmitting an illusion of an object. The invention makes use of the concept of real images" (139). Yes, historically it is true, "women were not expected or encouraged to be interested in technology and were generally excluded from studies and opportunities in these areas" (143). Nonetheless, Wright overcame the three hurdles AAW inventors commonly face: "getting people to accept their inventions (a hurdle that all inventors must face) and the double dose of prejudice they received due to the fact that they were both black and female" (143).

In an interview with Dr. Evelyn Hammonds (an assistant professor of the history of science at MIT) by Mary Morse (author of *Women Changing Science*), Morse (1995) inquires "Were there a lot of women of color working with you? Did you find that, as a women of color, you had more barriers?" (242). Hammonds responded:

> I was the only African American woman in my class, and there were only two other African Americans besides me. I encountered in my science and technical education, particularly when I transferred to whites schools, both racism and sexism, to the extent that I had professors or fellow students who didn't think that I should be studying a science either because I was black or because I was a woman (242).

The above-mentioned excerpts shed simultaneously weary roads of discouragement and also, trailblazing hope of a more promising tomorrow for AAW in the STEM fields. It is evident that in the words of Langston Hughes (1922), *Mother to Son* the road has not "been a crystal stair" for AAW "but all the time [they have] been a-climbin' on, and reachin landin's, and turnin' corners" despite the "racism and sexism in the science domain [which strategically attempts to restrict them to an] underrepresented [status] in the science programs and science occupations" (Kenschaft 1991; Malcolm et al. 1998; NSB 2000; NSF 2000; Vinning-Brown 1994; 52).

# CHAPTER 3: METHODOLOGY

## *Research Design*

Now having completed a profile of some historical AAW in the STEM fields, the overall qualitative methodological approach for the proposed research project will be introduced. As an approach to the underrepresentation of AAW in the STEM fields, I will use *subjectivity* to examine how an AAW (the "subject") sees her role, and how she sees that role as contributing (or not) to her identity and meaning. It is an attempt to see history from the perspective of the individuals who lived within that particular experience which in turn requires taking a serious look at "women's consciousness." In using a subjective approach, I will "not only [inquire] how gender defines [the] treatment, occupations, and so on, but also how [AAW} perceive the personal, social and political meanings of being female" as it relates to the experiences within the STEM fields (Nancy F. Cott and Elizabeth H. Pleck, *A Heritage of Her Own*; 2006*).*

Note that in recent years, increased attention has been paid to the issue of gender inequity. This has occurred

because of the historical and global stereotypical notions of masculine traits have been universally associated with STEM occupational perception; such concerns of gender disparities has led to low numbers of women. Even the more concerning, race-based stereotypes have led to the continual lack of participation of AAW in certain STEM fields as well. Thus, I conducted a comparative analysis utilizing an intersectional approach in order to understand the stereotypes associated with both race and gender. In doing so, I investigated the external and internal factors to determine if in fact there has been a change in perception of why the visibility of AAW in STEM.

The rationale for using a qualitative methodology is because it is known for its many complexities. However, it is a reliable method; one that is quite diverse and flexibly useful in the "interpretivist approach" (Glense, 2011, 9). Therefore, this research method is beneficial in analyzing the data collected from interviews that are used to measure specific outcomes of the AAW's internal and external experiences in academe.

Specifically, Warren (2005) points out that "the purpose of most qualitative interviewing is to derive interpretations, not facts or laws, from respondent talk" (83). For example, in qualitative interviewing it is based in conversation (Kvale, 1996), with the emphasis on researchers asking questions and listening, and respondents answering (Rubin and Rubin, 1995). In addition, it generates ideas and hypotheses from data identified as inductive reasoning. Glense defines (2011) inductive reasoning as reasoning that moves from the specific or concrete to the general or abstract. The relationship between theory and research in this form of study takes into consideration that questions should be asked. Qualitative inquiries propose passageways to edify ways in which knowledge is socially and individually constructed. Therefore, in interpreting the responses of the interviewees, I as the researcher can gage whether or not the under-representation of AAW is more so experienced due to the collective barriers of sexism and racism or if in fact there are individual internal and external barriers.

Research on institutions of higher education and their position of influence was pertinent to this dissertation

research because it speaks to the strategic politics exercised that are related to the low representation of AAW in STEM. For example, Trower and Chait (2002) partly attributes the severe underrepresentation of women and ethnic minorities in STEM academia to an unwelcoming institutional and departmental culture therefore, this would be examined as a social construct. In a survey of over 1,800 STEM faculty members within 56 universities, the single most important prediction for job satisfaction is the individual's perception as well as the overall workplace climate (Trower and Chait, 2002). This in fact gives am individual a sense of belonging to not only their department but, to the institution as well.

Another study, using interviews of established AAW in the physical sciences, demonstrated that belonging to a community allowed them to stay abreast of issues within their field and provided important opportunities to network and collaborate with others (Liefshitz, 2011). Having supportive and collegial relationships, colleagues, and mentors are especially important for AAW in STEM. Supportive communities help them build the confidence "needed to succeed and persist, [in order to] counteract

negative experiences, and sustain endurance in challenging circumstances" (Liefshitz, 2011, 14).

### *Data Collection/Sample*

The method of collecting data was via in-depth interviews. The interactive, collaborative interviews prompted stories that reflect the interviewee's career choice processes and lived experiences. The primary location of field and short-term observational research took place between Michigan and New Jersey. As part of the advanced study of AAW in higher education STEM departments, majors, and other occupational roles, certain variables were measured amongst the participants.

The participants completed an *Informed Consent Form* (see Appendix A), and received the interview questions prior to the scheduled meeting time. They were informed that the interview would be tape-recorded and transcribed verbatim (see Appendix A). Participants also completed a *Demographic Sheet* (see Appendix B). The respondents had an opportunity to review and, if necessary, correct the contents of the interview after it had been transcribed (see Appendix C for Interview Protocol). The initial

sampling included 10 AAW respondents who were found through key individual contacts. As a result of these contacts, the participant characteristics were AAW in STEM, who met the criterion. That is, of identifying as Black, African American, or Caribbean women within academic or industry careers. All participants earned their Ph.D. in STEM in the US. However, the initial sample of 10 was limited to a final sample of five based on availability and research timeline constraints. Therefore, the five interviews were conveniently and purposefully selected based on their availability and willingness to participate in this dissertation research. Additionally, I was able to secure participation by expressing my high interest in bringing a clearer understanding of the lack of AAW in the STEM fields. As an AAW myself, accompanied by another AAW (the referee), I gained an assurance from those willing to partake in the study.

In conducting interviews for the qualitative research process, it was my job as the researcher to determine the meaning that the participants hold about the under-representation of AAW in STEM. I used the open-ended conversational format to facilitate the development of

trust, rapport, and maximum exploration in attempts to elicit stories from the participants, since stories tend to reflect human consciousness. Based on their professional profiles, I was able to formulate questions. From these questions, I systematized the following themes: importance of science past and present, inspiration to pursue STEM, earning a degree in STEM, measuring of career pathway(s)/science occupations post-doctorate, to name a few.

I conducted the interviews face to face, either in person or virtually, which allowed me to observe body language and facial expressions, enabling me to build from responses given. The taped interviews were from 60 to 120 long and were transcribed verbatim.

**Profile of Participants**

Study participants ranged from age 30 to 76. Originally 10 women from varied backgrounds were recruited. For instance, one of the five were of Caribbean origin and the others were all African American. The final group included five participants: two industry scientists, 1 government science affiliate and two tenured faculty members. Of the

five, two were chemists, one was in bio-chemistry, another in public health and one in human services. Two of the women were married and had families while pursuing their careers in STEM. Of the five, one had two or more children, one had one child and three were without any children.

*Table 1:1 PROFILE OF PARTICIPANTS*

| | ***P1*** | ***P2*** | ***P3*** | ***P4*** | ***P5*** |
|---|---|---|---|---|---|
| ***Name (all names are pseudonyms )*** | ***Dr. Evans*** | ***Dr. Bruman*** | ***Dr. Stubbles*** | ***Dr. Goldsmith*** | ***Dr. Foster*** |
| ***School(s)*** | ***HBCU****<br>***PWI******<br>***PWI****** | ***HBCU****<br>***PWI******<br>***PWI******<br>***PWI****** | ***PWI******<br>***PWI****** | ***HBCU****<br>***PWI******<br>***PWI****** | ***Other (International University )***<br>***PWI****** |
| ***Degree (s)*** | ***BS/MS/PhD*** | ***BS/MS/PhD*** | ***BS/PhD*** | ***BS/MS/PhD*** | ***BS/PhD*** |
| ***STEM Field*** | ***Bio Chemistry***<br>***Defense Strategic*** | ***Human Services***<br>***Journalism***<br>***Adult &***<br>***Continuing Education***<br>***Community Development*** | ***Chemistry*** | ***Nursing***<br>***Public Health*** | ***Chemistry*** |
| ***Title*** | ***Senior Science & Technology Manager & Chemist*** | ***Tenured Associate Professor*** | ***Senior Chemist*** | ***Associate Professor of Emeritus*** | ***Senior Chemist*** |

****Historically Black Colleges and Universities (HBCU)***

***** Predominately White Institutions (PWI)***

***Data Analysis***

In the qualitative methodology, data collection and analysis proceed simultaneously (Merriam, 1998). The steps in qualitative analysis included: (1) preliminary exploration of the data by reading through the transcripts and writing memos; (2) connecting and interrelating themes; and (3) constructing a narrative (Creswell, 2002). Data analysis involved developing a detailed description of each case.

While analyzing these data, I situate the case within its context so the description and themes are related to the specific activities and situations involved in the case (Creswell & Maitta, 2002). This form of data analysis enables the researcher to provide a more detailed description of the case, using either an intricate perspective about some incidents, chronologically, or major events followed by a microscopic illustration of the results.

In order to triangulate the multiple techniques for gathering and/or handling data, themes were established by joining diverse sources of data or perspectives from

participants. In using Creswell's convergent mixed methods approach (2014) by collecting both qualitative and quantitative data, I analyzed "them separately, and then compare[d] the results to see if the findings confirm[ed] or disconfirm[ed] each other" (219). This method is associated with "the historic concept of the multimethod, multitrait idea from Campbell and Fiske (1959), who felt that a psychological trait could be understood by gathering different forms of data (219). This in turn served greatly in developing better measurement instruments to triangulate the data.

I have chosen to utilize a procedure called "transformation" (also called the transformation research paradigm, Mertens 2009). This approach is essential because it "applies to people who experience discrimination and oppression, including (but not limited to) race/ethnicity, disability, immigrant status, political conflicts, sexual orientation, poverty, gender and age (Mertens, 2010). Note that this process occurs in two steps: First, the qualitative themes are listed to form a comparative analysis in order to locate similarities and distinctions. Secondly, I merged variables into a table which is in

reference to "jointly display[ing] both forms of data---effectively merging them---in a single visual" (Creswell, 223). Li, Marquart, & Zercher offer another explanation (2000) of the procedures of transformation, "It might be a table with key questions or concepts on a vertical axis indicating qualitative responses and quantitative results to the concepts" (223).

***Establishing Credibility***

In using in-depth interviews, I, as the interviewer, was sensitive to the confidentiality of the stories while, at the same time, offering the interviewees the freedom to express their own thoughts and experiences, and lastly, it enabled me to listen beyond words expressed. In qualitative design, the researcher seeks believability, based on coherence, insight, and instrumental utility (Eisner, 1991) and trustworthiness (Lincoln & Guba, 1985) through a process of verification unlike a quantitative research, which is through a traditional lens of validity and reliability measures. The uniqueness of the qualitative study within a specific context precludes its being exactly replicated in another context. However, statements about

the researcher's positions – the central assumptions, the selection of informants, the biases and values of the researcher – enhance the study's chances of being replicated in another setting (Creswell, 2002).

**Limitations**

1. The study sample was comprised of five AAW (Black women) in STEM at universities (presently as tenured faculty and/or in past tense as college students) in the US. Due to this small size, the results are not generalizable to other countries and other races. Moreover, the proposed study may be difficult to replicate exactly in another context because of the small numbers of AAW in STEM in higher education (Creswell, 2002).

2. Since there was a small sample size of five participants, all sampling procedures were not specifically selected and identify all under-represented faculty in STEM. Results may be less representative of STEM faculty who are employed primarily in research positions.

3. Participants' responses are reflections of, and limited to their individual experiences in the STEM fields involving a self-assessment module.

4. The study focused only on AAW in STEM fields thus, excluding those in other scientific programs.

5. Due to the nature of qualitative research, the data obtained may be influenced by the investigators own potential biases when analyzing the findings; because the researcher is also an AAW.

A qualitative methodological approach was used to develop a clearer interpretation of the data during the interviewing processes as well as the transcribing stages. The research design specifically consists of a comparative analysis of the participants' responses by identifying themes. In pinpointing the themes, it gives clarity to the similarities and differences amongst the respondents lived experiences within the STEM fields. As a result, the thesis analysis consists of an examination of the findings within those themes, which reveal patterns of participants' internal and external barriers.

## CHAPTER 4: EXTERNAL AND INTERNAL FACTORS HINDER AAW IN HIGHER EDUCATION STEM DISCIPLINE ACADEMIC CAREERS

The historical implementation of systematic oppression exercised by the White power structure against African Americans has in particular hindered AAW due to their biological identity which has created both internal and external barriers derived from socially constructed racial and gender biases. The internal barriers such as self-doubt and question of competency stems from stereotypical threats derived from the external barriers of being Black and also, woman.

AAW's have developed coping mechanisms as a means to survive. For example, they've obtained healthy support systems through family and social ties, as well as, safe collegial and mentorship guidance. The support mechanisms and their chosen spiritual pathways have enabled them to progress psychological and emotionally in order to advance in STEM despite the endless obstacles.

AAW's have combated with strength and resilience their external barriers in STEM, which has marked them as "tokens." This marginalization due to race and gender has

placed them into a position of "double-jeopardy". Consequently, their intellectual competency is often questioned within the field of STEM by virtue of being women and African American.

As a result, AAW continually experience repeated chains of constraint. Stereotypical racist notions such as African descendent people are less capable of engaging intellectually and/or prospering professionally compared to their white counterparts is often used as a method to disinvite AAW in STEM and therefore, the ill-treatment of "second-class citizenship" is often reenacted in academe.

Below, I will present and discuss the themes that are reflective of the salient points from the participants. These are organized under the following headings:

- *The Outsider*
- *Motives for Pursuing STEM (Making their Way into STEM)*
- *Support Systems (Family and Social Ties)*
- *Mentorships/Collegial Relationships*
- *Internal & External Barriers: Intersection of Race & Gender*
- *Persistence is the Secret*

- *To God be the Glory*

***The Outsiders***

Reminiscing through their lived experiences as "outsiders" within a pool of overt and covert assumptive ridicule, more than a few of the participants spoke on the interconnectedness of racial disparities as well as gender biases while in pursuit of STEM based degrees and occupational positioning. Notably, the participants have pinpointed ethnic barriers as the primary hurdle more so than their gender inequity. In alignment with their testimonies, research has recurrently shown that "the culture of science was historically, and is currently, a male culture that is often hostile to women and minorities" (Harding 1986; NSF 2000; Rossiter 1982).

Frequently, science research speaks on women's and minorities' experiences, however, it neglects to acknowledge specifically AAW, and the distinctions within this subgroup. Therefore, this research is intended to provide information on the special barriers experienced specifically by AAW and the coping mechanisms they implement in their daily lives' to succeed against all odds

as not only students of STEM but ultimately, researchers and seasoned scholars.

### ***Motives for Pursuing STEM (Making their way into STEM)***

As early as her undergraduate years, Dr. Paulina Stubbles developed a passion for science and mathematics during her undergraduate research and internship experiences. Currently, she is a chemist at a Midwest science lab. Dr. Stubbles openly expressed her motive for pursuing STEM from her undergraduate years into the progression of her career pathways. She details:

> I was introduced to research while pursuing undergraduate studies as part of the Research Education Support (RES) Program at [Southern institution], a program aiming to influence more minority students to go into the PhD level science programs. As part of the program, I worked in a chemistry research lab for over two years and this influenced me the most by far. I worked in the polymer chemistry lab [… of the then] Chemistry Department Chair.

This quote expresses the on-start of Stubbles interests in Science research; she was extended an opportunity and she took it without concern of whether or not she belonged there.

US military researcher and HBCU graduate of a Southern women's college, Dr. Olivia Evans shares her initial teenage attraction to the field of science. She reminisces:

> I decided to pursue science as a career in high school because my favorite soap opera character contracted HIV on the show. I was so emotionally involved in the show that it sparked my interest in clinical research.

Additionally, she asserts, "I choose this particular career path because I recognized early in my graduate career that I did not want to be at the bench. I did not want the traditional career." This concern of "[being] at the bench" is what propelled her to make herself more marketable, freeing herself from a fixed position of contentment. She goes on to outline other contributing factors, which granted her promising opportunities for advancement in STEM. She states:

> The PMF program allowed me to use my PhD in science in an alternative career. I was fortunate in that I went directly from grad school to my first job with Department of Defense (DOD) where I stayed and thrived for 5 ½ years. I then moved to [governmental position] where I have been for 8 months.

Recognizing that her interest in seeking a non-traditional pathway associated with the sciences is what led to her tenacity to pursue higher levels of achievements in STEM.

A seasoned veteran in the academy, Dr. Peggy Goldsmith boldly attests that her pathways in science were led by her resilient and determined mind. She protests that growing up in Mississippi during the *Jim Crow era* afforded her a "tough skin; a skin that could not easily be scarred nor broken." She announces her present pursuits while simultaneously revisiting her past achievements in STEM:

> My motive for my current career choice was not something that I had envisioned…I decided I was going to do as a rebellion to my teachers and parents…so I knew I have always knew that my parents and teachers have relished the role of teacher they didn't know anything about research so [this was] my motives for my career choice.

Born and raised in the deep skirts of the South, Dr. Goldsmith relives the segregated boundaries that once strategically omitted our presence from certain occupations merely due to the color of one's skin and also, the places where women were permitted. She proclaims:

> The aspect of being African American initially was a strong component to propel me to go into education; at the basic level of education as well as at the higher level and to try to have a career that would permit me to give back to my race.

Similarly to Dr. Evans, Dr. Goldsmith equally refused to be confined in the ugliness of the Jim Crow Laws; she

too dared to be an exception to the rule and positioned herself to have access to multiple sectors in science by taking advantage of the opportunities set before her despite what others felt was 'best' for her. She paved her own road with an unapologetic fearlessness which extended her two callings, although, one inspired her more than the other:

> Actually you can almost say I had two careers [, a] career in Nursing and a career in Public Health and in the 1980's the government started a Nurse Scientist Program and you could choose from various disciplines to fit with the Nursing role and I choose Public Health…Public Health is what really inspired me towards research I was interested in why there are so much talented differences amongst Blacks and Whites.

In the above-mentioned quote, Goldsmith's curiously pursues science to develop a mental understanding and demonstrate her commitment that "Yes, I am Black and a woman; and I belong here too!" (Tenisha Howard, *Lecture Spring 2016*). Her motive to pursue a career in the sciences was much bigger than her, she proclaims "I began to understand why my mentors thought that education was so important it was the one thing they said […] could [change] the lives of [multiple] Black kids at one time."

Clearly Goldsmith's greatest motive was a collective triumph, for in of her own eyes and those of her mentors she saw herself fit to look behind the confining laws of the racist South's segregation and positioned herself towards greatness. Goldsmith understood that her triumphs would create a new generation of successors. She proceeds to share her decision in using Public Health as a tool to create a platform for outreach within the Black community, in particularly for AAW. She states:

> I could be out in the community, I could be doing research that affected the health of the population. So clearly being an African American and being an African American woman has been a big factor in my career path and I think one that happened most recently, I was doing research on Health Commotion of Menopausal Women.

Elaborating further, she speaks on how her successes in research and within the Black population made her an appealing asset to the academy and the STEM industry. She reveals:

> Drug companies sought me out in hopes that I would assist them in selling in other words they thought I would serve as a pipeline to a Black female market and uh I wasn't about to do that.
>
> I remember them saying that they are so happy to see a Black researcher [but even the more] a Black woman…the women I were researching wanted me to be successful.

From the above-mentioned quotes, it is evident that a key component to their achievements is seeing themselves fit to succeed; for as Black history has shown it definitely "takes a village to raise a child." Hence, having healthy support systems in the academy are crucial however, it is through family and social ties that their foundational inner strength of resilience stems thus, propelling them to their ultimate success.

***Support Systems (Family/Social Ties)***

Dr. Evans recalls her social networks of AAW who played a pivotal role in helping her overcome trying times as a PhD candidate. As a first generation student to pursue higher education in her family, her confidence to pursue a PhD initiated from a long legacy of strong willed women; women of the prominent southern HBCU she attended as an undergraduate. She shares her thoughts on the importance of support systems, she states:

> The single most important factor in my pursuing and maintaining a career in STEM [was] my support [from] friends and family. I have several AAW friends who are in STEM who inspired me and family [members who offer encouragement].

Correspondingly, Dr. Goldsmith candidly reveals her initial peaks of interest in STEM to having access to enrichment programs designed to help her succeed, "Being an African American women has shaped my experiences in terms of who I often sought out for guidance as well as some of the opportunities that I was afforded." Further explaining her preferred sources of support, Goldsmith details her experience in the *Math and Science Education Network* (MSEN):

> [It] was a Saturday program that I attended in middle and high school on the campus of [a southern] HBCU. Although MSEN was a state-wide program open to all, in the north eastern part of North Carolina it was largely attended by African Americans. The RES Program [… specifically] targeted minorities. Both maintained my interest in math and science and provided great exposure to the STEM fields.

Therefore, it is evident that opportunities were available to AAW however, one must have the gumption to attain such accomplishments and have strategies in place to successfully compete in the face of adversity.

Dr. Foster is all too familiar with overcoming hardships through rekindling her family ties, she states:

> They keep me grounded; there is absolutely nothing that I have experienced that they weren't right along near me cheering me on. Their belief in me is what confirmed that there is nothing on the face of this earth I cannot accomplish when I put my focused mind to it.

Attesting further, "Just when I think I'm down and I can't go on any longer, they lift my spirits up and I back flourishing to my best self, Dr. Foster proclaims.

***Mentorship/Collegial Relationships***

Building collegial relationships of support was crucial for AAW for their advancement and persistence in STEM fields. Dr. Stubbles speaks of her navigational steps towards obtaining a successful academic research and career position in STEM as a Chemist. She shares:

> I have managed to progress by studying and performing as required. A support system among my peers has also been good in helping me navigate through the field, but the support system also includes a number of White men. I do not see them as the enemy because they are the majority. Building relationships with all kinds of people has been helpful because like with other career fields, who you know can make all the difference.

From the above quote, it is evident that relationships building coupled with a good reputation opens doors to the gateway of success.

Also, Dr. Stubbles shares "I encourage people to seek like-minded people if such organizations [of support] do not exist in their program or job. It is very critical to

have support not only when things are tough, but to just navigate period." I concur, in my journey towards higher levels of success my great-aunt always parrots to me "My doctor niece, I am here to tell you, it is not who you know but, who knows you."

Dr. Stubbles voice resonated with Dr. Evan's "double confirmation" when she articulated the importance of relationship building. For example, Dr. Evans states:

> I made it a point to choose a mentor as well as committee members that I felt had my best interest at heart so I didn't face those barriers in the academy. I have however encountered this as mentioned before in my professional career.

Dr. Bruman recognizes that good counseling in the undergraduate level is pertinent to one becoming successful in STEM, however, she points out the need to go outside of your comfort zone to find the needed support:

> Suddenly [you are] left out of the group with no support for you in terms of mentoring but you just get smart if you can't get it there you look around and you go to the outside and to a larger degree that is what I did in regards to my research.

However, those who lack committed and long-lasting mentoring relationships and have to fend for themselves leave the field as many women attest to. This is due to the

different degrees and different ways AAW experience both internal and external barriers that often create major challenges and setbacks. Dr. Foster shares, "I experienced both racism and sexism, but, you see, for me quitting was not an option; I refused to settle for less than what I came for. So, despite my discomforts my end goal surpassed it all however, delays did occur."

***Internal/External Barriers (Intersection of Race & Gender)***

Against all odds, the AAW interviewees have implemented varies objectives to keep afloat while living in the patriarchal systems of White male domination. When participants were asked, "How might your identity as an AAW affect your position/experiences in your educational pursuit as well as career paths up to the current position you hold? Describe some experiences." The majority of the women in the study commented on the significance of racial bias during their graduate and professional training. Specifically, they shared how prejudice and discrimination affected their experiences in STEM.

From the research, we see that as early as elementary school girls are often times discouraged from developing an

interest in the sciences. Dr. Goldsmith touches on the disappointing but factual hindrances within the school system, when she announces "In high school some counselors don't understand the full spectrum of careers that women can have." Additionally, she speaks to the continual disadvantages of AAW at the college level:

> One of the barriers in academe… the number one, I think in academe at the college and university level is [that it is] still dominated by males, women are still primarily relegated to High School and Elementary education I think another barrier is socialization; women [need] to help socialize [one another in] higher education.

Dr. Goldsmith openly protests that STEM is not made appealing specifically to AAW. When asked as an AAW has she experienced barriers, she specifies her race as a factor of concern stating:

> Racial barriers, [yes] I have experienced throughout my career primarily around people that were trying to put doubt [in my mind]. [They would ask do] you know why you want to do that, do you think you can have it?

Even more troubling than the insertion of intellectual uncertainty, Dr. Goldsmith testifies to witnessing a colleague being referred to by a very demeaning racial

slur; one, which reconnected her immediately to her Southern roots. She reveals:

> Even more recently at [an] university setting some incidents where people surpassed me and even called one of the Black faculty the N word. I just never thought I would hear that from faculty educators.

Although shockingly appalled, Dr. Goldsmith associates this slanderous hatred as familiar territory growing up in the South. Therefore, when asked "How might your identity as an AAW affect your position/experiences in your educational pursuit as well as career paths up to the current position you hold?" Describing some detailed experiences Dr. Goldsmith asserts:

> Oh being an African American was just a factor out of my life…coming from the State of Mississippi with this Jim Crow history or whatever, growing up in a university town I could walk to the university but I was not permitted to go because of discrimination really […] but many of us that [were] going to make some changes however [were] also going to move ahead.

The *Jim Crow Era* was a time of heightened marginalization, especially for the segregated South. It was a time period when people were "judged by the color of the skin rather than the content of their character" (*I Have a Dream*, Dr. Martin Luther King, 1963). However, the

long awaited battle to desegregate the educational system in the deep South was won with the triumphant Brown vs. Board of Education Topeka case of 1954. Nonetheless, the Women's Rights Movement was equally frustrating to AAW for its refusal to admit to advocacy of racist ideologies. Yes, the White feminists themselves added to the oppression of AAW, Dr. Goldsmith details:

> [T]hen coming into the area of women's rights or for the lack thereof it's kind of a two sided thing inequality among women as well as inequality amongst African Americans so again it just continued to serve as a stimulant for me to continue to have a career path and to continue to have career paths that I thought would make some differences.

Facing ongoing racist patriarchal systems, Dr. Goldsmith sought her way out of these chains of oppression by grooming herself into a scientific "change agent." Her heart to help her community was a key ingredient to what motivated her to persist.

Unlike most of the interviewees Dr. Oliva Evans believes the following, "I think my gender has been more of a barrier than my race, however my age has probably been the greatest barrier." For example, Dr. Evans shares a bit of disappointment in her earlier pursuits:

> My identity as an African American woman can both help and hurt me in both my educational as well as professional experiences. I can remember following up with one institution when I was applying for school and they responded to a forwarded email they had sent amongst their faculty that was labeled "Minority student has research interest." At first I was offended but then I realized that my application probably drew attention that others did not because I was an African American woman.

Listening to Dr. Evans, she recalls her initial experiences of differential treatment as a young AAW eager to enter into the sciences was quite alarming. She became a spectacle, a "Black token" of virtual discussion within a White dominated "Minority Report."

Additionally, Dr. Evans goes on to express that "professionally, I have often been mistaken for a college intern and referred to as "little girl" by my older White colleagues." Clearly unacceptable but often experienced, that a person's creditability is diminished with the adding of the term "little." This resonates with me personally for I as an AAW have often experienced males (of all races in particularly Latino and Black) saying "Oh, how is your little job coming along?" "Did you finish that little assignment, you were working on?"

The term "girl," is often used to question someone's maturity level. Therefore, when Evans was referred to as a "little girl," this was done so in a very condescending manner to discount not only her adulthood but also to put into question her level of intelligence. From the tone of her voice, I could hear it still pricked at her insides; the discomfort still resided in pure disbelief. From these above-mentioned examples, we know that:

> There are definitely barriers that African American women face in the academy because it is run by White men. We have to deal with both racism and sexism and for those of us straight out of school ageism (Dr. Evans).

However, Dr. Goldsmith questions if there is anyone to blame or it in fact a matter of self-perception. She pronounces:

> Is it a real barrier or is it your perceptions. When you get the perception that you can't do. Looking at how you can get through the challenges and understand that there are going to be challenges. Nobody is going to make it easier for you…it is not based on intellect it is based on he who knows how to deal with the system.

Dr. Goldsmith clarifies:

> [Did I experience] some barriers yeah but, I didn't let them hinder me. You don't let nothing stand in the way

> of your education and your goals, you find a way to get over it, under it, [and] around it.

As a native of the South, Dr. Goldsmith prepared her mind for the field and its political gaming.

Similarly put, Dr. Bruman counsels with great fortitude, “My advice to young people [is that] you will experience barriers but you don’t let them stop your advances.” Taking a distinctive stance, Dr. Stubbles shares “I cannot think of anything specific that AAW face that others (even white men) do not face.

One thing that may be a factor on some level at some time is just comfort level in interacting with people who are different. This is true of fields outside of STEM. And thus, when asked of her personal run-ins with barriers, she without hesitation claims “No experience comes to mind.” Therefore, a question then comes to mind, “Do women choose not to [enter STEM programs] or fail to even apply?” (Valian; 2006, 329). Valian claims the dearth welcoming of women and minorities hinders their visibility. However, the above-mentioned testimonies of the participants with the exception of Dr. Stubbles speaks to Valian’s take on social perception and evaluation of the men and women which

creates “daily inequities in our treatment of our colleagues” (324).

Still, regardless of their lack of support from their elementary schooling to their higher education pursuits, something deeply rooted within these AAW sprouted out and allowed them to excel with great persistence, to surpass the strategically orchestrated barriers by any means necessary. With resilience and committed vision to see themselves to the finish line, they have managed to advance despite the blatant and repeated cases of discrimination piercing against them. What is their “secret”? Could it be that they are in possession of an unmatched persistence and/or unwavering faith?

***Persistence is the Secret***

Tenured associate professor, Dr. Bruman’s successful track record in and outside of the academy’s walls speaks to the need to have a “hustler’s spirit.” In order for one to obtain this “hustler’s spirit” she articulates, “you must train your mind to think differently.” Her determination is the key ingredient to obtaining tenure in less than the amount of time that was given to her! Paying

homage is what she advises young scholars in STEM to do. She recommends to "start imagining yourself in the seat of the ones who have come before you in STEM whether they are white, Black, etc." For Bruman, the *First Black Surgeon General of the United States*, Joycelyn Elders is the one she refers to for a point of reference in her roster of role models. She stresses the importance of being committed to your passion. She asserts, "I enjoy research, I enjoy what I do, I have a research agenda, it is how you gain respect. But, I was curious how you pursue leadership with a research agenda."

Dr. Bruman asserts "Do whatever motivates you […] do it again and again […] and eliminate negative people from your life." She protests with surety:

> This is not for the faint of heart…it is just not that kind of field you have to be motivated yourself, it is not enough to be good…you have to be able to have tenacity to understand how things work [;]the culture of the university.

It is for this very reason, Dr. Goldsmith demands that a "strong perception of yourself [is key] and I don't mean selfish self-perception" she says. One of the major internal barriers of a woman's success is that they tend to

"have difficulties identifying their natural worth" (Dr. Goldsmith). Therefore in bridging the guidance of both Drs. Bruman and Goldsmith, it is evidently clear that "knowing thyself" is a key component to leading with an unwavering determined mind. Hence, Dr. Bruman pronounces "We have the intellect, we are just not being pointed in the right direction." Possibly being turned back to the right direction is a self-development responsibility that AAW must embrace for their survival within STEM.

As a result, this question still remains unanswered: Why are AAW under-represented in STEM? Dr. Stubbles ponders the reasoning and then states:

> I am not completely sure. [However,] it is definitely not because we aren't capable. It is a very time consuming pursuit in terms of just the education that is required and also entails a lot of stress and demands that pull us in the opposite direction of some other life goals generally common to women such as starting a family (most notably). This is a larger feat for women that already have children, though it is still very possible.

Dr. Evans believes that the sacrificial commitment of long hours and focus could affect one's home life. She speaks from the disciplinary needs of a traditional scientist, "Once AAW realize this and aren't presented with

any alternative they probably seek other professions." Additionally she states, "Young Black girls are not encouraged." Mathematician and Retired University Professor, Dr. Kenschaft (1991) details the historical discrepancy with the under-representation of Blacks presence into the STEM fields especially, AAW:

> Too many American children part, but especially black children, are taught only arithmetic in an uninteresting fashion. They receive far too little instruction in the geometry, statistics, probability, logic and algebra that are taught to elementary school children in most of the world. Too often they are not exposed to the excitement and satisfaction of mathematics – exploring patterns and using them to solve intriguing problems. [Therefore,] stimulating mathematical competence before black youngsters meet the anti-intellectual peer pressures so common in the teen years (2)

The above-mentioned quotation from Dr. Kenschaft makes it evidently clear that the initial difficulty starts for AAW at the adolescence stages. It is at this time the AAW face the trying times of becoming mathematically challenged as elementary students and thus, they are not given a fair chance to advance.

With most of her research predominately focused on the equality for African American women, Dr. Goldsmith shares,

"When I came to the *College of Nursing*, I was told that there was not a Black tenure person and of course I asked how dare they, this is a state school but I was told there were some problems of attracting Blacks." Dr. Goldsmith continues honing in on the need to look within to remain whole in our pursuits despite the naysayers and the White male dominant hierarchy:

> Well you have to accept that I think it is dominated by males and in my profession of nursing by White women […] I'm sorry that's just the facts of life but this is not going to hinder me and one of the things I try to do is to continue to pursue what I wanted to pursue and also the thing I am most proud of in my career is I tried to do the same with students […] that there are going to be hindrances but you cannot let them get in your way.

In referring to a master's student whose research professor would not talk to her, Goldsmith asked her directly "Are you going to let her win?" On the backs of her ancestors she stands firm in her advice to a young scholar in the making. Her words hit home to me; she is ministering to me too while she asserts her own roadblocks towards success and the inner courage to never give up. She protests:

> Stop giving people so much power over you…being Black today, we give too much power [away]. [For example,] young men [who blame their shortcomings on Whites who they often refer to as] "the man." I can't do this because they won't let, I can't do this because "the man"…you do as much as you can do.

Advising the new generation to become the "change agents," Dr. Goldsmith professes so heroically the need to stop making excuses:

> I don't care who it is dominated by, you get your goals and […] you do what you need to do to get the support and don't be afraid to get the support whether it is beside you, outside you, next to you or whatever…you get what it takes!

Dr. Goldsmith words speak volumes beyond measure as I know her contribution to this interview process is much bigger than my end goal of obtaining my doctoral degree. It equally motivates me to soar higher while lifting others as I climb. Her wisdom heals me and it echoes in unison with my dear grandmother's voice "No time for excuses; let's get our PhD because when you graduate, we all graduate!"

Dr. Evans asserts:

> I have managed to advance in STEM because I recognized I had to prove I deserved to be there early and often. I did not shy away from the hard assignments and I took every opportunity to learn from whomever I was around. I read everything there was available to me about my projects and those around me so I could help if needed.

> This allowed people to see that I was knowledgeable and a hard worker.
>
> This speaks to Dr. Bruman's motivational truth:
>
> What you need to realize that you are always Black...you need to have a strong sense of who you are…you need to know why you are doing what you are doing. We do not apologize for who we are and who we bring along…understand your industry…understand so that you know.

Dr. Bruman asserts that it is very pivotal to acknowledge the unchangeable facts while also being unapologetic of who you are and what you came to do. She declares, in order to be successful as an AAW in this field, "[You] need to have thick skin, [be] sharp, well-spoken, polished, and focused to advance in STEM."

All of the participants stressed the importance of an understanding of self-worth, which builds levels of confidence. Thus knowing their true value, AAW can push themselves successfully into the academy as well as negotiate their promotions. Additionally, Dr. Bruman makes clear that although she has an agenda to be successful; her self-worth is never to be put into question by anyone especially as a "Child of God."

***To God be the Glory***

When asked, "What roles if any has spirituality played in your success and career development?," Dr. Bruman makes it known that "Spirituality is who I am…it has opened up doors for me…opening up doors that were extremely competitive and helping me to where I am today." Similarly Dr. Goldsmith refers to her biggest cheerleader as God. While in pursuit of STEM research and career advancement she shares her southern roots in Mississippi and how communion with God was never optional but rather a necessity and an unmatched source of strength. She often expresses to her students as a means to encourage them to embrace unwavering faith:

> God made you and what He has planned for you. […]. Talking about race, you forget I'm from Mississippi I came up in the Jim Crow area. Knowing that you are a child of God, support learning how to get support through many ways including prayer even from your enemies.

Dr. Bruman concurs with Dr. Goldsmith stating, "I am use to swimming in this particular pond and you know the sharks are still here at the end of the day." However, despite "the sharks" she knew that having tenure is like having a seat at the table "and that is value in the

academy; its value its saying that my university has invested in me." The most insightful advice Dr. Goldsmith has gifted to her students is this example:

> Often I say to students…there is not a single person on the planet that can take what God has ordained for you. […] God opened this door for you to get in this doctoral program and nobody and I said I mean nobody can stop you from being in this doctoral program but you, if you decide through your will you're going to sit here and give up then you got it, you got it made but I said He opened the door and can't nobody shut it.

Dr. Goldsmith goes on to share the impact of the seed and how it sprouted in its on timing. After two weeks of non-contact the student reached out to her and said, "You know [Dr. Goldsmith], I thank you for that spiritual analysis, I've decided I'm staying." And that is exactly it; one must decide no matter what "I am staying," I will see this through.

Similarly, Dr. Evans states, "My spirituality played a huge role in my success. When I wanted to give up [I turned to] my faith [for it always] pull[s] me through. To add to a determined mind, the interviewee's sought after alternative ways to cope with the constant isolation by seeking a higher power. Dr. Stubbles stated, "It has kept

me grounded and encouraged when I did not think I could make it or contemplated switching education and career paths."

From these testimonials as well as existing studies of African American women in science [demonstrate that there are a…] considerable [amount of] barriers that these women face *(Kenschaft 1991; Malcolm, Hall, and Brown 1976; Sammons 1990; Vinning-Brown 1994).*

# CHAPTER 5: CONCLUSION

The overriding purpose of this research was to explore the experiences of under-represented AAW in STEM fields at various points in their STEM education and career pursuits. In this study, I examined self-efficacy, interests, goals, outcome expectations and choice to return and/or leave the university to study STEM. I discovered the importance of support systems and perceptions of both racial and gender disparities and additionally, the actual internal and external barriers, which have halted, if not hindered, their ability to advance while locating their sources of stress and overwhelming workload responsibilities. To retrieve such results the qualitative method of in-depth interviews was used to capture the five participant's stories. The qualitative research interview assisted in description of clarity as well as creating meaningful central themes to the subjects lived experiences. The primary task in interviewing the AAW was to bring understanding and specific meaning to their collective and individual responses; for qualitative research interview seeks to cover both a factual and a meaning level of results. Therefore, in using open-ended questions, I was

able to maximize their responses to learn their unique lived experiences as students and professionals in STEM.

The presence of AAW in STEM presents challenges; they are faced with issues of under representation, stereotyping based on racial and gender biases, inadequate mentoring and exclusion from informal networks. Among the challenges AAW face, beyond race, gender, and cultural differences are poor evaluations of their technical capability and competence, resulting in erosion of authority at every step and an arduous road to higher levels.

However, regardless of the existing hurdles, research reveals that AAW have impacted STEM disciplines significantly, with their matchless attributes of culture, strength, courage, character, outstanding skills, and analytical abilities which are essential to the STEM environment (Jordan, 2006). They bring tremendous character, persistence, talent and a deep commitment to STEM fields (MacLachlan, 2000). They are nurturing, possessing strong social values and decision-making skills, while being collaborative and consensus building and including context in analysis (Van Beers, Sittig AC, Denier

van der Gon J.J., 1996). They also bring a totally different perspective and creativity to STEM (*Land of Plenty*, 2001). With all the added values that women, AAW contribute to the STEM environment, why do the barriers still exist and how can they be overcome?

***Further Reflection on the Findings of this Study***

The participants were all African American women in the sciences; 2 chemists, 2 tenured professors and 1 government scientists. They differed in age (31-76 years old), experience, and background. This, in turn, affected the internal and external barriers findings. Some of the barriers included, but were not limited to, gender and racial biases which (1) questioned their competency, (2) caused struggles in obtaining acceptance (developing a sense of belonging), (3) lack of mentorship and collegial relationships, and (4) exclusion from STEM networks. This in turn led to concerns of adequacy for some of the participants. Although some shared these above-mentioned similarities, their unique backgrounds presented some distinctions. For instance out of the five AAW respondents all expressed on-going run-ins with racism and sexism with the exception of the Caribbean born and schooled

participant. Her experience differed from the other four because unlike the US academic environment, Jamaica is predominately of African descent. Another similarity however, was that most of the women identified themselves as Christian except for one which stated she was 'spiritual' but not, religious. Predominately, all of the participants expressed the strategies for coping with extenuating internal and external barriers to be their family and social ties as well as their faith ('belief in God').

The results suggest that healthy support systems and supportive academic achievements had a lasting effect on the participants' choices. Their initial aspirations and accomplishments as undergraduate students, impacted their belief and commitment, enabling them to persist and succeed in STEM. The AAW in this study mentioned the importance and value of making a difference in the field of STEM via their completion of their degrees and their individual contributions to their fields.

The barriers the participants overcame against all odds afforded them a higher source of strength; it gifted them

with resilience to persevere towards successful STEM careers. The findings in this study can inform AAW undergraduates in the field of STEM, as they aim to increase the visibility of AAW. By changing the gender gap in STEM, the under-representation for AAW in STEM will increase the earning power of women, the diversity of people who are working in STEM, and roles of leadership within the academy.

AAW still remain at the very bottom, the odds continue to be against them. Though nearly two-thirds of all the women reported in a survey reported having to "prove" their competency, AAW experienced the highest bias. While all women have to prove their competency in the workplace the AAW carry the heaviest burden for that proof. About 76.9% of AAW experienced this, versus 64.5% of Latinas, 63.6% of Asian-Americans and 62.7% of White women (NSF, 2006).

Not only do the AAW have to 'prove it again', they also have to face the obstacles alone without support from their organizations. There is a very different emotional attitude for AAW; a clear sense of bleak isolation. Within the research testimonials of this research as well as previous

studies conducted, AAW repeatedly expressed facing profound contempt and ridicule. Although research indicates that women have the same innate ability to engage in STEM occupations as their male counterparts; women, and particularly AAW are still under-represented, under-employed and unemployed.

The institutional structures often create the barriers in both academic and industry based environments. Questions of intellectual maturity have surfaced in collegial conversations about their person; belittling their womanhood by being referred to as little girls. This sexist behavior has been often against women in power (or those in pursuit of it) throughout history to place query on their level of competence. These covert exercises of prejudice were done to make the AAW ponder to themselves "do I belong here?" This in turn induces self-doubt; making one question the mental stamina of ones self-worth. The levels of character assassination have been frequently exercised towards AAW. Although there are several hurdles they face, many attests racism to be more overbearing than sexiest mistreatment despite its ongoing presence within the academy.

Despite these odds, the participants in this study all testify that their drive to be successful in STEM is what has led them to ultimately overcome all barriers; both internal and external. From the earliest year of schooling while pursuing the sciences, initially as academic requirement, AAW face barriers. They are discouraged, criticized and excluded, whereas, AAW need to be invited and supported. Some of the external barriers become internalized when individuals face them at a young age. Specifically because the models are not present, AAW do not feel wanted. This in turn creates a disconnection and a concern for acceptance as they grow older.

There are many reasons expressed throughout the body of STEM research why AAW are excluded from opportunities. A major tool of exclusion is the "weeding out" practice. And, the author can attest to having more than her fair share of it. This practice has more negative effects on AAW than it does on any another ethnicity. The science education system, in which 'weeding out' is an essential element, tests for characteristics traditionally associated with masculinity in Western societies. It is based on notions such as "the challenge," understood by young men who have

encountered it in various rites of passage into manhood (Bystydzienski and Bird, 2006; 7). The connecting elements and motivating factors to masculine atmospheres have to do with what is means to be a man. As young boys, men are taught to 'take charge' and to lead by any means necessary in order be in power. Therefore, some men tend to come into workplace environments with a competitive behavior; they are driven to succeed and have an agenda to popularize themselves intellectually and professionally. Some men (not all) buy into this takeover mentality and in order to do so, play into sexist antics to disempower women. And thus, specifically for AAW they are ostracized by both their gender and the biological makeup.

In recent years, resources for STEM education and support at the institutional level have decreased due the reluctant commitment to keep minority recruitment and retention as a focal point. For it is the absence of AAW that discourages the generations to follow; AAW need a legacy of visibility to promote and support others to diminish the ongoing "pipeline problem."

For some of the participants in this study gender seems to be a more bearable barrier than race however, both created discomfort in some capacity or another for them. However, both race and gender have a negative impact on the work experiences and career advancement of African American women (Combs 2003; Bell & Nkomo, 2001). African Americans often feel like they are outsiders within work environments, especially those which are predominately White. Cultural differences at social gatherings make individuals feel out of place. They are often isolated in the work environment. Without mentors they must learn to succeed from the main stream of organizational life. There is a limited supply of these mentors because in the past educators have failed to nurture and mentor young Black women (Jordan, 2006). Another and crucially important disadvantage for African American professional women is the lack of mentors and mentoring.

The participants throughout the interviewing process expressed the effects of stereotyping and how this strategic oppression has not only created moments of isolation but pressure to excel in order to receive acceptance and respectability. As a result of stereotyping

they often feel that their work is unfairly scrutinized and that they are not adequately challenged (Tickles, 2006). It is this social marker of "double-jeopardy" that haunts them especially, being labeled the "token" Black; "affirmative action hire."

As defined earlier, a "token" is a member of a group that is included in a larger group through procedure or practice to integrate. The experience of tokenism is exercised when AAW joins a community and is fixed in positions as the "lone ranger;" in an area where they are under-represented or the only one of a kind. Karter (1997) highlights the work environments, which leads to high surveillance and sets into place an atmosphere of negative perceptions of those categorized as tokens. When African Americans are perceived as tokens by majority group employees their behavior and job performance, whether good or bad, are magnified, distorted and overly scrutinized. In many cases, increased pressure to perform leads to choking under pressure (Steele and Aronson, 1995). Performance decreases because token members get the attention for judgment versus their research. This is a strategy implemented to devalue their ability to succeed. Therefore,

to overcome questioning of their competence, the participants all expressed a need to produce a high level performance not only to receive acceptance but, to be perceived as capable and advanced as their White counterparts.

In capturing the participants' stories, invaluable contributions have been extended to this body of work. What I appreciated the most is their resilience, their strength to overcome all obstacles no matter what and the fight for pursuing what speaks to their hearts; their passion for STEM. Their stories are a testament that despite barriers, once their minds were made up the women became unstoppable. Yes, the barriers were plentiful and their knowledge of hardships African Americans often endured due to the color of their skin equipped them with a tough skin. This tough skin served as a shield of protection from the White power structure that deemed them unwanted and unfit for the sciences. Their tenacity proved as a respondent said, 'I belong here, whatever door I see fit to open, I have the strength and the brilliance to not only survive but, to thrive and to do so unapologetically'. Yes, it has not always been an easy road, yes there were moments of

darkness where I fought armed with my faith to see to the light but, I am here, I am here and because I am here and I am alive all things are made possible.

The majority of the women in the study are Christians and this is a pathway they shared. Thus as the biblical text says "Faith without works is dead!" (James 2:26). And so, these women worked toiling to be exceptional and that they surely did accomplish. From their testimonials, it was evident that they appreciated their beginnings; the struggles only propelled them to soar higher. In the midst of their storms they knew when they won, everyone wins and therefore, many referred to trailblazing AAW in STEM for extra courage and celebrated in the spirit. Being Christian women they understood, "Now faith is the substance of things hoped for, the evidence of things not seen" (Hebrews 11:1; *King James Version*).

***Future Research Directions and Recommendations***

Dr. Foster says we cannot overlook the need for Black males advancing in the STEM fields either. She protests:

> One additional challenge that I think cannot be minimized is the fact that there are so few Black men

> in these communities the higher you go. I am married, but I have seen other sisters struggle to find happiness in their personal lives. They have a hard time finding companionship. Just wanted to add that little tidbit, because I think it often gets left out of the discussion. Where are our men?!

Although, my study reflects on the personal lived experiences of AAW in STEM; I too concur men cannot be exempt from this concern of under-representation; this too is problem that needs to be resolved. From my research, I have discovered that AAW's passionate commitment to seeing change in this male-dominated field is not only for themselves but for those who are pursuing Science, Technology, Engineering and Mathematics (STEM) currently and in the near future. While the phenomenon of the under-representation for AAW in STEM may start during the grade school years, research has shown that it accumulates during the pursuits of higher education.

AAW who move beyond the undergraduate stages into the advanced degrees face even more challenges. This structural under-representation affects the climate for diversity on two levels in an institution: 1)it directly affects the behaviors and interactions with others in a campus context, and, 2) on a psychological level, it shapes the perceptions

that others hold of women of color, as well as their own perceptions of the learning and work environments (Hurtado, 204-221). Understanding the cycles of gender inequality in pursuit of career advancement, I repeatedly heard the AAW interviewees refer to their trying experiences of professional isolation as well as their challenges coping with their internal and external barriers. With this being said, the question is *not* 'does racism and sexism exist in the STEM fields' but, the question is 'what are we doing about it?' Some specific recommendations are as follows:

(1) Conducting departmental and institutional reviews of the salary gaps for AAW

(2) Reduction of isolation for AAW by examining key problems associated with the under-representation

(3) Making these concerns a priority for the administration

(4) Making clear the requirements for promotion

(5) Discovering how to successfully navigate through the political "waters"

(6) Identifying racial and gender biases operating in academic settings

(7) Supporting Black men to advancement in the STEM fields as well

If the above suggestions were implemented, AAW in the academy will do more than merely survive, they will thrive and the historical double disadvantages of being African American and woman will be diminished.

In completing this research, as well as the discovery of its findings, a new direction on the under-representation of AAW in the STEM fields is warranted. Seldom does research hone in on intersectionality of being both African American and a woman. Mostly, the research addresses gender issues and groups minorities into one cluster. Although research has shown some similarities amongst women of color collectively; it is pertinent to locate the cultural and racial distinctions as well as bi-culturalism of AAW in particularly for they are not one in the same. Scholars should also question how traits of power and privilege, such as Whiteness and maleness, as well as different forms of oppression, operate together to construct the experiences of AAW in STEM from all ethnic backgrounds. AAW have multiple ethnicities that make-up

their identities. For example, one can be Nigerian and Trinidadian; this bi-cultural identity would need to be explored to fully understand the cultural dynamics that affect ones social experiences. Similarly put, one respondent openly expressed that because of her cultural background of being a Jamaican woman, she personally never witnessed or experienced racism or sexism. Additionally, she articulated that possibly it happened to her and/or another however, her upbringing and schooling in the islands has left her unknowledgeable of such experiences. Such investigations are improved by, but not limited to, ethnically diverse samples. Certainly, every possible effort must be made to involve AAW from diverse backgrounds; however, the lack of such diversity does not prohibit an analysis of the dynamics of power, privilege, and oppression in STEM fields. It is particularly important that AAW are studied further under this lens to unpack the multi-layered barriers due to their bi-culturalism. In turn, this will create a better understanding of their oppressive conditions that are historically rooted in patriarchal social markers of racism and sexism.

Additional research is needed on how AAW in STEM experience sense of belonging too, both to the overall institution and the STEM communities. Further study would require directly interrogating the specific majors to examine differences among STEM fields. For example, it may be that the sense of belonging differs for AAW enrolled in STEM majors with more AAW than in STEM majors with fewer AAW. Hoffman (2003) identifies several dimensions of sense of belonging, including perceived support from faculty and peers, and the classroom environment. Using qualitative research methods, future research can examine whether the findings from the current study are generalizable to local populations of undergraduate and graduate women in STEM majors at research universities.

Next, data collection methods such as in-depth interviews or focus groups can uncover the unique and similar ways AAW differ racially within ethnic groups; to learn how they construct their sense of belonging both to their college community and STEM major, and what aspects of their campus experiences, and personal and social identities contribute to or inhibit their sense of belonging in predominantly White and male environments. A

qualitative focus allows for the intersection of identities (e.g., race, gender, sexual orientation) to be explored, for women to connect with each other (via focus groups) to share their experiences and form support networks, and for discussions about how AAW from all various backgrounds would transform STEM into more welcoming and supportive environments.

Further research on the concept of racial climate is needed in two areas. First, the racial climate in STEM departments should be examined directly. The current study was an initial examination of the under-representation of AAW in STEM fields, namely through degree pursuit to occupational advancement. Another investigation should include items that pertain to racialized gender stereotypes and other forms of "gendered racism" (St. Jean & Feagin, 1998) experienced by AAW. In doing so, one can identify the unique ways AAW experience the internal and external barriers as students and as professionals.

### *Final Thoughts*

From this research, there is additional evidence that the under-representation of AAW in science consists of a

cycle caused by interrelated and self-perpetuating (internal and external barriers) factors. Therefore, in order to break this cycle common solutions towards improving social problems need to be in place to invest in the next generation of STEM researchers. Hence, we must have the courage to speak the words that racial and gender inequity is unjust. AAW must never give up to make AAW visible. Not merely as affirmative action hires, but as intellectually competent researchers with the same access to resources as those who have "White privilege." Until we can see each other as equal we cannot overcome these injustices that are reared in pure hate and fear. We too (AAW) "deserve to sit at any table" we choose to (Dr. Judi Brown Clarke, Michigan State University, Fall 2010).

In bringing additional lived experiences of AAW in STEM fields through this body of research, it has been made evident that every institution has its own politics, however, the overarching hindrance in the success rates of AAW is more deeply rooted than at the level of a particular institution. Therefore, all sectors of STEM academia, government, industry and professional associations need to

band together in concentrated efforts to address the problems of the under-representation of AAW in science.

In addition, AAW need to be granted access to the sciences earlier on to improve the achievement gap in academics to change their attitudes towards STEM in their adolescent years. For example, access includes accelerated science classes, pursuing majors and earning degrees in the sciences. Increasing their achievements definitely derives from their access of resources. Early standardized exam practices and preparation to develop professional skills for science occupations and opportunities for internships are some examples.

Regarding attitudes towards the sciences; AAW must see themselves as STEM successors despite the predominated White male representation. As research has shown, AAW are overlooked, when it comes to math talent specifically at the elementary level. Until mathematics are taught effectively by committed and skilled teachers at the elementary levels, there will continue to be underrepresentation. Stereotyping, bicultural stress, and tokenism affect the manner in which AAW obtain and maintain

success in STEM academic research, as well as obtain leadership roles in the science industry. Access to mentoring, family and social support systems and collaborative efforts among industry, academic and professional organizations are strategies to combat their uniquely experienced internal and external barriers. To overcome such obstacles will build self-confidence necessary for success in academia among all STEM researchers.

From this research, it is evident that these barriers exist beyond academia, and extend to agencies and organizations that hire scientists, technologists, engineers, and mathematicians throughout the country. These obstructions not only prohibit the personal advancement of African American women in STEM, but they also limit the organizational effectiveness of those institutions.

# APPENDICES

## Appendix A

## Informed Consent Form

Dear Participant:

You are invited to participate in a research study that will attempt to understand the under-representation of Women of Color in the STEM fields. You can decide not to participate. The following information is provided in order to help you make an informed decision whether or not you would like to participate. If you have any questions please do not hesitate to ask. You are eligible to participate in this study because you have identified yourself as an AAW in STEM.

**Project:** The Under-representation of Women of Color in the STEM Fields

**Purpose of the Project:** This study will investigate the reasons behind the under-representation of African American Women in the STEM fields in institutions of higher education.

**Procedures:** You will be asked to participate in an interview that will be audio-recorded which will take place in a private and comfortable meeting location of your preference. During the interview you will be asked a series of questions. These questions are designed to allow you to share your experiences as AAW in STEM who are in position to speak to the under-representation of women in such fields. Additionally, you will be sent via email (to a private email address if you desire) an electronic survey which will include similar questions.

**Risks and/or Discomforts:** There are no known risks or discomforts associated with this research.

**Benefits:** The information gained from this study may help us to better understand the experiences of AAW in STEM and also, additionally promote some alliances to increase the representation of AAW in the sciences.

**Confidentiality:** During the interview, you will be asked to provide a pseudonym to insure that your identity is protected. The audio-recording will be assigned the pseudonym that you choose during the interview. The survey will not identify you. The survey will only have the pseudonym that you chose during the interview. The xeroxed copy of the document you provide via electronic submission will be printed out and kept with the rest of the surveys. Audio tapes will only be used to transcribe interview. Once the interview is transcribed, the audio tapes, interview transcripts, and the xeroxed copies of the documents you provide will be kept in a secured locked cabinet that only I will have access to them as the researcher of this study. You will not be asked to write your name on the anonymous survey. Once all surveys are entered in a database, they will be destroyed. The information obtained during this study may be published in journals or presented at conferences but the data will be prepared and presented as aggregated data.

**Compensation:** You will not receive any type of compensation for participating in this study.

**Opportunity to Ask Questions:** You may ask any questions concerning this research and have those questions answered before agreeing to participate or during the study. Or you may call Tenisha Howard at (917) 636-3736 and/or email me at tenisha9@gmail.com. If you have questions about your rights as a research participant that have not been answered by the investigator or report any concerns about

the study, you may contact the Michigan State University Institutional Review Board, telephone (517) 355-2180.

**Freedom to Withdraw:** You are free to decide not to enroll in this study or to withdraw at any time without adversely affecting you or your relationship with the investigator or Michigan State University. Your decision will not result in any loss of benefits to which you are otherwise entitled.

**Consent:** If you wish to participate in this study, you will be interviewed, observed, and complete a survey. You are voluntary making a decision whether or not to participate in this research study. Your signature certifies that you have decided to participate, having read and understood the information presented. You will be given a copy of this consent form to keep.

Signature of Participant Date

_____ _____

I hereby give consent to audio record my interview.

Initials of Participant Date

_____ _____

In my judgment I am voluntary and knowingly giving informed consent and possess the legal capacity to give informed consent to participate in this research study.

Signature of Investigator Date

_____ _____

**Research Investigator:**

Tenisha Howard (Cellular): (917) 636-3637

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East Lansing, MI 48824

**Research Committee Co-Chairs:**

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East Lansing, MI 48824, 517-432-0869.

## Appendix B

## Demographic Sheet

**Age: _____**

**Marital Status:**

**Single Married Separated**

**Colleges Attended: _____**

**Degrees Obtained:**

**BA MA PhD MD**

**Positions Held: _____**

**Children: _____**

**Siblings:_____**

**Highest Degree of Parents:_____**

**Parents Area of Study:_____**

## Appendix C

## Interview Protocol

**Date**_____ **Interviewee ID**_____

**Pseudonym**_____

**Introduction**

- Introduce self
- Discuss the purpose of the study
- Provide informed consent
- Provide structure of the interview (audio recording, taking notes, and use of pseudonym)
- Ask if they have any questions
- Test audio recording equipment
- SMILE-make sure the participant feels comfortable

**Interview Questions:**

The following questions will be asked in attempts to elicit thoughts, intentions, and meanings about their career paths and issues pertaining to the impact of race through semi-structured interviews:

1. Why did you pursue higher education? Who inspired you to do so?

2. Was your education halted at any time if so, why and how exactly did you re-enter?

3. What is your current position? Were your career paths before this current position? What are some of your motives for this career choice? (How did you come to this position?

What or who inspired you towards this career choice?/ Who would you say most influenced your choice of a STEM career?

4. How long have you aspired this career path? Describe your path?) What would you say has been the single most factor in your pursuing and maintaining a career in the STEM discipline?

5. Tell me, how do you see yourself in your career in the future? Do you have plans to advance to higher levels in this particular field? Or do you have interests to pursue other alternatives and why?

6. How might your identity as an African American Women (hereafter, AAW) affect your position/experiences in your educational pursuit as well as career paths up to the current position you hold? Describe some experiences.

7. Why do you believe there continues to be a low representation of AAW in the STEM fields?

8. Would you say there were and are barriers that AAW face in the academy? If so, please describe those barriers?

9. Have you experienced such barriers? If so, have those barriers hindered your career advancement?

10. How have you managed to advance career wise in the STEM field, being that it- and the institution itself- is dominated by White males? (Do you think that this fact has delayed/hindered your advancement if so, how exactly?

11. What do you suggest are the needed qualities AAW should possess in order to advance?

12. What are the biggest challenges to attracting and retaining young women in STEM fields, and what are the most promising solutions to these challenges?

13. Do you find the resources available to AAW useful for their advancement in the STEM fields? Do you have other recommendations for resource/support systems that could aid

AAW in the career pursuits within the academy/career pursuits? What advice would you give to AAW pursuing a career in a STEM discipline?

14. For you, what has been more of a barrier to you pursuing a STEM career, your gender (sex) or your race/ethnicity? Explain.

15. Can you name any historical Black women in the STEM field that you would consider to be pioneers?

16. What role if any has spirituality played in your success and career development?

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