THE PERSPECTIVES AND EXPERIENCES OF AFRICAN AMERICAN STUDENTS IN AN INFORMAL SCIENCE PROGRAM

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ABSTRACT

Domonique L. Bulls: The Perspectives and Experiences of African American Students in an Informal Science Program
(Under the direction of Eileen Parsons)

Science, technology, engineering, and mathematics (STEM) fields are the fastest growing sectors of the economy, nationally and globally. In order for the United States (U.S.) to maintain its competitiveness, it is important to address STEM experiences at the precollege level. In early years, science education serves as a foundation and pipeline for students to pursue STEM in college and beyond. Alternative approaches to instruction in formal classrooms have been introduced to engage more students in science. One alternative is informal science education. Informal science education is an avenue used to promote science education literacy. Because it is less regulated than science teaching in formal classroom settings, it allows for the incorporation of culture into science instruction. Culturally relevant science teaching is one way to relate science to African American students, a population that continually underperforms in K-12 science education.

This study explores the science perspectives and experiences of African American middle school students participating in an informal science program. The research is framed by the tenets of culturally relevant pedagogy and shaped by the following questions: (1) What specific aspects of the Carver Program make it unique to African American students? (2) How is culturally relevant pedagogy incorporated into the informal science program? (3) How does the

incorporation of culturally relevant pedagogy into the informal science program influence African American students' perceptions about science? The findings to the previously stated questions add to the limited research on African American students in informal science learning environments and contribute to the growing research on culturally relevant science. This study is unique in that it explores the cultural components of an informal science program.

DEDICATION

I WOULD LIKE TO HONOR THE MEMORY OF MY MOTHER DEBORAH A. BULLS &

MY BROTHER DARYL

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I would like to thank God for ordering my steps. I would like to thank my family for praying, encouraging, and believing in me during this journey. Thank you to my father (Carl Sr.), my brother (Carl Jr.), grandparents, and thank you to Diamond, Nelson, and Scott for helping me to complete this great achievement.

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CHAPTER I

INTRODUCTION

Science is a significant part of our society. It is also a critical component in a student's life opportunities. The Programme for International Student Assessment (PISA) conducts a survey to assess the competencies of 15 year-olds in reading, mathematics, and science in sixty-five countries. PISA provides the most comprehensive picture of the math and science skills developed in schools that have ever been available, looking not just at what students know in the different domains of mathematics and science, but also what they do with what they know (PISA, 2012). PISA noted that foundational skills in mathematics and science had a significant impact on individuals' life chances. The survey showed that poor mathematics and science skills severely limit peoples' access to better paying and more rewarding jobs. That is, individuals who lack mathematical and scientific skills are at a disadvantage in competing for well-paying jobs. The U.S. Department of Commerce Economics and Statistic Administration (2011) reported that STEM workers command higher wages, earning 26% more than their non-STEM counterparts. Additionally, STEM degree holders earn higher earnings, regardless of whether they work in STEM or non-STEM occupations. STEM is not only necessary for economic livelihood, but it is also essential to understanding and addressing many of society's most pressing current and future challenges (National Research Council, 2012).

Science, technology, engineering, and mathematics (STEM) fields are vital to a nation's economy as evident in the workforce statistics for the United States (U.S.). The estimated size of the STEM workforce in the U.S. will be 8,650,000 by 2018 (U.S. Bureau of Labor Statistics, 2015). STEM-related jobs are growing faster than any other U.S. sector. The United States is currently the world hub of science and technology, but it is now being challenged by the rapid growth of STEM talent in other parts of the world (National Science Board, 2010).

STEM talent is cultivated in our school systems. Adequate access to supplies and resources, and the way in which our educators present science education to students is very important. The first experience that most students have with STEM is in school. To help foster science interests, educators must connect the content to the lives and interests of students. Culturally relevant pedagogy empowers students by using cultural referents to impart knowledge (Ladson-Billings, 1994). Culturally relevant teachers can possibly help students better understand science education by using culturally relevant pedagogy.

Statement of the Problem

In 2012, there were twenty-two nations whose high school students performed better than U.S. students in science (PISA, 2012). In 2008, 4% of U.S. bachelor's degrees were awarded in engineering, compared to 31% in China (National Science Board, 2012). In 2008, 31% of U.S. bachelor's degrees were awarded in the science and engineering fields, compared with 61% in Japan and 51% in China. (National Science Board, 2012). The World Economic Forum ranks the United States 52nd in the quality of mathematics and science education (World Economic Forum, 2011), and there have been concerns about the ability of the U.S. to compete in the global economy. The previously stated present a broad view of the importance and growth of STEM in the lives of individuals with an emphasis on available opportunity and the well-being of the U.S.

as a nation. To address the highlighted concerns, we must look at science education across the spectrum beginning in primary school.

Precollege STEM

In early years, science education serves as a foundation and pipeline for students to pursue STEM in college and beyond. The elementary through high school years are important to examine when addressing the position of the United States and its competitive status in STEM. The nation's report card in STEM at the precollege level indicated that improvement is needed. The National Assessment of Educational Progress (NAEP) science assessment reports a broad view of what U.S. students know and can do in science. The assessment measures student knowledge and abilities in the areas of physical science, life science, and earth and space science among select grade levels. The most recent results that are available focus on eighth-grade students.

NAEP views achievement at three different levels. The NAEP achievement level definitions are as follows:

- **Basic** - Partial mastery of prerequisite knowledge and skills that are fundamental for proficient work at each grade.
- **Proficient** - Solid academic performance for each grade assessed. Students reaching this level have demonstrated competency over challenging subject matter.
- **Advanced** - Superior performance.

(NAEP, 2011).

Traditionally, the NAEP science assessment occurs every four years, but the last science administration was in 2015. This evaluation was given to students in grades 4, 8, and 12. The 2015 results are not released. At the time of this writing, the 2011 NAEP results were available. Results from the 2011 NAEP assessment highlight the eighth grade and report the performance of students attending public schools, private schools, Bureau of Indian Education schools, and Department of Defense schools. Eighth grade is the main group of this assessment because the

2011 NAEP science assessment was a special administration to permit comparisons with the Trends in International Mathematics and Science Study (TIMSS), an international assessment. TIMSS is a voluntary science assessment and all 50 states and the District of Columbia agreed to participate. The available results showed group disparities in precollege STEM.

In 2011 the average scale scores for science, grade 8 by race/ethnicity were as follows:

- The national average scale score for White students was 163
- The national average scale score for Black students was 129
- The national average scale score for Hispanic students was 137
- The national average scale score for Asian students was 161
- The national average scale score for American Indian/Alaska Native students was 141
- The national average scale score for Native Hawaiian/Other Pacific Islander was 139
- The national average scale score for two or more races was 156

(NAEP, 2011).

The numbers above indicate that there are disparities between racial/ethnic groups in science education among eighth-grade students. White students outperformed other ethnic groups on the 2011 science assessment while Black students scored the lowest on the NAEP science assessment.

The grade 8 nationwide results from 2011 reports that 63% of Black students performed below basic on the assessment; greater than half of Black students demonstrated partial mastery of prerequisite knowledge and skills, 37% were at or above basic and 10% were at or above proficient, a solid academic performance for each grade assessed (NAEP, 2011). For Hispanic students, 52% scored below basic, 48% scored at or above basic, and 16% at or above proficient. Twenty-four percent of Asian students scored below basic, 76% at or above basic, and 43% at or

above proficient. The American Indian/Alaska Native students had 49% below basic, 51% at or above basic, and 20% at or above proficient. For the Native Hawaiian/Other Pacific Islander group, 48% were below basic, 52% were at or above basic, and 17% were at or above proficient. Students that self-identified as two or more races had 31% below basic, 69% at or above basic, and 35% at or above proficient (NAEP, 2011). Again the above data show that Black students' performance lagged behind their counterparts on the 2011 NAEP science assessment.

The Importance of Diversity in STEM

It is important to recognize and address the racial/ethnic disparities in the most recent publicized NAEP science assessment. These data indicated that there are clear differences as it relates to achievement, as measured by standardized assessments, among particular groups of students. These data become even more important in light of the current makeup of our country. According to the United States Census Bureau, the estimated population in 2014 was 318,857,056. Black/African Americans constituted 13.2% of the population, and 17.1% were Hispanic or Latino. The Latino population grew to 53 million in 2012, which is a 50% increase since 2000. The overall U.S. population increased by only 12% from 2000-2012; the Latino population growth accounted for more than half of the country's growth in this period (U.S. Census Bureau Data, 2012).

It is important that our education system and STEM workforce reflect the demographic changes. A policy report by the President's Council of Advisors on Science and Technology (PCAST, 2012) noted that if the United States is to retain its preeminence in science and technology and remain competitive in a fast-changing economy, it will need one million more STEM professionals over the next decade (PCAST, 2012). All segments of the U.S. population must be tapped to meet the STEM workforce demand. The attention placed on STEM has led to

numerous calls for national efforts to increase the number and diversity of students pursuing degrees and careers in STEM (National Academy of Science, 2005; National Governors Association, 2007; National Research Council, 2012, National Science Board, 2007). One reason to promote diversity is that it is critical to science excellence. Diversity can bring new perspectives needed to promote innovation in STEM (Tachibana, 2012). A lack of diversity may reflect a loss of talent, a staple for scientific advancement. Ultimately diversity is needed to sustain long-term economic growth and global competitiveness. For the STEM workforce to reflect the demographic diversity of the U.S. population, a necessity for global competitiveness, efforts must include a focus on precollege STEM education; science education is of interest in this study.

The demographics in the U.S. are changing, and a disproportionate percentage of the populations experiencing the greatest growth are not performing well in science in comparison to their White counterparts. Even with decades of science education reform movements, concern about the science achievement among ethnic minority groups, especially African American students, remains. For example, the National Science Education Standards posited by the National Research Council (NRC) heralded “science for all.” The rhetoric "science for all" is prevalent in the science education literature, but equitable science education practices are not implemented in the science classrooms for African American students (Simpson, 2007). In 2013, the National Research Council (NRC) facilitated the release of *The Next Generation Science Standards (NGSS)*. The NRC purports that the new standards, if applied appropriately in classrooms, will enable all students to acquire the skills needed for college and careers in STEM fields. *NGSS*, with a focus on all grade levels, realize accessibility to STEM must begin in the

early years and attempt to make STEM accessible to all racial and ethnic groups. The success of this next wave of reform, especially for ethnic minorities, is yet to be determined.

Students of Color in Science

The challenges experienced by students of color within the science classroom have been documented (Atwater, 2000; Brickhouse & Potter, 2001; Carlone & Johnson, 2007; Carlone et al., 2011; Rascoe & Atwater, 2005). Malone and Barabino (2009) assert that ethnic minority students report feeling isolated and marginalized within science classrooms. Many students of color often view the field of science as foreign, distant, inaccessible, boring, irrelevant, and alienating (Basu & Barton, 2007; Lee & Luykx, 2005). Students tend to invest in or withdraw from learning depending on their interests (Singh, Granville, & Duka, 2002). Many interests are rooted in the students' cultural backgrounds.

To better address the learning needs among students from non-dominant backgrounds it is important to place greater attention on the cultural knowledge and resources they bring to learning. This concept of including culture in the teaching of science is not a new phenomenon. Cultural practices that are acquired outside of school may spark and increase student interest in science learning ((Elmesky & Seiler, 2007; Upadhyay, 2006). Data indicated that ethnic minority students developed a sustained interest in science when (a) their science experiences connected with how they envisioned their future; (b) their learning environments supported the kinds of social relationships they valued; and (c) their science activities supported their sense of agency for enacting their views on science (Basu & Barton, 2007). A sustained interest in science is critical because interest in science early in children's lives influences their decision to pursue a science-related career. Students that report an interest in science in the eighth grade are three times more likely to obtain a college degree in a science field than those who did not show an

interest (Tai, Liu, Maltese, & Tan, 2006). The benefit of using the students' cultures as resources was not limited to interest. Within the literature, in the studies in which the context of learning was altered to match the cultural values of the participants, the minority students experienced significant gains in achievement (Allen & Boykin, 1991; Boykin, 1982, 1979; Boykin & Allen, 1988; Tuck & Boykin, 1989, Tharp, 1989; Tharp et al., 1984). The previously discussed research is evidence that approaches grounded in students' cultural backgrounds, and everyday knowledge can make a difference in the learning process (Lee & Luykx, 2005). Such procedures are rare in science classrooms. Traditional science classroom learning is typically teacher driven with the use of foreign terms, concepts and language. According to Elmesky and Seiler (2007), school science is taught in an authoritative and technical manner, which means the classroom is teacher- and standards-centered to the exclusion of consideration for and participation by the students. This type of teaching can disconnect students from science. Informal science programs are an alternative way to engaging students in science.

Informal science programs play an important role in influencing participation in science learning. Informal science programs have been considered especially important for students from groups underrepresented in science, groups who are likely to attend schools with inadequate science education resources (Rahm, 2008). Over the last ten years, informal science programs have multiplied to increase student's exposure to science (Bell, Lewenstein, Shorise, & Feder, 2009). The United States education system is currently being challenged to meet the needs of a diverse student population. Classrooms are becoming more diverse, but the curriculum and teaching are not changing to meet the needs of diverse students; this is particularly pronounced for African American students.

Purpose of the Study

It is clear that to engage children in science, efforts need to take place at an early age. The situation is further complicated by the changes in U.S. demography. With the change in demographics, our education system and methods of teaching must also change. The majority of practicing science teachers today has not been prepared to address diversity within their classrooms (Johnson, 2011). Educators will need to be ready to teach this new population of students adequately. To provide meaningful knowledge and skills, educators must be able to analyze critically important issues such as race, ethnicity, and culture while also recognizing how these concepts shape the learning experiences for students (Howard, 2001). To address these issues, educators need to be able to create pedagogical practices that are relevant and meaningful to students. This can be a difficult task to perform, and the task is further complicated within science education.

Science is a significant part of our society, it is a critical component of a student's educational experience, and it is essential for understanding and addressing many of society's current and future challenges (NRC, 2012). There are a low number of citizens in the United States pursuing science careers (Parker& Gerber, 2000). Consequently, efforts are needed to help prepare students to assume science-related careers. Many efforts to address concerns have been implemented within schools, but fewer initiatives in comparison have occurred in out-of-school settings. This study emphasizes informal science learning environments in relation to cultural practices to be explained in chapter 2. The study addresses the cultural disconnection of science education, the importance of cultural capital to African American students in science education, and the possible influence of culturally relevant informal science learning environments on the

advancement of science education for African-American students. Cultural practices are further explained in chapter two.

Informal science learning can be an alternative avenue in which to engage students in science, especially African American students. School science often fails to provide equitable learning opportunities for many marginalized students, particularly with respect to curriculum, materials, teaching methods, and assessment practices (Bryan & Atwater, 2000; Lee, 2005). As previously noted African American students are continually underperforming in K-12 science education. The literature suggests that the incorporation of culture into teaching can improve science education for African American students. Many students of color adhere to their cultural practices when learning science. Often the cultural practices that minority students embrace are not valued by the traditional school system and may create conflict or tension. These pressures can be alleviated and African American students' engagement with science improved through the adoption of culturally respectful and caring approaches (Parsons, 2008). Few research studies focus specifically on African American students and their engagement with science in informal learning settings. In fact, after conducting an ERIC search in January 2016 of "informal science education," there were 405 results of peer-reviewed articles that had a focus on informal science. When the search was narrowed down to “informal science education” and “African Americans" there were only seven results of peer-reviewed articles. Out of the seven results, only one study focused on African American students in elementary and middle school (Simpson & Parsons, 2009).

Research Questions

This study explores the science perspectives and experiences of African American middle school students participating in an informal science program. The research is framed by the

tenets of culturally relevant pedagogy (academic success, cultural competence, and critical consciousness) and shaped by the following questions:

1. What specific aspects of the Carver Program make it unique to African American students?
2. How is culturally relevant pedagogy incorporated into the informal science program?
3. How does the incorporation of culturally relevant pedagogy into the informal science program influence African American students' perceptions about science?

The findings to the previously stated questions add to the limited research on African American students in informal science learning environments. The study also contributes to the growing research on culturally relevant science. This study is unique in that it explores the cultural components of an informal science program.

Significance of the Study

There have been a limited number of studies that focus on science learning in classrooms where students of color are educated (Varelas, Kane, & Wylie, 2011), and a greater dearth of literature exists when referencing students of color learning science outside of school. More recently within the literature there are some researchers that focus on the positive aspects of students of color learning science (Haun-Frank, 2011; Brown et al., 2013; Buck et al., 2014; Adjapong & Emdin, 2015; Archer et al., 2015; Schademan, 2015). Even though these researchers are highlighting the importance and positive aspects of science education for students of color, most studies that focus on students of color rarely shed light on the positive aspects of the learning processes of these students. Children of color are often represented in science education in ways that emphasize deficit views (Bryan & Atwater, 2002). Within the deficit frame of thinking, failure is associated with the students' ethnic backgrounds, social positioning,

or the cultural disconnect between home and school rather than the structural inequalities of schools. The blame is often placed on the students. A deficit perspective assumes that the cultural, social, educational, political, and economic spheres of life are the same for all Americans. Deficit perspectives take into account ethnicity, gender, or social class, but they consider them in a negative way (Parsons, 2008). Viewing children of color from a deficit frame prevents teachers from being able to interact effectively with diverse students (Villegas & Lucas, 2002). This study is important in that it uses an alternative lens and values the perspectives and culture of the participating students. This orientation in science education research is not the norm, and it adds to the literature on the teaching of science education to African American students.

Race and ethnicity often shape school experiences and opportunities, but in science education race and ethnicity are often overlooked when doing educational research (Parsons & Turner, 2014). How can we accurately assess the education of students of color without addressing the salient factors that are ever so present in their daily lives? This study addresses this issue by including the personal stories and perspectives of the students. Beyond the problem of deficit practices, there is a problem with learning science in schools. This problem affects a large population of students, and students of color seem to be affected disproportionately. Research indicates that compared to other school subjects, science is failing to engage young people (Jenkins & Nelson, 2005; Lyons, 2006; Osbourne & Collins, 2001; Sjoberg & Schreiner, 2005). Science content is often based on national science education standards, and state mandated instructional objectives that place additional stressors on science teachers. This study is significant in that it researches a setting where said stressors are not present.

An important aspect of science content to be considered is the relevancy of the information to the personal lives of students (Parker & Gerber, 2000). Many students continue to be underserved by science education, which may jeopardize their ability to attain career goals and affect the contributions the nation makes to the world of science. Beyond students, this is an issue as it pertains to the position of the United States as a global competitor in STEM. It is an imperative to develop students that can flourish in science and contribute to the nation's success in STEM, but to make a difference challenges in K-12 science education must be addressed and remedied.

The need to foster success among diverse student populations in STEM is greater than ever before (Lewis, Lee, Santau, & Cone, 2010; Next Generation of Science Standards, 2013). This study addresses issues that African American students encounter in science education. The study provides insight into factors that foster the participation of African American students in science.

Study Limitations

There are some study limitations in this research study. Although the study emphasizes the science perspectives of African American students in an informal science program, science learning is not assessed. Also, this is a qualitative study that only focuses on four students and two teachers so the findings have limited generalizability. The information collected from this study is greatly needed and will help to direct further research on this topic, but it is not reflective of the experiences of all African American students.

Organization of the Dissertation

This dissertation is organized into five chapters. Chapter I presented the statement of the problem, purpose, research questions, and significance of the study. Chapter II discusses

literature related to African American students and science education, informal science education and culturally relevant pedagogy. Chapter III describes the methods used to conduct the study and Chapter IV presents the study's results. Chapter V concludes the dissertation with the summary, discussion, and implications of the research study.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter presents a review of the literature on African American students in science education, culturally relevant pedagogy and informal science education. Culturally relevant pedagogy is the conceptual framework used for the analysis and interpretations of the study. Chapter II reviews the tenets of culturally relevant pedagogy and how it has developed over time, and how culturally relevant pedagogy connects to the study. Because the study is located in an informal science program, the chapter also reviews the informal science education literature by discussing the progression of informal science education and the forms it has taken over time.

African American Students in Science Education

As mentioned in chapter one as the statement of the problem, the general underachievement and underrepresentation of African American students in science indicate that critical attention needs to be paid to science learning environments. Historically and in contemporary times, many African American children continue to fare poorly in K-12 science (National Center for Education Statistics, 2000). Science achievement among African American students remains low despite decades of intervention programs to increase their performance in the discipline (Campbell, Denes, & Morrison, 2000; Clark, 1996; Rose-Century, 1997; Tobias, 1992). According to the literature, the current status of African American science achievement appears to result from a variety of education and social disparities. Seiler (2001) suggests that the achievement discrepancy for African Americans persists despite massive education reform

efforts because the strategies that are used focus on assessment rather than the underlying social and cultural factors that play a role in science learning. A wide range of factors impacts the status of various groups in science. These factors include, but are not limited to, ethnicity, socioeconomic status (SES), gender, K-12 experiences with science, early ideas about science, and family and peer influence (Barab & Hay, 2001; Catsambis, 1995; Ferguson & Mehta, 2002). Underrepresented students often perceive the world of science as different from their own and may resist participation in school science (Costa, 1995; Gilbert & Yerrick, 2001; Seiler, 2001; Simpson, 2007).

According to Parsons, Travis, & Simpson (2005), science is inherently cultural and in order to meet students' needs, instruction must reflect, in some ways, students' unique cultural learning contexts. Boykin (1986) believes that African American children should be allowed to function and perform in learning environments in a manner that are congruent with their cultural worldviews. Scholars such as Norman et al. (2001) and Parsons et al. (2005) have indicated that the cultural practices and norms of African American students should be used as capital for improving how students learn science. Learning environments that connect the science disciplines with students' cultural practices enable students to capitalize on their experiences for science learning and to construct meanings in ways that relate science to their cultural identities (Lee, 2004).

The culture of African American students plays a significant role in their learning of science. For this study, Boykin's (1986) Black Cultural Ethos defines and explains what is meant by African American culture. The Black Cultural Ethos consists of nine themes that are rooted in West African customs and values. Boykin (1986) states that not all African Americans will possess these characteristics to the same degree, but he believes that these nine cultural themes

are deeply embedded in the African-American cultural way of being (Boykin, 1986; Parsons et al., 2005). The nine dimensions that Boykin (1986, 1992) described as part of the Black Cultural Ethos are the following:

1. Spirituality – the acknowledgment of a realm beyond the material or physical world
2. Harmony – a view in which interconnections among seemingly independent parts is prominent
3. Movement –an affinity for rhythm and music
4. Verve –a person or group's preferences for energy filled environments
5. Affect –an importance given to the expression of one's emotions and feelings
6. Expressive Individualism – the importance of expressing uniqueness
7. Orality - a preference for the creative dynamic and flare of the verbal or audio forms of communication
8. Sociality – a premium placed on social interactions as evidenced by a fluid rather than rigid view and use of time
9. Communalism –a preference for group solidarity and responsibilities

Black Cultural Ethos has been proposed as a way for educators to think about African American culture. Black Cultural Ethos is not the conceptual framework for this study, but a way to define African American culture when referring to the culture that African American students bring with them into the classroom as it provides the necessary context for understanding culturally relevant pedagogy.

Cultural Approaches to Education

There are many general conceptualizations of culture in the literature; I have chosen the conceptualization that best aligns with the focus of the study. Culture is not a trait but a repertoire of practices. These practices are influenced by an individuals' continued participation in cultural communities (Gutierrez & Rogoff, 2003). According to Gutierrez and Rogoff, cultural communities are coordinated groups of people who share traditions and understandings (Gutierrez & Rogoff, 2003). The researchers argue against the conventional approach of assuming that culture is static; instead, attention is placed on variations in individuals' and groups' histories of engagement in cultural practices. This conceptualization of culture focuses more on the experiences of individuals. Culture is the beliefs, values, and ways of being (Nobles, 1980) as well as practices. In the science education literature, culture is often situated as one or the other. Throughout this dissertation, this eclectic view of culture is used.

Anthropologists have presented an array of terms and attempts to develop school cultures that more closely align with student culture in order to promote academic success. This work has had a variety of labels including "culturally appropriate", (Au & Jordan, 1981), "culturally congruent" (Mohatt & Erickson, 1981), "culturally compatible" (Jordan, 1985; Vogt, Jordan, & Tharp, 1987), "culturally responsible" (Cazden & Leggett, 1981; Erickson & Mohatt, 1982; Gay, 2002), and "culturally relevant" (Ladson-Billings, 1995a, 2006).

Culturally appropriate was developed from a study of teacher practices with Hawaiian students in Hawaii (Au & Jordan, 1981). This approach uses a method called "talk story" to incorporate students' cultural backgrounds into reading instruction. Culturally compatible is similar to culturally appropriate in their origination in that both approaches involved Hawaiian children, but it differs in its broader application because this method uses students' culture to guide instruction (Au & Jordan, 1981; Jordan 1985; Vogt, Jordan, & Tharp, 1987). A similar

focus is emphasized in culturally congruent instruction. Culturally congruent instruction utilized Native American and Anglo language patterns to bridge the home and school cultures in the study from which the concept originated, and was founded on observations of student-teacher interactions with Navajo children (Mohatt &Erickson, 1981). The previously described efforts highlighted distinct approaches; culturally responsive and culturally relevant were more comprehensive in scope.

Culturally responsive pedagogy was derived from the synthesis of literature regarding the underachievement of students of color (Cazden & Leggett, 1981; Erickson & Mohatt, 1982; Gay, 2002). It uses the cultural characteristics, experiences, and perspectives of ethnically diverse students for more effective teaching. Culturally relevant is a term coined by Gloria Ladson-Billings, and this methodology was founded on an ethnographic study of the successful teachers of African American students (Ladson-Billings, 1995a, 2006). Culturally relevant pedagogy critically examines teaching and encourages teachers to question the nature of the student-teacher relationships, the curriculum, schooling, and society. Culturally relevant pedagogy is the conceptual framework used in this study to analyze and interpret findings.

Gloria Ladson-Billings noticed that there were only a few studies in the literature that focused on cultural relevance for African American students in the classroom. The studies that she found viewed African American students from a deficit frame of thought. The primary focus was on what the students were "lacking" in the classroom, and ways to "fix" or assimilate students into mainstream culture. The studies did not value what the students contributed to the class or honor their cultural differences. To find the positive contributions of African American students and a focus on successful African American students and their teachers, Gloria Ladson-

Billings embarked on an ethnographic research study where she ultimately developed culturally relevant pedagogy.

Culturally Relevant Pedagogy: Its Development

It has been approximately twenty years since the creation of culturally relevant pedagogy. Since its inception, the methodology has grown and been introduced into many education arenas across the world. As of January 2016, according to Google Scholar, searching the term culturally relevant pedagogy brings up 245,000 results. Gloria Ladson-Billings' article: *Toward a theory of culturally relevant pedagogy* has been cited 2,826 times. The term culturally relevant pedagogy has been used many times in the literature, and it is important to understand the history of the phrase.

Culturally relevant pedagogy was birthed out of a need to find an instruction that recognized and celebrated African and African American culture (Ladson-Billings, 1992a). According to Ladson-Billings (2009):

> The notion of "cultural relevance" moves beyond language to include other aspects of student and school culture. Thus, culturally relevant teaching uses student culture to maintain it and to transcend the adverse effects of the dominant culture. (p. 19)

There have been some attempts to bridge the gap between home and school culture, but none of these efforts focused solely on African American students. As a researcher, Gloria Ladson-Billings wanted to develop a methodology and pedagogy for African American students. One of the challenges faced by Ladson-Billings was the notion of her work being viewed as biased or skewed because of her vested interests in the African American community. The location of Gloria Ladson-Billings as a native to the community being researched could have possibly worked against the credibility of the pedagogy she developed (Banks, 1992; Padilla, 1994). To address this issue, Ladson-Billings searched for a theoretical grounding that acknowledged the

researcher's standpoint while simultaneously forcing the researcher to problematize that point of view. The work of Patricia Hill Collins (1991) on Black feminism met the above requirements and, therefore, was used as a grounding to help develop culturally relevant pedagogy (CRP).

Patricia Hill Collins's (1991) work is based on four dimensions:

1. Concrete experience as criterion of meaning
2. The use of dialogue in assessing knowledge claims
3. The ethic of caring
4. The ethic of personal accountability

Real experience according to Patricia Hill Collins creates meaning. Collins asserts that individuals who have lived through the experiences, about which they claim to be experts, are more believable and credible than those who have just read and thought about such experiences. Her second dimension is the use of dialogue in assessing knowledge claims. This dimension can be used to help connect the researcher with the study. Collins's use of ethic of caring refers to affective connections between and among people, and an understanding of a greater sense of commitment to what scholarship can mean in the lives of people (Collins, 1991). Lastly, the ethic of personal accountability addresses the notion of who makes the knowledge claims is as important as what those knowledge claims are. Individuals' commitments to ideological and value positions are important in understanding knowledge claims (Ladson-Billings, 1995a). The work of Patricia Hill Collins helped Gloria Ladson-Billings to think about her work as a researcher and to help guide her positionality as a researcher, but it did not provide a way to theorize about her research project.

Gloria Ladson-Billings decided to generate theory as she practiced theory. She decided to conduct a study to examine the pedagogical excellence of teachers who were successful teachers

of African American students. As Gloria Ladson-Billings researched and studied exemplary teachers of African American students, she began to develop a grounded theory of culturally relevant pedagogy.

In 1988, Gloria Ladson-Billings started working as a lone investigator with a group of eight teachers in a small (less than 3,000 students), predominantly African American, low-income elementary school in Northern California (Ladson-Billings, 1995a). As mentioned above, one of the goals of this project was to find excellent teachers of African American students. The eight teachers chosen for this research project were identified through a process of community nomination. African American mothers within the community helped to nominate who they believed were excellent teachers. The parents' criteria for teaching excellence included being accorded respect by the teacher, student enthusiasm for school and academic tasks, and student attitudes towards themselves and others. The parents' choices were crosschecked by an independent list of excellent teachers generated by school principals. The principal's criteria for selection included good classroom management skills, student achievement on standardized tests, and personal observations of teaching practice (Ladson-Billings, 1995a). The selected teachers were all females, five African American, and three White teachers.

From the findings of her research, Ladson-Billings has defined culturally relevant teaching as the pedagogy of opposition, which is explicitly committed to collective empowerment (Ladson-Billings, 1992b). According to Ladson- Billings (1995a), culturally relevant pedagogy is based on three criteria:

1. Students must experience academic success
2. Students must develop and maintain cultural competence

3. Students must develop a critical consciousness through which they challenge the status quo of the current social order.

According to Ladson-Billings, students must demonstrate academic competence to become academically successful. Culturally relevant teaching requires that students maintain integrity with respect to their culture which is known as cultural competence, as well as academic excellence and that teachers utilize student's culture as a vehicle for learning (Ladson-Billings, 1995b). Teachers must encourage academic success and cultural competence, but they must also help students to recognize, understand, and critique current social inequities (Ladson-Billings, 1995a). The three criteria above can be surmised as three tenets: academic success, cultural competence, and critical consciousness.

Academic Success

Among the scholarship that has examined academically successful African American students, a disturbing finding was observed by Ladson-Billings. The research reviewed by Ladson-Billings showed that the students' academic success came at the expense of their cultural and psychosocial being (Fine, 1986; Fordham, 1988). Another finding suggested that African American students who are academically successful are often ostracized by their peers for "acting white" in school (Fordham & Ogbu, 1986). Ladson-Billings addressed these issues with the eight teachers involved in her study.

The eight teachers in her study demanded, reinforced and produced academic excellence in their students (Ladson-Billings, 1995b). Culturally relevant teaching requires that teachers not only make students "feel good" by only improving their self-esteem but also to attend to the students' academic needs. The teachers in the study encouraged their students to "choose"

academic excellence. Below is an example of academic success noted by Gloria Ladson-Billings during her study:

> In one of the classrooms I studied, the teacher, Ann Lewis, focused a great deal of positive attention on the African American boys. Lewis, a white woman, recognized that the African American boys possessed social power. Rather than allow that power to influence their peers in negative ways, Lewis challenged the boys to demonstrate academic power by drawing on issues and ideas they found meaningful. As the boys began to take on educational leadership, other students saw this as a positive trait and developed similar behaviors. Instead of entering into an antagonistic relationship with the boys, Lewis found ways to value their skills and abilities and channel them in academically important ways. (Ladson-Billings, 1995b, p. 160).

As noted in the above scenario, academic success is a critical component of culturally relevant teaching. To incorporate culturally relevant pedagogy in a classroom, teachers must create an environment that is conducive to academic success for all students.

Cultural Competence

The dilemma for some African American students in schools is negotiating the academic demands of school while demonstrating cultural competence. Cultural competence is when students maintain cultural integrity as well as academic success (Ladson-Billings, 1995a). Most African American students bring to school a psychological repertoire that incorporates specific cultural themes (Boykin, 1986). Unfortunately, these themes are not constructively acknowledged in schools, and they may even be dismissed as inappropriate (Boykin & Ellison, 1995). Gordon and Yowell (1994) referred to this lack of acknowledgment for culture as a cultural mismatch; this is believed to play a role in students' attitudes toward schooling, their motivation to achieve and their academic performance.

Cultural competence is an important part of culturally relevant teaching, but it can also be difficult to enact in the classroom. Gloria Ladson-Billings (1995b) provided an example of cultural competence in the classroom:

> Another way teachers can support cultural competence was demonstrated by Gertrude Winston, a white woman who has taught school for 40 years. Winston worked hard to involve parents in her classroom. She created an "artist or craftsperson-in-residence" program so that the students could both learn from each other's parents and affirm cultural knowledge. Winston developed a rapport with parents and invited them to come into the classroom for 1 or 2 hours at a time for 2-4 days. The parents, in consultation with Winston, demonstrated skills upon which Winston later built (p. 161).

As mentioned above, maintaining cultural competence is important in utilizing the students' culture as a vehicle for learning.

Critical Consciousness

Students must develop a broader sociopolitical consciousness that allows them to critique the values and cultural norms of institutions that produce and maintain social inequities. Freire used the term “conscientization" which is a process that invites learners to engage the world and others critically (McLaren, 1989). To help students to evaluate critically society, teachers themselves must recognize social inequities and their causes (Ladson-Billings, 1995a).

In the classrooms of culturally relevant teachers, students are expected to think critically, rather than digest and believe facts that their textbook suggests. Ladson-Billings (1995b) provided an example of critical consciousness:

> Several of the teachers in the study, in conjunction with their students, critiqued the knowledge represented in the textbooks, and the system of inequitable funding that allowed middle-class students to have newer texts. They wrote letters to the editor of the local newspaper to inform the community of the situation. The teachers also brought in articles and papers that represented counter knowledge to help the students develop multiple perspectives on a variety of social and historical phenomena (Ladson-Billings, 1995b, p. 162)

It is imperative for teachers to help students develop a critical lens. Critical consciousness is important in developing a culturally relevant classroom and teaching style.

Culturally relevant pedagogy as described by Gloria Ladson-Billings is a unique pedagogy in that it does not require students to assimilate into mainstream culture. Instead, culturally relevant

pedagogy recognizes students' home culture as valid and significant. The history of CRP is a great indication of the importance and value of this type of pedagogy for all students. The three tenets of culturally relevant pedagogy emphasize academic excellence inside the classroom, the celebration of one's own cultural identity, and critical consciousness for use inside and outside the classroom.

Culturally Relevant Pedagogy: Research and Applications

The term culturally relevant pedagogy is commonly used, but the way in which the term is applied varies. The above sections gave a historical overview of culturally relevant pedagogy, and how Ladson-Billings intended for it to be used. The conceptualization of CRP previously explained is the conceptualization used in this study because it was the original form and it best addresses the specific aspects and questions of the research study. The conceptualization of CRP includes and incorporates the critical aspect of cultural relevance, an element the researcher for this study deemed extremely important when researching African American students. In science education culturally relevant pedagogy has been incorporated in various ways in the teaching of science to students.

As the nation's student population becomes more diverse, science educators are becoming aware of the need for equity in science education. Research on diverse students in science education challenges conventional notions of science content, learning, teaching, and assessment (Lee, 2005). Culturally relevant science teaching was created because educators and researchers wanted to make science relevant to the lives of everyone; this is a recent and growing field of research that promotes the development of culturally relevant science teaching with a specific aim of engaging all students in the learning of science (Barton, Koch, Contento & Hagiwara, 2005; Basu & Barton, 2010; Johnson, 2011). Culturally relevant science teaching has a

conceptual and methodological connection to culturally relevant pedagogy. Barton (2002,2003) is a foundational voice in the growing field of culturally relevant science teaching. The field was created because Barton (2003) found teachers who tended to see issues of social justice or cultural relevancy as appropriate in the arts and humanities, but not in the hard sciences. Barton created three underlying goals for culturally relevant science teaching; these goals were designed to correspond to the tenets of culturally relevant pedagogy. The goals are a science curriculum (1) should allow multiple points of entry, (b) allow for thinking about structures through recognizing networks, and (3) allow for the development of identities and relationships centered on a desire for change.

The goals for culturally relevant science teaching are modeled after Ladson-Billings' tenets for CRP and intended to mirror them. Instead, the goals are broad and vague. Academic excellence, cultural competence, and critical consciousness are not explicitly stated in the above goals. The goals take on a very generic approach to learning, and it misses the intended application for CRP. Culturally relevant pedagogy in the area of science is still new and growing, but the way in which it is being applied does not totally align with Ladson-Billings (1995a) intended use for culturally relevant pedagogy. As a result of the previously discussed reasons, Gloria Ladson-Billings conception of CRP is the guiding frame for the study.

The Current State of Culturally Relevant Pedagogy

Culturally relevant pedagogy has been around for over two decades and has helped to guide many research studies in the academy. Society has changed since 1995, and therefore, the use of the term has evolved. A new pedagogy has developed as an updated version of culturally relevant pedagogy.

Gloria Ladson-Billings (2014) reflects on the history of CRP and the ways it has been used and misused. She suggests that it is time for a "remix" of her original theory. Ladson-Billings states:

> The notion of a remix means that there was an original version and that there may be more versions to come, taking on previously developed ideas and synthesizing them to create new and exciting forms (p. 76).

Additionally, Ladson-Billings also addresses the following:

> Despite the apparent popularity of culturally relevant pedagogy, I have grown increasingly dissatisfied with what seems to be a static conception of what it means to be culturally relevant. Many practitioners and those who claim to translate research into practice seem stuck in very limited and superficial notions of culture. Thus, the fluidity and variety of cultural groups have regularly been lost in discussions and implementation of culturally relevant pedagogy (p. 77).

Gloria Ladson-Billings used this article to voice her concerns about the way in which culturally relevant pedagogy has evolved and also to introduce a new pedagogy developed by Django Paris. The newer concept of culturally relevant pedagogy is culturally sustaining pedagogy (CSP).

The discussion of culturally relevant pedagogy remains active and important to the education community. It is also important to note that a great deal has changed since Gloria Ladson-Billings proposed culturally relevant pedagogy to education. There continues to be demographic changes within our schools, and student identities are evolving. To keep up with this change, scholars have been rethinking and creating new pedagogical theories that best respond to the changes in society. One of these theories is culturally sustaining pedagogy. Culturally sustaining pedagogy is a theory that seeks to perpetuate and sustain linguistic, literate, and cultural pluralism as part of the democratic project of schooling (Paris, 2012). According to Paris, the theory was birthed because of the following:

> Recently, however, I have begun to question if these terms are really descriptive of much of the teaching and research founded on them, and more importantly, if they go far enough in their orientation to the languages and literacies and other cultural practices of

> students and communities to ensure the valuing and maintenance of our increasingly multiethnic and multilingual society (Paris, 2012, p. 94)

Culturally sustaining pedagogy is an emergent idea, but still a nascent concept. Scholars are beginning to embrace the newly proposed theory by adding new literature and research studies that further explores the theory. Gloria Ladson-Billings is a supporter of this theory. In her 2014 article: Culturally Relevant Pedagogy 2.0: a.k.a. the Remix she states:

> I hope to help those who subscribe to earlier visions of culturally relevant pedagogy make transition to the remix: culturally sustaining pedagogy. For, if we ever get to a place of complete certainty and assuredness about our practice, we will stop growing. If we stop growing, we will die, and, more importantly, our students will wither and die in our presence (p. 77).

The evolution of culturally relevant pedagogy has evolved into a new theory: culturally sustaining pedagogy. What makes the work of Django Paris different from other researchers is that he used culturally relevant pedagogy as the foundation for his new theory without changing or misusing the original conception of the theory. Instead of changing the original meaning of the theory, he made additions to evolve the theory. CSP is still new and developing, and because of this, I will not be using culturally sustaining pedagogy as the theoretical framework for this study.

The above sections reviewed the history and application of culturally relevant pedagogy. In this research study, culturally relevant pedagogy was used as a lens to examine data related to the perceptions and experiences of African Americans in an informal science program.

Informal Science Education

The advancement of science education is important. Researchers have proposed alternative approaches as a way to continually improve science education, specifically to enhance interest and engagement in science. An alternative to teaching science in the traditional classroom is teaching science in informal environments.

Science learning can take place in both formal and informal settings. Within the literature, there is no clear agreement regarding the definition of informal science education. A problem that persists in trying to develop a unified definition for informal science learning is that such learning can take place in many environments with different structures and goals. Consequently, there are numerous explanations for informal science learning. One of the most commonly used and seminal definitions for informal science learning used throughout the literature is from Falk & Dierking (1992). Central to Falk & Dierking's definition is a contrast to formal learning that is defined as learning that takes place when a teacher and student interact with each other within a structured framework for fixed curriculum and standards. They broadly defined informal science education as science programs and experiences that occur outside the traditional classroom. Dierking (1991) also puts forward that the physical setting is only one factor governing learning in informal science environments. Dierking states: "Learning is learning, and it is strongly influenced by setting, social interaction, and individual beliefs, knowledge and attitudes" (Dierking, 1991, p. 8). Setting is important, but it is not the only factor that can influence science learning and that constitutes what is meant by informal science education.

To further characterize informal science education, refer to informal science learning as activities that occur outside the school setting, are not developed primarily for school use, are not developed to be part of an ongoing school curriculum, and are characterized by voluntary as opposed to mandatory participation in the context of a credited school experience (Crane, V., Chen, M., Bitgood, S., Serrel, B., Thompson, D., & Nicholson, H, 1994). The authors also noted that informal learning experiences could be structured to meet a set of objectives and may influence attitudes, convey information, or change behavior. Informal learning activities may serve as a supplement to formal learning; teachers can use them in schools to improve and

enhance their teaching methods. The distinguishing characteristic of informal science education is that it was originally developed for out-of-school learning (Crane et al., 1994). Along the same lines of distinguishing between formal and informal learning, Hofstein and Rosenfield (1996) believes that it is hard to define informal science learning because you must be able to determine whether or not informal science learning can take place within formal settings. When describing informal science learning, it is commonly positioned in an informal environment without consideration of a traditional formal environment such as school. According to Nasir et al. (2006), informal science environments can resemble the traditional classroom. The authors assert that informal science learning environments are designed to be safe and to allow exploration, supporting interactions with people and materials that arise from curiosity and are free of the performance demands that are characteristic of schools. These features distinguish informal science learning from formal science learning.

Formal and informal science learning are sometimes compared to nonformal science learning. Nonformal science learning is another term used to distinguish the ways in which people learn science. The Human Science Research Council (1981) developed the following definitions for formal, informal, and nonformal education:

> Formal education is education that takes place in a planned way at recognized institutions such as schools, colleges and universities. Nonformal education is education that proceeds in a planned but highly adaptable way in institutions, organizations, and situations outside the sphere of formal and informal education. For example in-service training, field trips, museum visits, and educational television and radio, informal education is education that is given in situations in life that come about spontaneously, for example within the family circle and neighborhood. A typical example of informal science teaching arising from formal science teaching would be school pupils in a bus or coffee bar spontaneously discussing a topic or problem posed in the class. (p. 91).

The above statement gives a broader and less structured definition for informal learning. The definition also incorporates what the authors define as nonformal learning. The other definitions

of informal science learning presented in this section do not consider nonformal learning, but instead, they group this learning with informal learning. Other researchers have taken a more hybrid approach to defining informal science learning. Crane Nicholson & Chen (1994) also defined informal science learning by connecting informal science learning with formal learning:

> Informal learning activities also may serve as a supplement to formal learning or even be used in schools or by teachers, but their distinguishing characteristic is that they were developed for out-of-school learning in competition with other less challenging uses of time. There are many informal learning media including exhibits and demonstrations in museums, aquariums, and zoo; television, radio, and community-based programs, books, magazines, hobbies, and newspapers. (p. 3).

This definition is an example of the hybrid approach to defining informal science learning. Providing one definition for informal science learning is difficult. Some describe informal science learning and education according to the setting in which learning occurred; others conceptualized informal science learning regarding its affordances, and yet some posited a hybrid of the two.

Other conceptualizations define informal science education beyond informal science learning. For example, Maarschalk (1988) and Tamir (1990) both described informal science learning as including factors such as motivation, interest, social context, and assessment. In 1999, the view of informal science education posited by the National Association for Research in Science Teaching (NARST) included previously discussed aspects. NARST formed an Ad Hoc Committee on informal science education with the charge to clarify just what constituted informal science education. The committee posited that informal science education constituted out of school learning that is self-motivated, voluntary, and guided by learners' needs and interests. The committee agreed that certain aspects of learning are critical to investigate such as the role of motivation, choice, control, interest, and expectations in the learning process. The

committee was able to provide a layout of the meaning of informal science education, but as mentioned before there is still no one widely accepted definition. For this research study, informal science education is defined as the learning of science outside the traditional school classroom, with the flexibility to incorporate formal learning structures.

The Structures of Informal Science Education

Informal science education can take place in various environments, and has been categorized in many ways. This section reviews the most common structures of informal science education, which are: everyday learning, designed environments, school-based field trips, student projects, and community-based programs. Although there are many different forms of informal science education, the most prominent forms in the literature and the forms connected to this research study are reviewed here.

Everyday Learning

Everyday learning includes a range of experiences that may extend over a lifetime (Schweingruber & Fenichel, 2010). Everyday learning includes family discussions, walks in the woods, personal hobbies, watching television, reading books or magazines, browsing the Internet, or helping out on the farm (Schweingruber & Fenichel, 2010). The experiences listed are shaped by the learner and can vary widely across families and cultures. Everyday learning happens often, but people engaging in this type of learning may not be aware that they are learning. The agenda and manner of interaction in this environment are largely selected, organized, and coordinated by the learners, and can vary across and within cultures (Bell et al., 2008). Students participate in everyday science learning when they explain to their parents what they learned in science class. Everyday science learning can include watching a television show on a science concept and learning a new science fact. This type of learning is extremely informal, and the student usually

drives his/her learning. Everyday learning is pervasive in people's lives and includes a range of experiences that may extend over a lifetime.

Designed Environments

Museums, science and environment centers, botanical gardens, zoos, planetariums, aquariums, visitor centers, historical settings, and libraries are considered to be designed environments. Artifacts, media, and signage are primarily used to guide the learner's experience in designed environments (Bell et. al., 2008). The individual often determines the nature of their interaction with the environment. The staff of the institution structures most designed environments, but the individual learner can determine for himself or herself how they interact within the setting. In designed environments, learners have a choice in selecting their learning experiences, and usually, learners decide to participate in exhibits or experiences that align with their interests. Learner engagement in designed environments is typically short-term and sporadic. The learning can take place individually, with family, or with school groups.

School Based Field Trips

A school-based field trip as it pertains to informal science learning is a trip arranged by a school and undertaken for educational purposes. Students can visit a place where the materials of instruction may be observed and studied directly in their functional setting (Krepel & Durall, 1981). Field trips are standard practice in science education, and much has been written concerning their educational desirability. Field trips take place in a more open, flexible, and democratic environment (Hofstein & Rosenfeld, 1996). This approach of informal science learning has the potential for providing for instructional techniques that are more student-centered in which participants can move around at their pace to explore (Feher, 1990). Field trips may be a part of a day, a day long, or a long weekend excursion. A field trip can be a simple

guided tour of an area of interest, or it may include an active research field project (Beiersdorfer & Davis, 1994). The ways in which students learn on a field trip can be ineffective; it may be just moving a classroom lecture to the outdoors, or it may be extremely effective when the tasks are clear and structured (Hofstein & Rosenfeld, 1996). Field trips are difficult to implement and are often expensive. Sometimes the purpose of the field trip is lost when there are too many students involved, then it becomes a socializing trip instead of a learning experience. As a result, some teachers and administrators see field trips as a disruption to the normal school program (Crane, V., Nicholson, T., & Chen, M, 1994).

Student Projects

Student science projects involving individual investigation are well-known student learning activities (Hofstein & Rosenfeld, 1996). A project may be an individual or a small group effort aimed at understanding a science question. In a research project, students can follow their interests, and develop themselves as socially minded, self-governing people exhibiting self-direction, initiative, self-criticism, and persistence (Kilpatrick, 1951). The intended goal of the research project is to develop a more independent and autonomous learner. Student projects can take place in informal science environments.

Community-Based Programs

According to Crane et al. (1994), there are three types of community-based informal science programs. These programs are discovery programs, science camps, and career programs. Discovery programs usually refer to after school programs that make engagement in science the priority (Crane et al., 1994). The goals of science discovery programs are to offer practical hands-on science experiences to youth and their families. These programs are usually enjoyable and follow the "science is play" stance (Nicholson et al. 1994). The informal science program in

this study mostly resembles a discovery program. Science camps are often associated with community organizations, businesses, and colleges and universities (Crane et al., 1994). Science camps are known as short-term intensive programs with course-like immersion in science. The goals of science camps are to participate in an intensive encounter with science that will increase participant confidence in science and allow them to become insiders to the world of science (Crane et al., 1994).

Career programs are multi-faceted support systems designed to ensure that students stay in the scientific pipeline (Crane et al., 1994). Career programs are more extensive, and they offer support and guidance over a longer period. These programs have frequent participation and multiple strategies for learning, including targeted contact with science professionals and focus on preparing participants for careers in science. Career programs are often referred to as university outreach programs (Crane et al., 1994). University outreach programs can be further divided into two categories (1) those that offer authentic activities to academically strong students, and focus on helping them understand the true nature of science through engagement in authentic science with scientists and (2) those that aim to increase ethnic diversity on university campuses through enrichment programs for diverse students (Rahm, 2012).

The structures of informal science education may vary, but they all have a common goal of advancing science learning for students. Each informal science entity listed above offers meaningful science activities to students. The role of informal settings in making science appealing has become widely recognized for making science accessible to more students (Falk & Dierking, 1992). When looking at research on informal science programs and efforts such as science discovery programs, summer camps, and science career programs, their effectiveness has been documented. These programs have helped to influence improvements in students'

academic standing as well as changes in scientific knowledge, interest, attitudes, confidence in science and career trajectories (Atwater, Colson, & Simpson, 1999; Fadigan & Hammrich, 2004; Hofstein, Maoz, & Rishpon, 1990; Nicholson, Weiss, & Campbell, 1994).

The Evaluation of Informal Science Education

Informal settings for science learning typically do not use tests, grades, class rankings and other practices commonly used in schools to document achievement (Bell et. al., 2008); the lack of assessment can be essential to the learning process of children. Less stress is placed on the students and teachers, and more time can be spent on teaching science (Bell, Lewenstein, Shouse, & Feder, 2009). Competitiveness is lowered when rankings and grades are eliminated. Less competition can promote student collaboration creating a more relaxed science learning environment (Bell et al., 2009). It is important to assess the progress and achievement of students in informal science learning. Although grades and rankings are not usually employed, science researchers have embraced the case of assessing the impact of out-of-school learning experiences, seeking to understand how every day, after-school, museum, and other types of settings contribute to the development of scientific knowledge and capabilities.

In both informal and formal learning environments, assessment requires plausible evidence of outcomes and is used to support further learning. The problem with assessing informal science learning is the diversity of informal learning environments. One of the main challenges is the development of practical, evidence-centered means for assessing learning outcomes of participants across the range of science learning experiences (Allen et al., 2007; Falk & Dierking, 2000). For many practitioners and researchers, concerns about the appropriateness of assessment tasks in the context of the setting are a major constraint on assessing science learning outcomes (Allen et al, 2007). Despite the difficulties of assessing

outcomes, researchers have managed to do important and valuable work in this field. Researchers have used a range of outcomes to characterize what participants learn about science in informal environments. These outcomes can include particular types of knowledge, skills, attitudes, feelings, and behaviors (Bell et. al., 2008). Being able to assess outcomes in these environments is important to the advancement of informal science learning. It is essential to be able to determine whether an informal science learning experience is beneficial to its participants so that changes can be made to better instruct the students.

The Importance of Informal Science Education

To truly understand children's science learning, one should look not only at the learning that takes place in the traditional school but also at learning that takes place out-of-school. Eighty-five percent of the time children are awake is spent outside of the classroom (Medrich et al., 1982). Much of what students learn about science, they learn outside the classroom (Gerber, Cavallo, & Marek, 2001). Children's life experiences both in and out of school have profound effects on their achievement in school and their functioning in society (Resnik, 1987).

By the third grade, many students lose their natural sense of curiosity, insightfulness, and ability to learn from exploration when the primary method of teaching is mundane classroom learning (Harte, 1989; Semper, 1990). Additionally, positive attitudes toward science as early as kindergarten and primary school are important because many scientists appear to make early decisions about their careers (Blatchford, 1992). There is a strong association between attitudes toward science and a child's performance in the science classroom. Children with more positive attitudes toward science show increased attentiveness to classroom instruction and participate more in science activities (German, 1988). Research suggests that personal interest and enthusiasm are important for supporting children's participation in learning science (Jolly,

Campbell, & Perlman, 2004). It is clear that to interest a child in science, efforts need to take place at an early age. Informal science learning can be an avenue in which to spark interest in science.

The National Science Teachers Association (NSTA, 2012) released a position statement about informal science in 2012. The statement reads:

> Informal science environments play an important role in promoting science learning for preK-12 students and beyond. The learning experiences delivered by parents, friends, and educators in informal environments can spark student interest in science and provide opportunities to broaden and deepen students' engagement; reinforce scientific concepts and practices introduced during the school day; and promote an appreciation for and interest in the pursuit of science in school and in daily life. (NSTA, 2012)

This position statement supports and shows the importance of informal science education. Informal science learning environments can engage and excite students to experience science in ways uncommon to the classroom. This type of learning has potential to extend science classroom learning by providing students with a range of rich motivating experiences (Ramey-Gassert, 1997). Informal science has an impact on increasing the probability of students pursuing career trajectories in science (Fadigan & Hammrich, 2004). According to Ramey-Gassert, Walberg, & Walberg (1994) informal science has many potential advantages such as nurturing curiosity, improving motivation and attitudes, and engaging through participation and social interaction and enrichment. When students experience informal science learning, it may provide a more open venue than formal school settings for incorporating the cultural values of students. These environments offer learners more direct non-verbal experiences, instead of discourse to relay information (Beer, 1987; Falk, Koran, & Dierking, 1986);this is important because informal learning can be catered to the individual.

Students in informal science environments display interests, enthusiasm, motivation, alertness, awareness, and a general openness and eagerness to learn science (Wellington, 1990).

As it compares to traditional in-school learning, informal science learning provides a rich learning environment for students with a variety of learning styles (Ramey-Gassert, 1997). Unlike many classrooms, informal science learning environments provide free-choice, self-paced, and socially interactive spaces for learning science by being able to actively "do" science (Ramey-Gassert, 1997). Luehmann (2007) argued that traditional school settings provide only limited opportunities for a meaningful apprenticeship in inquiry-based science teaching while out-of-school learning can offer opportunities to experience new practices. In-school science learning tends to be solitary, based on symbols, and divorced from real-world experiences, with little or no connection with the actual objects or events represented (Resnick, 1987). In contrast, out-of-school science learning uses real elements, which allows learning to take on greater meaning (Resnick, 1987). Wellington (1990) also stated that science, as it is presented in school, bears little resemblance to the natural world where science and technology are everywhere.

Engagement with science in out-of-school settings and practices can make a difference regarding youth academic standings in school, and it can also lead to increases in their levels of scientific literacy (Atwater et al. 1999). Engagement in informal science learning creates the opportunity for learners to experience a range of positive feelings and to attend to and find meaning about what they are learning (National Research Council, 2007). Evaluation of the last decade of organized informal science programs consistently have shown that such programs (1) raise student interest, confidence, and classroom achievement in mathematics and science and (2) generate student interest in pursuing STEM studies and careers (National Governors Association, 2007). The importance of informal science learning as indicated in research is one foundation of this research study.

The Research Study

This research study is focused on an informal science program. The program is classified as a community-based informal program. Culturally relevant pedagogy is used as the conceptual framework for this study because of the nature and population of the program. The Carver Program does not intentionally use CRP as the framework, as would be the case if CRP were employed to guide program or curriculum development. CRP emerged as the appropriate framework for the study after informally observing the program prior to conducting the research study. The Carver Program is over 90% African American and they use somewhat of a cultural lens to run the program (this will be outlined in Chapter IV). Chapter III details the research design, methods, and questions that shaped the study.

CHAPTER III

There is a need for increased research on informal science environments. Studies in this area are minimal in the literature. This research study is furthermore important because it explores culture in informal science settings, which is a new, and developing concept for informal science education. This chapter details the description and justification of the research design, research questions, setting and participants, data collection and analysis, and measures for the ethical protection of participants.

Nationally there have been efforts to increase engagement in science at earlier ages to maintain global competitiveness. The problem is that even with increased efforts certain groups of students still fare poorly in science education. The national drive to increase the number of students pursuing STEM has brought a focus on alternative approaches to learning science. The primary purpose of this qualitative research study is to explore the science perspectives of African American middle school students participating in an informal science program. The research was guided by the following questions:

1. What specific aspects of the Carver Program make it unique for African American students?
2. How is culturally relevant pedagogy incorporated into the informal science program?
3. How does the incorporation of culturally relevant pedagogy into the informal science program influence African American students' perceptions about science?

To protect the identity of the informal science program and the research participants, all names used in this research study are pseudonyms.

Research Context: The Carver Program

The following study examined the perspectives and experiences of student and teacher participants in an informal science program. The setting of the research study was the Carver Program. This program is considered to be a community-based informal program. The Carver Program is a part of a larger state and federal funded initiative, referred to here as the Community Initiative. The Community Initiative has been partnering with public school systems for over two decades. The vision for the Community Initiative is to help schools remove the barriers that put students at risk of wasting their potential. The mission of the Community Initiative is to surround students with a community of support, empowering them to stay in school and achieve in life. Overall the initiative is a national network of 181 affiliates serving more than 1.3 million students in 28 states. While the Community Initiative is a large national effort, the Carver Program is a unique specialized program that only exists in one county.

The Carver Program is located in the southeastern United States. The population of the city is about 400,000. The city is approximately 57% White, 29% Black, 11% Hispanic, and 4% Asian. The school district in which the informal science program is located has an enrollment of approximately 150,000 students. Approximately 98% of the students and 98% of the teachers that attend the Carver Program are African American. At the Carver Program students develop and reinforce academic skills to help them succeed in the classroom. Certified teachers lead the program. The Carver Program is a year-round program that includes after-school programming on Mondays through Thursdays from 3:00 p.m. to 6:00 p.m., weekend programming on Saturdays from 9:00 a.m. to 12:00 p.m. and Sundays from 3:00 p.m. to 6:00 p.m., and a summer

enrichment program from 9:00 a.m. to 5:00 p.m. The after school and weekend programs run from September through May, and the summer enrichment program runs from June through August. This research study primarily focused on the after school and weekend programming.

The Carver Program is situated in a community center that is located in the middle of a local public housing development. The public housing community is the oldest and one of the largest in the city. The development was originally built in 1938. The barrack style apartments were designed to be functional and affordable for the African American community. The community is named after an 18th century prominent African American figure who established one of the first schools in the area. A historic African-American university is also located close to the housing development. Adjacent to the housing community is a local middle school. The school was built in 1953 to educate African American children. It was integrated in 1971. The community in which the Carver Program is located has a strong African American history.

The demographics of the housing development where the Carver Program is located is as follows: On the 14.6 acres of the community, there are 296 units, 206 two-bedroom apartments, 45 one-bedroom apartments, and 45 three-bedroom apartments. There are currently 629 residents in the community. A vast majority of residents in the community are females, many which are young, single mothers. Seventy percent of the residents are 29 years or younger, and almost half of the residents are under the age of eighteen. Approximately 29% of the 320 adult residents are age 50 years or older. Ninety-two percent of the residents in the community are African American. Because this is a public housing community, rent is based on each household's income. The average rent is $137 with the highest rent being approximate $500. There are approximately 52 households with families that pay no rent because of income exclusions. The demographic data listed are similar for the closely surrounding neighborhoods of the community,

but it is drastically different and not highly representative for the county as a whole. The community is an important factor that contributed to the creation of the Carver Program. The larger organization in which the Carver Program stemmed from is an organization dedicated to keeping kids in school and helping them succeed in life.

The Carver Program serves elementary and middle school students and their parents. The community center in which the program is housed is a newly renovated center in the middle of the housing development. The program is located in three different sections of the building. In one section of the building, there are desktop computers (approximately 10) for students to use. The other sections of the building include circle and square tables for students to complete work. There is a small kitchen area located near the computer lab. While the students are present at the Carver Program, they rotate through the different sections of the building. For example, if the elementary group starts off the day in the computer lab after an allotted amount of time those students will switch with another group. When the Carver Program is not utilizing the space, the center is used for other community groups and organizations.

In general, the Carver Program focuses on English and language arts (ELA), mathematics, and science. During the weekend program, the students focus primarily on science, mathematics, and ELA through project-based learning. The after school program differs in that the students focus on homework and tutoring in addition to project-based learning. This study focused on the project-based science learning. The project-based science learning took place for approximately one hour during the weekend sessions and one hour on Mondays during the after-school program. Whatever the students worked on in project-based learning during the weekend session they repeated the same lesson on Monday during the after school program. The students that attended

the weekend program were not the same students that participated in the afterschool program, although some of the students attend both.

Research Design

John Creswell (2008) emphasizes that researchers must pay attention to the following domains when considering the design and implementation of a research study: ontological, epistemological, axiological, rhetorical, and methodological. Through the evaluation of the previously listed five domains, researchers can decide on the best research method. Some factors must be considered when making the choice of methodology. Barbour (2008) describes methodology as capturing the procedures used to carry out the study and the philosophical and theoretical propositions that undergird the procedures. The ontology includes the way in which the researcher views reality and how this view of reality infiltrates the design and implementation of the study. On one hand, the researcher can view the reality investigated by the study as being separate from the participants in that reality and see the investigator as an objective outsider who is independent of the study. On the other hand, the researcher can see the reality and the participants in that reality as being intertwined and serve as an active participant in constructing the reality within the study.

Epistemology is the theory of knowledge and is concerned with the question of what counts as valid knowledge; this is connected to the framework developed by Patricia Hill Collins (1991). Her dimension of concrete experience as a criterion of meaning refers to epistemology because it addresses the following: Is knowledge that results from the subjectivity of those involved in the study considered valid? Is knowledge valid only when it is generated in isolation of and detached from the participants in the study? When deciding on the best research method, researchers may decide to distance themselves from the phenomenon and participants in an

attempt to control bias in the study. Alternatively, the researcher may choose to interact and collaborate with those involved in the study. Axiological issues include the researcher's values and that researcher's association with the study. Researchers may attempt to keep their personal values out of the study, or use their values to help guide the study. Rhetoric includes the style of language utilized in the study, which is often reflected in the research method to be employed in the study. In addition to the listed considerations, the most important are how the researcher views the entire process of the study.

These considerations proposed by Creswell (2008) implicate positionality; consequently, the researcher of this study determined that a qualitative approach should be used as the research paradigm. Positionality is "a stance undertaken by an individual as she or he recognizes and makes sense of the workings of the factors and forces that constitute the politics of her/his context" (Teo, 2014). The researcher has a vested interest in the selected study population (African American students), and made the decision to participate actively in the research process, as opposed to distancing self from the process. This research study had no predetermined outcome because the study participants and their perceptions helped to guide the direction of the study. The above factors all played a significant role in the selection of a qualitative methodology.

Researcher Role

In qualitative inquiry the researcher is the instrument, and therefore self-disclosure about the role and background of the researcher is essential (Patton, 2005 Creswell, 2007). As participant researcher in the study, the researcher is centrally located in the research by providing observations and reflections, and interpreting the data from a personal and professional perspective. Because the researcher is an African American woman researching African

American students, she may be perceived by others to be, and the researcher considered herself to be, an "insider." The researcher's upbringing is very similar to the students that are being researched. The researcher's insider location to the community being researched could fuel bias and credibility concerns. The work of Patricia Hill Collins (1991) on Black feminist thought, discussed in chapter 2, addresses these concerns and can serve as a view that values the "insider" perspective.

Qualitative Research

There has been an increasing interest and representation of qualitative research in science education over the last three decades (Tobin & Fraser, 1990; Cobern, 1991; Gallagher, 1991; Shymanskky & Kyle, 1992; Roth & Roychoudhury, 1992, 1993). Qualitative research is a form of constructivism that occurs in a natural setting and utilizes an interpretative approach (Creswell, 1994). In qualitative research, the methods tend to be inductive by nature, in which patterns of events and themes evolve and change throughout the process of data collection and analysis (Creswell, 2003; Glesne, 2011; Rallis & Rossmann, 1998). According to Creswell (2011) the qualitative research design should be undertaken based on the following rationales (a) research questions begin with how and what, (b) the topic requires exploration because of multiple variables and/or a lack of theory, and (c) a natural setting is the place in which the study takes place. Through the use of qualitative research methods, researchers search for relationships that lie within systems and utilize inquiry to promote understanding rather than to explain it (Stake, 1995). Qualitative researchers use triangulation to view relationships from multiple perspectives.

The basis of interpretive research is the assumption that the participants and the researcher co-construct reality in their social interactions (Glesne & Peshkin, 1992). Research participants have a critical role in the research process. Qualitative research brings the language,

values, and behaviors of the people being studied to life; this places an emphasis on the importance of "humanizing" the data collected and is unique in that qualitative studies rarely conclude with findings. Instead, qualitative research uses the term assertions to stress the interaction between the researcher and those being studied (Stake, 1995).

A qualitative research design was chosen because it was the best fit to answer the research questions. Qualitative research requires flexibility and allows the researcher to respond to the data collected as it emerges from the study; this is important because it creates the opportunity for further exploration and to garner deeper meanings of the subjects and the data they provide.

Case Study

This study required in-depth descriptions of the participants and their perceptions about science. The utilization of case study methodology was the selected approach for the research study. Yin (1981) notes that the distinguishing characteristics of the case study are that it attempts to examine a phenomenon in its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident. The purpose of the case study is to reach deeper understandings of the case to stimulate theories and assertions about the relationships being examined (Eisenhardt, 1989; Yin, 2003). Merriam (1998) noted that researchers use the case study design to "gain an in-depth understanding of the situation and meaning for those involved"(p. 19). According to Yin (1994), the advantage of a case study is that it provides a holistic view of participants in a real-life context with multiple sources of evidence.

Case studies can be categorized into the following types; explanatory, exploratory, multiple-case studies, intrinsic, instrumental and collective. Each categorization is briefly

described using Yin (2003) and Stake (1995) to help construct the brief descriptions. Yin (2003) classifies case studies as being explanatory, exploratory or descriptive Explanatory case studies are used if the researcher is seeking to answer a question that explains the presumed causal links in real-life interventions that may be too complex for the survey or experimental strategies. Exploratory is the type of case study used to explore situations in which the intervention being evaluated has no clear, single set of outcomes. A multiple case study enables the researcher to explore differences within and between cases. Stake (1995) categorizes case studies as intrinsic, instrumental, or collective. Stake (1995) uses the term intrinsic and suggests that researchers who have a genuine interest in the case should use this approach. He suggests that the intent is to understand better the case. Instead of undertaking the case primarily because it represents other cases or because it illustrates a particular trait or problem, it is undertaken because of interest in the case. In contrast, an instrumental case study is used to accomplish something other than understanding a particular situation. The case study provides insight into an issue or helps to refine a theory; the case is of secondary interest. Collective case studies are similar in nature and description to multiple case studies. In either characterization, Yin or Stake, the case study design enables the researcher to develop a deeper, more comprehensive understanding of the topic of interest.

For this research study, an exploratory multiple-case study was used in which each study participant operated as a separate case. A multiple case study allows the researcher to analyze within each instance and across instances. The cases may influence each other and create further explorations for the research study. The critiques of using multiple cases studies are that it is considered to be robust and provides great data, but the process can be time-consuming. To

address the stated critiques the research study had boundaries. The case study boundaries were used to focus the study. These boundaries are further explored later in this chapter.

Study Participants

The student participants of the research study included African American middle school (grades 6-8) students that were registered participants in the Carver Program. The researcher informally spent two months in the program before the actual research project began, a period in which the researcher became familiar with the program and program participants. The majority of the students that participate in the Carver Program lives close to the research site and attends schools that are nearby. The Carver Program has approximately 40 students enrolled, but there is usually about 15-20 that regularly participate in the program. Approximately fifteen students attend the weekend sessions, and approximately twenty students participate in the after-school program. The following criteria were used to choose student participants and to help guide the research study:

1. All participants must have been present for at least seven out of the nine program sessions at the time of the beginning of the study
2. All participants must give written permission to participate in the study
3. All participants must receive written permission from their parents to participate in the study.

Four students met the above criteria and participated in the study. In addition, two teachers participated in the study. The two teachers were chosen for the study because the student participants identified them as their favorite teachers in the Carver Program. The director of the Carver Program also participated in the research study. Information on the participants is provided in chapter 4.

Data Collection

Yin (2003) has three principles of data collection for case study research: (1) the use of multiple data sources, (2) the creation of a case study database, and (3) maintenance of a chain of evidence. The use of multiple data sources results in a rich description of the case. Multiple data sources add to the rigor of the study because it ensures that the assertions made in the research are not solely from the researcher. Multiple sources of evidence provide triangulation that allows for more rigorous, in-depth case studies. This study utilized multiple sources of data. The official data collection started in November 2015 after IRB approval. The data collected included the following: observations, video and audio recording of events, audiotaped focus groups, audiotaped interviews, and program artifacts.

Observations can be used to gain first-hand data. Direct observations take place in real-time and include the context of events (Yin, 1994). Observations are important in that they may include unusual aspects or things that participants may be unaware of or not willing to discuss that can only be noticed during observations (Creswell, 1994). According to Stake (1995), observations are used to develop aggregates of data that will lead to a unique story or description of the phenomenon under investigation. Observations of the Carver Program were conducted twice a week for two hours over the span of three months. The last observation was conducted in January 2016. During the observations, the lessons being taught were video recorded. The video recordings were used as a supplement to observation data, obtained primarily through extensive field notes. Field notes highlighted the ways in which the students engaged with the lesson, how they interacted with the teacher, and how they interacted with each other. A goal of the observations was to highlight and identify cultural practices of the Carver Program. Culture and cultural relevance in the program were noted in instances where the teachers connected the

lessons to the everyday lives of the students when the students made their own connections with the curriculum based on their experiences, and when the teachers helped with "sense making" of the information by providing examples that were catered to the students and their communities. A research journal was also kept to note interesting interactions and times to revisit and further review on the video recording. One of the critiques of observations is that everything occurring in the room cannot be captured. The video-recordings supplemented by field notes helped address this critique by allowing for the extensive review of the occurrences that were taking place during the observation. The observations helped guide focus group and interview questions. Data collected from focus groups and interviews supplemented the observational data.

Focus groups were used to collect data on the students' perspectives. The research questions and research design influenced and guided how the focus groups were conducted. Well-designed focus groups usually last between 1-2 hours (Morgan, 1997; Vaughn et al., 1996) and consist of between 4 and 8 participants (Baumgartner, Strong, & Hensley, 2005 Bernard, 1995; Johnson & Christensen, 2004; Krueger, 1997; Langford, Schoenfeld, & Izzo, 2002; Morgan, 1997; Onwuegbuzie, Jiao, & Bostick, 2004). The rationale for choosing this range of focus group size stems from the goal that focus groups should include enough participants to yield diversity, but should not include too many participants because large groups can create an environment where participants do not feel comfortable sharing their thoughts, opinions, and experiences. For this study, two focus groups that lasted from a minimum of forty-five minutes to a maximum of sixty minutes were held. Each focus group contained four students.

The purpose of the first focus group was to gain insight on the participants' general perspectives of science and to serve as guide for subsequent interviews. After reviewing the observation data, a focus group protocol was developed (see Appendix C). The protocol was

created to guide the conversation with the students. Their responses to the questions led to additional questions, but ultimately the students guided the conversation. The first focus group took place in November 2015 approximately three weeks after data collection commenced and after four observations; this allowed time to review field notes and observation video to help guide the focus group session. By allowing time before the first focus group, the researcher was able to become more familiar with the students within the research situation, and they were able to become more familiar with the researcher. The first focus group was scheduled for one hour but only lasted for approximately forty-five minutes. The focus group took place at the Carver Program in the computer lab. There were no program facilitators present during the focus group.

All four of the student participants were involved in the focus group. During the focus group, the students verbally articulated their perspectives on science and talked about their experiences in the Carver Program. The students' responses were audio recorded as they participated in the focus group. The broad topics of the first focus group session included: (1) perceptions about science, (2) experiences in the informal science program and (3) favorite aspects of science. As previously mentioned, although these were the broad topics, the students guided most of the conversation. The students talked a lot about the differences between their school science classrooms and the activities they did at the Carver Program, their favorite things about the Carver Program, how they enjoyed the teachers at the Carver Program, and what they disliked about science. More about the focus group conversation is included in the analysis in chapter four. The second focus group was conducted in January 2016, with all four of the student participants. The purpose of the second focus group was to review the data collected during the study and to verify assertions derived from the data.

Interviews are a great data source because the perspectives of the participants are meaningful. According to Creswell (1994), interviews can supply data that cannot be obtained from observations and focus groups. Interviews can provide historical background and allow the researcher to determine what topic to explore further. Semi-structured interviews were conducted with the four student participants, the director, and the two teachers. Participants gave consent to audiotape and transcribe the interviews. Interviews revealed more of the personal stories of the participants. The students were interviewed twice. The student interviews were conducted throughout November 2015 and December 2015. The adult interviews were conducted in December 2015.

One hour was allotted for each interview. Each interview with the students lasted approximately thirty to forty-five minutes. The first interview was used to gather data that was related to the guiding research questions. Specifically, the first interview inquired about the students' general experiences and perspectives on science. During the first interview the students were presented with a scale to rate their general feelings on science. The scale ranged from one to five, one meaning "I really dislike science" and five meaning "I really love science." The scale used is located in Appendix D. The second interview was used to gain more insight into the students' perspectives of the Carver Program and activities at the program (see Appendix A for interview guide). All of the student interviews took place at the Carver Program in a separate room. Each of the parents was consulted to schedule interviews, and this setting worked best with their schedules. There were no program facilitators present in the room. The program director and the two teachers were interviewed once. The reasoning behind interviewing the adults only once was that their interviews went into more depth and lasted longer. The adult interviews lasted approximately one hour and thirty minutes to three hours. The program director

was interviewed at the director's office, which is located off-site from the Carver Program. The director interview primarily focused on the creation and history of the Carver Program. Both teachers were interviewed separately after a Saturday session at the Carver Program. The setting of both interviews was in the kitchen area of the Carver Program. The teacher interviews primarily focused on the project-based learning sessions at the Carver Program (see Appendix B for interview guide).

Program artifacts constituted the last set of data. Program artifacts such as lesson plans, lesson handouts, and program brochures were collected. The artifacts were used to clarify the mission of the program and the purpose of the activities at the Carver Program. The lesson plans were used to gain insight into the project-based learning activities the students engaged during the observations.

Data Analysis

Miles and Huberman's (1994) *An expanded sourcebook, qualitative data analysis* and Merriam's (1998) *Qualitative research and case study applications in education* were used to help guide and analyze data. Qualitative data analysis according to Miles and Huberman (1994) involve the following systemic procedures: (1) arranging data for qualitative content analysis, (2) deciding the unit of analysis, (3) moving from the unit of analysis to categories, (4) identifying emergent themes, (5) coding the data, (6) rechecking consistency of the coded data, and (7) drawing conclusions from the coded data.

Data were collected and simultaneously organized. The observations were considered in relation to the tenets of Culturally Relevant Pedagogy (CRP). The observational data were examined to uncover features that may be associated with the meanings of each CRP tenet (academic success, cultural competence, critical consciousness). For example: If the teacher uses

a cultural reference from the community to explain further a concept then this observation would be categorized as falling under cultural competence. The purpose of using CRP to guide the analysis of the observations is to address the research question: how is culturally relevant pedagogy incorporated into an informal science program.

The first step in the focus group analysis was to transcribe the focus group interview data from the audiotape. Like other researchers (Morgan, 1997), the group was used as the unit of analysis and the data were coded to present emergent themes. Unlike with the observational data, inductive coding was employed. That is, CRP was not employed as an a priori scheme. The codes were grouped together to develop themes, and the themes emerged from constant comparison analysis. Three major stages characterize constant comparison analysis (Strauss & Corbin, 1998). During the first stage, data are grouped into small units. Codes are then attached to each of the small units. During the second stage, the newly created codes are grouped into categories. In the last stage, themes are developed to express the contents of each of the categories. The interview data were analyzed using the same process. The table below illustrates the links between codes and data:

Table 1. Examples of codes derived from interview transcripts

	Code	Two Interview Excerpts
		What students liked about the Carver Program
1.	Working with friends	In elementary school we got to see and work with
2.	Get to see friends	our friends a lot, now we don't ever get to see
3.	Different from school	them except here. At school, I only get to see them in the hallway. I like it here because I get to see them and talk to them.
1.	Teachers care at the Carver Program	The teachers care. Sometimes in school, I write
2.	Different from school	whatever just to get done. I tried that here, and
3.	Teachers care at the Carver Program	they made me do it over like three times until I got it right.

What emerged from the processes was used to address the three research questions.

Some of the codes developed during the constant comparison analysis were cross-checked by a graduate student. The graduate student was a third-year doctoral student with an extensive qualitative research background, as well as a background in science. The cross-checking process included a comparison of the codes the researcher created and the codes the peer reviewer formulated. Code checking was done to ensure (a) the definitions of the codes agreed with what was being coded, (b) all important and or relevant data had been coded and (c) each unit of data was described by one and only one code (Merriam, 1998). A sample of the cross-check for initial coding is included in Appendix E.

After the initial coding, the second level of coding was implemented; as mentioned above this level of coding created themes for the data. The second level of codes for the interviews, focus groups and observations originated from the first level codes. Second level coding allows for a more in-depth understanding of themes and concepts, and for an examination of ways in which the themes interact and relate. The same graduate student that cross-checked the initial codes checked the pattern codes for the sample of interviews, focus groups, and observations. A sample of the second level coding cross-check is included in Appendix E. The table below illustrates the links among codes, data, and themes.

Table 2. Examples of themes derived from interview transcripts

	Code	Interview Excerpts	Theme
1.	Information makes sense	We are trying to create a center knowledge environment where we emphasize sense making, and we are trying to align the activities with common challenges in the society	Relevance
2.	Making connections		
3.	Information makes sense	Mr. Brown gets me, he like understands me so I like when he teaches because I can	
4.	Making connections		

understand him, and he makes
it so we can get it. He doesn't
use all those hard science words
to confuse us

In summary, a categorized coding scheme was used to analyze each data source. As previously mentioned, data were analyzed simultaneously with data collection and after data collection. The multiple sources of data were used as evidence to increase the rigor of the study. Also, a peer reviewer was used to identify inconsistencies and inaccuracies in the analysis process.

Ethics

Before the research study was conducted, there was approval from the Institutional Review Board (IRB). Consent forms were given to all participants and their parents. Consent forms articulated the purpose of the study, the role of the researcher, and the intended role of the participants. Each consent form made known that the study was entirely voluntary, and the participants could drop out of the study at any time. None of the participants dropped out of the study. During the data collection and analysis of the research all the participants' identities were masked. To be transparent with the research participants, interview and focus group data were available for review by the participants. Individuals in the focus groups only reviewed the comments they made, and interview participants had the opportunity to review their interview transcripts and assertions made from the data. A focus group was also used as a member check. A separate individual follow-up conversation was had with the students to clarify any misconceptions. Each adult participant had the opportunity to read over their verbatim transcripts along with the assertions made from the data. Individual conversations were had with the adult participants to clarify any misconceptions.

CHAPTER IV
FINDINGS

Chapter four details the findings that emerged from the data analysis and elaborates the history of the Carver program, and the program offerings. The seven study participants are also described. Additionally, the chapter provides detailed descriptions of the themes developed from a cross-case analysis of the perspectives and experiences of the seven participants during focus groups, interviews, and observations. These themes, with direct excerpts from the data analysis, are connected to the research questions and related to culturally relevant pedagogy throughout the chapter. The overall purpose of this study was to explore the perspectives and experiences of African American students in an informal science program. The purpose was explicated in three guiding questions:

1. What specific aspects of the Carver Program make it unique to African American students?
2. How is culturally relevant pedagogy incorporated into the informal science program?
3. How does the incorporation of culturally relevant pedagogy into the informal science program influence African American students' perceptions about science?

Background of the Carver Program

Mr. Miles, a pseudonym for one of the research participants, is the director and creator of the Carver Program. He founded the Carver Program in 2009. More detailed information is given later in the chapter. His family was one of the driving forces to create the Carver Program. According to Mr. Miles:

My wife is a public school educator. She went to a Historically Black College and University (HBCU), and I went to an HBCU. We were both born and raised in this community. We lived in Washington, D.C. and Atlanta. Why that backdrop is important is for this reason. We came back to this community from Atlanta in 2008, my daughter was in the first grade then, and my wife was teaching. When my wife went to her second school, her principal opened up a brand new school; my daughter was going to the second grade. And when…uh…when she traveled with my wife to her new school, we started looking at her report cards and then the end of grade tests. And when I looked at the end of grade tests, I couldn't see; she was making straight 4's on her report card, but her end of grade test didn't reflect that. I mean she was above average, but I thought she could be doing better. We began to question whether or not the report card was indicative of how she was performing. Straight 4's but why isn't it translating? So we were thinking, we don't get it, what are we missing? So we met Mr. Clark, he was tutoring, and we enrolled our daughter in some of his tutoring sessions. Even though she was making straight 4's, we could tell she wasn't confident in it. Mr. Clark had our daughter coming home getting duct tape and pipe cleaners, and I'm thinking, where the worksheets? She was tearing our house up. Now, what end up happening was we noticed that she wanted to go every weekend. And the reason she wanted to go is because she was doing project-based learning. The fact that she wanted to go and the fact that we saw her getting excited about math and science led us then to have some conversations with Mr. Clark. At the time, I was president of the Community Initiative for about a year or so…and…I was like how can I make this type of learning available for more students, so I met with Mr. Clark and developed a team, and we came up with the Carver Program.

The Carver Program was operating by 2010. The program is open to students in grades K-8, with special programs for high school students.

Project-based learning is one of the main features of the Carver Program. Mr. Miles describes project-based learning as "engaging in learning that makes sense, learning with a purpose. Project-based learning is allowing students to have a deeper understanding and mastery of a subject. It allows them to have hands-on experience and creates an environment for discovery" (Miles Interview, December 6, 2015). The Carver program, weekend and after school, runs from September through May. The summer enrichment program is from June through August.

Activities at the Carver Program

Fall 2015 sessions of the Carver Program were guided by the theme "From the Earth." Each of the activities the students completed was connected to the earth. The table below describes the Carver Program project-based learning activities observed from October 2015 to December 2015. Each of the descriptions was adapted from the experiment handouts given to the students.

Table 3. Fall 2015 Carver Program project-based learning activities

Project-Based Learning Activity	Purpose
Getting to Know Soil	To provide the opportunity for students to ask questions and make observations about soil. To introduce students to the properties of soil and the concept of soil profiles and horizons.
Abiotic vs. Biotic Factors	To develop a deeper level thinking about abiotic and biotic factors while connecting them to everyday life
Water Filtration	To create a water filtration system to explore how engineering has developed various means to remove impurities from water.
Paper Wind Turbines	To develop and investigate wind turbine rotor designs to evaluate which produces the most energy at a certain wind speed.

Attack of the Protista	To evaluate human influences on the water quality in basins, wetlands, and tidal environments. To compare the structures and life functions of single-celled organisms that carry out all of the basic functions of life.
Water Quality – Chemical Testing	To evaluate water quality
The Eco Column – Bottle Biology	To explain how abiotic and biotic factors interact to create the various biomes. To explain why biodiversity is important.
Aquatic Eco Column	To explore a mini freshwater habitat for aquatic plants

At the Carver Program, the number of students per project-based learning session was fifteen. The number of students observed during the project-based learning sessions ranged from fifteen to seven students. In the Carver Program there are approximately ten rotating teachers who teach project-based learning, and five of those teachers were present for the majority of the sessions (two of which are presented in this research study). Mr. Clark, a pseudonym for the first teacher participant, was observed seven times, and Mr. Brown, a pseudonym for the second teacher participant, was observed teaching five times. Both teachers are presented later in the chapter.

When the students walk into the Carver Program, they begin work immediately. Below is an excerpt from the researcher's research journal that describes the first ten minutes of an observation of the Carver Program.

> Currently, there are about four students present in the room. There are three girls and one boy. All of the students are in the computer lab, and it seems as if they are working on something educational. As the students file in the teacher is looking through a yellow folder and telling the student what to do on the computer. At around 9:00 there are twelve students in the computer lab all working on their assignment. Two of the teachers are

walking around helping the students. One of the male students has headphones on, and loud music can be heard. I walked past the student to see what he was doing, and it looks like he is doing math problems. I went to ask one of the teachers about the assignment the boy was working on, and he told me that the game incorporated music and math problems. Each of the students was working on something different. A few of the students went into the kitchen and came back with a snack; it looks like granola or cereal bar, and they went back to their computers and continued to work. I asked one of the teachers what the students were doing. He told me that each student is working in areas that they struggle with, so some of the students are doing reading comprehension, some students are doing the math, and some students are doing science related questions. The teacher told me that they are using a computer program that is connected to what they are learning at school, and it gives them quizzes and test to see their progress. At about 9:10, the teachers tell the students to meet in the large room." (Journal excerpt, November 14, 2015)

Mr. Miles provided additional context for understanding the above observation during his interview. According to Mr. Miles:

> We also use Triumph online which is our online portal. We introduce them to work that will build them on their areas of deficit. So we start them with an assessment; they are assessed on common core objectives that they are currently going over in school. We can then understand where they are…red, yellow, and green. Umm…and then we can create interactive instruction catered to their specific needs by loading skill building work on their individual portfolios. So if they receive less than 80%, then the teachers work along

with the students. If they show improvement, then we use online games as an incentive (Miles Interview, December 6, 2015).

During each of the sessions the students are encouraged to work collaboratively in groups, but each student has his/her materials. At the beginning of each session the students are given the opportunity to have an open discussion with the teachers. Sometimes this is a quick conversation for about one minute, and at other times, this conversation has lasted as long as ten minutes. The students talk about their day, exciting things going on in their lives, challenges they may be facing, upcoming events and activities, or whatever comes to their minds. While visiting the Carver Program one of the students (Caleb) shared his highlight of the day:

> Today I got a good grade on my math quiz. I'm happy about the grade, but I'm really happy that I get to play in the basketball tournament this weekend. My mom said I had to pass my math quiz so I could play. The tournament is Saturday and my team is undefeated so far for intramurals (November 14, 2016).

Once the students share out to the class, the teachers do an icebreaker with the students to "loosen" them up.

One of the most memorable icebreakers observed was on November 7, 2015, when Mr. Brown created a game that had the same principles of Simon Says, but he incorporated the latest new dance moves.

> All of the students stood around the room and listened to Mr. Brown's commands. There was a lot of concentration and laughter in the room. All of the students participated, and by the end of the game some of the students were breathing hard and tired, but I could tell that they were having fun. The game lasted for about ten minutes. After the icebreaker,

the day would start with the project-based learning session (Observation, November 7. 2015).

For the weekend session the schedule was project-based learning with science from about 9:30 a.m. until 10:45 a.m. From 11:00 a.m. until 11:30 a.m. the students would focus on ELA, and from 11:30 a.m. until 12:00 p.m. the students would work on math. If there were more than fifteen students present that day, the students would break up by grade. The middle school students would work with each other, and the elementary students would work together. They would rotate through the sessions, and the middle school group would start with math; this occurred only once during the observations. Due to fall sports and other obligations, some of the students could not attend every Saturday session.

Backgrounds of the Participants

Before discussing the themes that emerged from the data analysis, more information on the seven participants of the study is shared. In the following sections, the personnel cases, which include the director of the program Mr. Miles, and two teachers in the program, Mr. Clark and Mr. Brown are introduced, followed by the student cases, which include the four student participants Aliyah, Jaliyah, Sierra, and Caleb.

Personnel Cases

Three personnel in the Carver Program participated in the study: the director and two teachers. The three individuals are Black males who attended HBCUs. Detailed descriptions of the individuals are provided in the paragraphs below.

. Mr. Miles is in his early 50's and for the majority of his career (20 years) he was a media executive and journalist in Washington, D.C. and Atlanta. He was born and raised in the southeastern part of the United States (U.S.), and he attended a HBCU in the eastern U.S. Mr.

Miles, and his wife grew up together in the same community and went to the same high school. His wife is a public school educator. In 2008, Mr. Miles was offered the president position at the Community Initiative, and he relocated back to the southeastern U.S. The position was offered to him because of his involvement with the community in which he grew up and his communication background. While he was the president of the Community Initiative, he founded the Carver Program, and he is currently the director of the Carver Program. As the director of the Carver Program, Mr. Miles secures funding for programming. To date, he has secured over one million dollars in funding for the program. Mr. Miles creates community partnerships with local businesses, schools, universities, and entrepreneurs to develop further the Carver Program. He is currently working on his Master's degree in education administration.

Mr. Clark is in his 50s and the head project-based learning teacher for the Carver Program. He is one of the driving forces for the creation of the Carver Program. Mr. Clark was born and raised in the Southeast and attended college both in the southeast and in the northeast to major in Biology. He is a member of Omega Psi Phi Fraternity, a historically Black fraternity. Once Mr. Clark completed college, he continued to pursue a career as a scientist with the Environmental Protection Agency (EPA). After having a productive career with the EPA, Mr. Clark discovered his love for science teaching while visiting many classrooms to do EPA presentations. In the early 2000s, he left his career as an EPA scientist and began teaching high school science. After several years of teaching, Mr. Clark received his Master's degree in education with a focus on science.

Currently, Mr. Clark is a high school science teacher at Barry High School. He teaches biology and physical science. Barry High School is the oldest high school in the county opening up in 1929. The high school serves grades 9-12 and has approximately 2,123 students. The

student teacher ratio is 17:1, and the "non-white" student enrollment is 50% of the student body with the majority of students being African American.

Mr. Clark has been with the Carver Program since its inception. His primary responsibility at the Carver Program is to create the project-based learning activities and lead the science sessions with the students. Mr. Clark has developed a project-based learning book with over 200 activities that has served as the blueprint for all of the science related project-based learning activities for the Carver Program. All of the activities in the book are aligned with the elementary and middle school curriculum. He is currently in the process of publishing the book for public use. In addition to serving as a high school science teacher and lead project-based learning teacher for the Carver Program, Mr. Clark also offers to tutor for local communities.

Mr. Brown is 41 years old, and he is a project-based learning teacher with the Carver Program. He is responsible for leading the science sessions at the program. Mr. Brown started with the Carver Program in 2013 after being referred by a colleague. He was born and raised in the northeast and attended college at an HBCU in the southeast U.S. His initial career plans were to become a doctor but discovered his love for teaching after college. Mr. Brown has been a science teacher for about 15 years serving in elementary, middle and high school classrooms. He started his teaching career in public schools located in the northern region of the U.S. and received a Master's in education in the same region

In 2012, Mr. Brown relocated to the southeast. Currently, Mr. Brown is a middle school science teacher at Lisbon Middle School, and he primarily teaches seventh grade. Lisbon Middle School serves students in grades 6-8 and has approximately 1,195 students. The student teacher ratio is 17:1, and 56% of the student body is African American. Lisbon Middle School is located directly across the street from the Carver Program. In addition to being a project-based learning

teacher with the Carver Program and a middle school science teacher, Mr. Brown offers free tutoring to students at his school and the surrounding community.

Student Cases

Aliyah is an 11-year-old student participant at the Carver Program. She is a sixth-grade student at Lisbon Middle School, where Mr. Brown teaches. Aliyah has been attending the Carver Program since October 2015. She was born and raised in the community near Lisbon Middle School and the Carver Program. Aliyah is one of three children, and her twin sister also attends the Carver Program. After her mother learned about the Carver Program from a teacher, she attended an information session and signed the twins up for the after school sessions of the Carver Program. When Aliyah is done with school on Mondays through Thursdays a school official escorts her and the other students across the street to the Carver Program.

Aliyah has dreams of becoming a doctor when she grows up, and she wants to live in California. Currently, Aliyah is interested in doing art, and she likes to draw in her free time. All of her drawings are kept in a folder, and she wants to create eventually a book with her drawings. Most of the drawings in her folder are of fashion and portraits of her friends. At the Carver Program, Aliyah is extremely talkative and often takes the leadership role in activities. She assists the teachers with passing out materials and helps to keep the other students on task by telling them to be quiet if it gets too loud and offering to help with assignments. Aliyah seems to be respected by the other students, and she works with a different group for each activity. When asked to rate how much she liked or disliked science on a scale from 1-5, one being a strong dislike and five being a strong like (the scale is included in Appendix D), Aliyah chose a three. She is neutral about the subject of science, and her decision fluctuates based on the science activity or experiment being performed. She began to like science in the fifth grade when her

teacher did experiments and fun activities. Her dislike for science started in the sixth grade when she no longer had the opportunity to do fun experiments and had to complete hard tests and quizzes and listen to lectures. Currently, Aliyah has a B in science.

Jaliyah is an 11-year-old student participant at the Carver Program. She is a sixth-grade student at Lisbon Middle School. Jaliyah has been attending the Carver Program since October 2015. She was born and raised in the community near Lisbon Middle School and the Carver Program. Jaliyah is the fraternal twin sister of Aliyah who also attends the Carver program.

Jaliyah has dreams of becoming a pediatrician when she grows up. Jaliyah is interested in doing hair and playing basketball. Her aunt taught her how to braid and outside of school she does her sister and friends' hair. Jaliyah does not play basketball for the school team because of her grades, but she enjoys playing basketball in her neighborhood. She seems to be a very quiet girl and usually only talks to her sister or small groups of friends at the Carver Program. When asked to rate how much she liked or disliked science on a scale from 1-5, Jaliyah chose a two. She never really liked science, but the dislike grew in fifth grade because it was boring. Even though Jaliyah dislikes science, she enjoys doing projects and lab experiments. Currently, Jaliyah has a D in science but expects her grade to improve in the next quarter.

Sierra is a 12-year-old student participant at the Carver Program. She is a sixth-grade student at East Ward Middle School. East Ward Middle School serves students in grades 6-8, and has approximately 927 students. The student teacher ratio is 17:1, and 83% of the student population is African American. Sierra lives in the neighborhood of her school, which is about 20 minutes from the Carver Program. Sierra attends both the after school and weekend sessions of the Carver Program. She began participating in the Carver Program during the summer of 2015. Sierra is an only child. When she grows up Sierra would like to become an obstetrician-

gynecologist (OBGYN). At the Carver Program, Sierra usually works with the same group of girls. Within her group of friends, she laughs a lot and is very talkative. Outside of her friend group, Sierra seems shy and does not interact much with the other students in the program. Sierra likes to read, and she is a member of the book club at school, and she won an award for reading over fifty chapter books in five months. Outside of school, Sierra loves to dance, and she is a member of a local dance studio. Primarily she studies ballet, classical, and hip-hop dance. Her love for dance started when she was four years old, and she takes a dancing class twice a week. When asked to rate how much she liked or disliked science on a scale from 1-5, Sierra chose a four. She has liked science her whole life and her favorite part about science is doing hands-on experiments. In elementary school, she loved science but likes it even better in middle school because they are required to do projects and fun activities. Currently, Sierra has an A in science.

Caleb is a 13-year-old student participant at the Carver Program. Caleb is in the eighth grade at Lisbon Middle School. He is one of two children, and his brother is in elementary school; both are participants in the Carver Program. Caleb attends both the weekend and after school sessions of the Carver Program and his brother only attends the weekend sessions. Caleb lives in the neighborhood of the Carver Program. At the Carver Program, Caleb is very outgoing and funny. He usually makes the students and teachers laugh at the jokes he tells while doing the project-based learning activities. Caleb is considered the social butterfly and "jokester" of the Carver Program. He is always out of his seat socializing with the students and teachers. When he grows up Caleb would like to be a baseball player. He is on the school basketball team and a member of a Boy Scout troop where he holds a leadership position. His favorite thing to do outside of school is to play sports. When asked to rate how much he liked or disliked science on a scale from 1-5, Caleb's first response was a negative two, because he strongly dislikes science.

Since this number was not on the scale, he chose a two. Caleb started to dislike science in seventh grade because it became boring and he had to take a lot of tests. Even though he dislikes science now, Caleb enjoyed science in elementary school when he was able to do lab experiments. Caleb currently has a B in science.

An in-depth analysis of the participants' experiences and perspectives are presented in the following paragraphs. The themes that emerged from the data were: student bonds, relevance, caring, and community. Student bonds and the sub-themes of fun science, friendship, and student-teacher relationships emerged in response to research question one. Also, the themes of relevance, caring, and community emerged while exploring research question two. The themes are further explained below.

Research Question 1: Connections at the Carver Program

After analysis of the observations, interviews, and focus groups it was clear that there were certain parts of the Carver Program that the students liked, connected with, and appreciated. Meaning when students talked about or were asked about the Carver Program, they would highlight specific aspects of the program that made it "unique" and different from other programs they attended and made it unique from their experiences at school. What stood out is that all of the student participants in this study during their interviews and focus groups continuously referred to the type of learning that occurs at the Carver Program, the time they spent with their friends, and how much they enjoyed the teachers at the Carver Program. Upon further investigation, the theme that emerged from the data was "student bonds."

Student bonds include the personal connections the students made with the Carver Program. The sub-themes that emerged from student bonds were fun science (referring to the instructional connections), friendship (referring to the bonds that were developed or fostered

among the students at the Carver Program), and student-teacher relationships (referring to the connections the students made with the teachers at the Carver Program). Broadly speaking student bonds encompass the aspects of the Carver Program that made it unique, possible reasons why the students excelled at the Carver Program, and how the Carver Program remained relevant in the students' lives to potentially influence their academic achievement. These themes addressed the research question: What specific aspects of the Carver Program make it unique to African American students? Each student connected with the Carver Program in different ways, and these connections were classified as unique bonds that the students developed with specific parts of the program.

Student Bonds

The four student participants each mentioned the type of activities they participated in at the Carver Program as one of their favorite parts about the program. As previously said the Carver Program uses the term "project-based" learning to describe the instructional approach implemented by the teachers at the program. According to the program brochure, the Carver Program defines project-based learning as:

> "Project-Based Learning (experiential learning): Students practically apply the math and ELA principles that they have learned in a fun and interesting science-project."(The Carver Program Brochure).

This definition, developed by the director and advertised in the program brochure, is specific to the Carver Program, and may differ from definitions that are used in science education and by other organizations. The program used the term project-based learning to describe any hands-on inquiry-based learning that took place in the program. The program models each activity around a larger theme and the program personnel consider each activity to be project-based because the

activities connect to a larger theme. The director of the program and the two teachers provided a more in-depth description of what encompasses project-based learning in the Carver Program. All three defined project-based learning as taking a hands-on inquiry approach with the students that allowed them to explore and make meaning of the activity. They agreed that the students must be challenged and be able to manipulate the materials to develop a deeper understanding of the activity. During an interview with Mr. Clark he talked about project-based learning and mentioned:

> It's how their minds work, none of our brains are wired to just sit there and learn. We must be active. I'm not saying everything has to have fireworks, but it does have to include an element of excitement, or you will totally miss the students (Clark Interview, December 12, 2015).

The director and the teachers described project-based learning as a way of learning through active participation. Project-based learning is a large component of the Carver Program.

A keyword that was prevalent in the data analysis from student interviews and focus groups was fun science. Fun science was a term used by students to describe the activities at the Carver Program. The sub-theme of fun science and its connection to the students at the Carver Program are further explored in the next section.

Fun Science

The term "fun science" refers to the exciting, collaborative, and interesting science activities that the students enjoyed doing at the Carver Program. According to the four student participants at the Carver Program they did science that was not boring, but enjoyable. The students showed a specific interest in the type of learning that was employed at the program. They specifically talked highly about the project-based science learning activities, and each

student mentioned that the project-based learning activities were one of their favorite parts of the program. The students associated fun science with the project-based learning activities at the Carver Program. When asked during interviews what their favorite project-based learning activity was, all four-students said the water filtration project. During the water filtration project, the students created a water filter to test dirty lake water. The final challenge of the water filter project was for the students to create a filter that would allow a live goldfish to survive in the dirty lake water (a diagram of the water filtration project is included in Appendix F). The students described their experience with the filtration project as being challenging but exciting. The students mentioned that they had fun making the filter, but especially liked that they were able to work with a live animal. In an interview, Caleb talked about his experience with the water filtration project. He stated:

> It was hard, but I got the hang of it once I saw the directions and stuff. We had to make sure that our fish did not die as mine died. It was a cool lab; I want to try it again, to see if I can get my fish to live. I think I know what I did wrong.
>
> (Caleb Interview, November 21, 2015)

Caleb also mentioned that this project was different from any project he completed at school, and this was the first time he did something of this nature. The water filtration project sparked the interest of the students, and they all considered the project to be fun science; this was also observed while the students were participating in the experiment. Below the atmosphere in the room was described in a research journal entry:

> The students are all actively working on the project. Some are working in teams, and some are working by themselves. There is a lot of movement, and the students seem to be very interested in the activity. Mr. Clark is moving from table to table to assist the

> students. A team of three students is working in the back corner, and they are focused on trying to create the filter. Students are laughing, talking, and moving rapidly around the room to get more materials. It seems as though the students are having fun with this activity. (research journal entry, November 21, 2015)

The students were actively engaged in the project, and some of them decided to stray away from the directions and add their materials based on what they thought would work. The last part of the project was exciting for the students. Many of the students turned this part into a competition to see whose fish would survive the longest. The teacher used this time to talk about the importance of filters and connected the topic back to the lecture. The teacher posed questions to the students to see how they would change their filtration system to enable the fish to live. Overall the water filtration project was a fun learning experience for the students.

The sub-theme fun science was also connected to how the students learned science. Several of the students mentioned that they learned science best when working with others. They also mentioned that they loved doing the projects at the Carver Program because they could work together. All of the students emphasized that doing experiments and activities were fun and that they much rather do experiments and hands-on activities then just hearing the teachers talk and pass out worksheets. The students characterized their science class at school as mostly encompassing lecture and worksheets with limited hands-on opportunities. Fun science was prevalent throughout this research study; the students connected it with doing the project-based learning activities at the Carver Program. In interview and focus group conversations the student participants distinguished between the science they did at the Carver Program and the science they did at school. During an interview, Aliyah discussed her feelings about school science and the Carver Program. Below is an excerpt from her interview:

> We always have worksheets in science at school, like fill in the blank and match. We always have to take notes and never get to do fun stuff. Like this year, we only got to do one lab, and he [the teacher] did most of it. The class is always loud; no one pays attention and we never have enough stuff and always have to share in big groups. Here we never have to share. We get to work by ourselves if we want to. They don't give us worksheets here; it's always fun stuff like we get to touch it and have our materials. Science in school is boring like I don't get it. Here they make it, so we understand." (Aliyah Interview #1, November 21, 2015).

The above interview excerpt shows how Aliyah feels about the science she does at school and the project-based learning she does at the Carver Program. Students connected fun science to the activities they engaged at the Carver Program.

Friendship

Data analysis uncovered friendship as an important aspect of the Carver Program. Friendship is characterized as the special bonds students have with each other. All four student participants multiple times in their focus groups and interviews mentioned the term friends. During observations, the students seemed joyful and enthusiastic when asked to do group work or partner work. The students were actively engaged and for the most part on task when working on the project-based learning at the Carver Program. Without being prompted each student referred to their friends at the Carver Program during their individual interviews. The idea of friendship was first introduced during a focus group conversation. The students had the following conversation:

> Jaliyah: In elementary school we always saw our friends, we were all in the same classes. Then in middle school they split us up, so we don't get to see each other a lot. Sometimes

I only get to see and talk to my school friends here at the Carver Program. I like it here because we get to work with our friends, and we can help each other.

Caleb: Yeah, they don't pick our groups for us. They like…they let us pick our groups. I like that better; I work better with my friends.

Aliyah: I hate it when teachers pick our groups. I work better with my friends too. Like here I always work with my sister, Asia, and TT, like we get loud sometimes but we always get our work done. Like for real, we do, and we always help each other. " (Focus group #1, November 14, 2015).

The students did not just mention their friends but attributed their friendships as one of the reasons why they liked the Carver Program. Being able to talk to their friends, work with their friends, and help their friends were important to the student participants. During an interview with Jaliyah, she talked about why she liked the Carver Program and working with her friends. She stated:

I like it here better than school sometimes because I get to work with my sister and friends. When I don't know something they help me, they don't make me feel stupid. In school when you ask questions the teacher always get an attitude so, I don't even ask questions. Here if I don't get something, I talk to them first and then ask the teachers. My sister motivates me sometimes and keep me focused because she knows I get off track sometimes like I start to day dream and stuff, but we all look out for each other. My sister is like the leader, we all look up to her, and she make sure that we get our work done (Jaliyah Interview #2, December 19, 2015).

Working alone to the students was not as rewarding as being able to collaborate in groups. In the case of Aliyah and Jaliyah, the twin sisters, they appreciated being able to work together. There

was a sense of accountability that was present in their relationship. As presented above, Jaliyah looked up to her sister and Aliyah enjoyed taking on the leader role for her friends. In an interview, Aliyah stated:

> My friends here always come to me for help, especially my sister. I think she feels like sad sometimes, well not sad, but umm…embarrassed to ask for help, so we all help each other when we work in groups. I always make sure they do their work; I like helping them and sometimes they help me. Like at home, my mom always has me check my sister work and help her, so I do the same here (Aliyah Interview #2, December 19, 2015).

The Carver Program maximized on this relationship by allowing the sisters to work together.

Along the same lines, Caleb also mentioned that his friends at the Carver Program are important to him. Similar to the relationship the twin sisters have, Caleb also developed special friendships with a group of boys at the Carver Program. The friendship goes beyond having fun with each other, but they have developed a learning system with each other. The three boys each excel in a certain academic area, but instead of working alone they help each other with their work. In an interview Caleb stated:

> I learn fast, and math is my subject. I'm pretty good at math. I usually work with Malik and Rashad for group work. It's like Malik is a genius in science like he knows everything. So we help each other. They always come to me for the math help and Malik helps us with the science. Rashad is in some of my classes at school, but Malik isn't. We only get to work together here at the Carver Program (Caleb Interview #1, November 21, 2015).

As previously mentioned most of the students go to the same school. Sierra is a unique case in that she does not attend Lisbon Middle School, but she attends East Ward Middle School.

Friendship was explained by Sierra differently from the other three student participants. Initially, Sierra did not have many friends at the Carver Program, because of this she was shy and did not like to work in groups. Due to the project-based learning activities, Sierra was encouraged to work in different groups. During an interview, Sierra mentioned that she was able to make a group of girlfriends. The friendship that she developed with these girls was important because it helped her to navigate the Carver Program and become more comfortable to participate. In an interview Sierra stated:

> When I started here I didn't have that many friends. Most of them go to the same school and they…umm…they always worked together. I think it's like a few of us, like three of us that come from my school. I started to get to know everybody when we did the different projects and the cooking class, and everybody's cool. Now I always work with Kayla and Brice; they 're like my best friends. We always work together and help each other out with the projects and our homework (Sierra Interview #1, November 22, 2015).

It is interesting to see how the students used their friendships to help each other. From the outside looking in one would not be able to figure this out. During the observations it was evident that the students liked group work because they were normally loud, laughing, and very energetic. Upon further conversations with the students they used group work to talk to their friends and help each other. The Carver Program is a very close-knit family-oriented environment. Friendship was a common theme between the student participants. It was made clear through discussion that the students appreciated the Carver Program for allowing them to work with their friends and giving them the freedom to pick their groups. The program did not force friendships on the students but allowed them to genuinely connect with other students and foster their relationships. The type of learning and the friendships developed at the Carver

Program all contribute to the "uniqueness" of the program. The teachers also play a major role in the success of the program.

Student-Teacher Relationships

"Teachers don't make a program; relationships do" is a quote that is often heard at the Carver Program. This quote was heard during my interview with both Mr. Miles and Mr. Clark. This quote is also present on the program website. The teachers and director all agree that you could have the best teachers in the world, but if they do not develop a genuine relationship with the students, then the students will not learn or connect with the material. Spanning from the students to the teacher, the theme of student-teacher relationship was seen throughout the conversations and observations at the Carver Program. Mr. Clark and Mr. Brown were both identified as the students' favorite project-based learning teachers. When asked why they were their favorite teachers, the students had various responses.

Mr. Brown was a favorite of the students because of his personality and approach to teaching. Mr. Brown used comedy to lighten the mood of the classroom and to get the students involved in activities. The students feel as if Mr. Brown relates to them and they can talk to him about anything. In an interview, Jaliyah expressed how she feels about Mr. Brown:

> Mr. Brown thinks he's a comedian. He's always crackin jokes, like all the time. He's funny, though, he makes everything fun. Like we can be focused and serious, and Mr. Brown will crack a joke out of nowhere, and everybody will laugh but still be doing work. He's so crazy. I could be having a bad day, but I know Mr. Brown will make me laugh because I know he's going to tell so many jokes. I like when he's there (Jaliyah Interview #2, December 19, 2015).

Mr. Brown takes a less serious approach with the students, but he makes sure that they are learning and on task. The way that Mr. Brown leads the classroom is different from a traditional teacher and very different from what the students experience at school. During an interview, Caleb described how Mr. Brown is at the Carver Program. He stated:

> Mr. Brown is so cool, he makes a joke out of everything and they are funny. Like we can joke around with Mr. Brown, and it's cool, he's not like too boring. He can rap too like he's good. He's always coming up with a rhyme for something, and it stays in your head forever. At first, I thought he was crazy, but I like that about him. One day we had a dance battle, it was so hyped like everybody got in on it. So stuff like that, like he makes it fun here. Sometimes at school, I go to his class during lunch (Caleb Interview #1, November 21, 2015).

The students are comfortable with Mr. Brown and respect him as a teacher. Relationship building is important, and the teachers at the Carver Program connect with the students in different ways.

Mr. Clark is very different from Mr. Brown, but they both get mutual respect from the students. Mr. Clark takes a more serious approach with the students, but he is extremely dedicated and committed to the success of the students, and they appreciate his efforts. In an interview, Caleb described his relationship with the teachers:

> I look up to both of them. Mr. Brown is like a big brother. He keeps it real all the time, like all the time. He makes things so we can understand them. I feel like I can tell Mr. Brown anything. Mr. Clark is like a dad to us. Like, he's not like Mr. Brown he doesn't joke around with us, but he's still funny kind of. He's strict with us like he means business…umm…like we know to respect him. I like him ‘cause he knows so much, he's

like a genius. I like when he teaches because he breaks it down and he expects for us to know it like he believes in us (Caleb Interview #2, December 19, 2015).

Caleb is empowered by both Mr. Brown and Mr. Clark. This empowerment can be seen in the manner in which Caleb talks about his teachers at the Carver Program. He talks very highly about them and mentioned that he looked up to them (Caleb Interview #1, November 21, 2015). The relationship that Caleb has with Mr. Brown and Mr. Clark extends beyond the classroom into his personal life. Throughout the observations, both teachers uplifted and encouraged Caleb as well as other students throughout the session (Observations, November 7 & 8, 2015). Having a special relationship with male figures, especially African American male figures, helped Caleb to navigate through and be successful at the Carver Program. Through conversations with Caleb, Caleb revealed that the Carver Program is the only setting where he has ever had more than one African American male teacher, and he appreciates the relationships he has with Mr. Brown and Mr. Clark (Observations, November 7, 2015).

The student-teacher relationship is an important factor at the Carver Program. The teachers go above and beyond to make sure that the students are learning and enjoying their time at the program. All of the students mentioned how helpful the teachers are at the Carver Program. In an interview, Sierra highlighted another aspect of the student-teacher relationship at the Carver Program. She mentioned that after awhile the teachers really got to know her, and this was important because it was reflected in how they taught her (Sierra Interview #2, December 20, 2015). Sierra is sometimes quiet and shy and instead of forcing her to participate sometimes the teachers would work with her individually until she felt comfortable to speak in front of the entire class (Observation, November 14, 2015). In an interview with Mr. Clark, he discussed his approach with students:

> I try to make this environment realistic for students. I want them to feel at home. How would you feel if you went to your house every day, and someone else's stuff was always there, but nothing of your own? I want to create an environment where they want to come. Of course, you know, students learn differently. You have your outgoing, extra live students, and then you have those that are more comfortable in quieter settings and there's a range of others. My job is to make everyone feel comfortable, so they learn, whatever I have to do to make this place conducive for learning, I try to do. And not only me, we all have that goal in mind here (Clark Interview, December 5, 2015).

The students notice this extra effort, and it helps to strengthen the relationships they have with the teachers. In an interview Sierra mentioned how Mr. Brown helped her figure out a math problem. She stated:

> Mr. Brown is just funny. He makes everything funny. He knows how to get me talking in class. One time he helped me with a math problem by coming up with this funny story and rap and now every time I do one of those problems I remember what he told me, I'll be humming it in class (Sierra Interview #2, December 20, 2015).

Having great relationships are not only important to the students, but during the interviews, the teachers also talked about their relationships with the students.

Both teachers take their job serious and value the students at the Carver Program. They strive to foster personal relationships with each student to truly get to know the student. In an interview, Mr. Clark described his feelings about student-teacher relationships:

> I think it's the teachers job to nurture the talents and dreams of students. I think each student comes to class with a unique, intriguing, yet incomplete story. A good teacher will know how to read a student's story and recognize the opportunity to help author the

> story. You have to build relationships with your students. I look at all of my students as family, and I am constantly trying to figure out how to strengthen my family (Clark Interview, December 5, 2015).

The relationships at the Carver Program help to strengthen the experience of the students at the program. They value the relationships they have teachers at the Carver Program. For many of the students they have never had a positive relationship with a teacher; this was highlighted in the first focus group with the students. Two of the students had the following conversation:

> Jaliyah: Our teachers just give us work just to give us work. They don't care if we do it. Like Mrs. P [teacher at Lisbon Middle School] always gets an attitude with us when we complain about worksheets and copying vocab out the book and one time she called a boy stupid. I can't stand that lady.
>
> Caleb: Yeah, she's a horrible teacher. And Mr. K [a teacher at Lisbon Middle School] is the same, he talks down about everybody. I hate going to his class; I 'm hoping my mom switches me out his class." (Focus group #1, November 14, 2015).

The student-teacher relationships at the Carver Program are also unique in that the teachers maximize learning by genuinely getting to know the student. The specific aspects (student bonds) of the Carver Program mentioned in this section make the student experience unique from other programs and school. The types of activities, friendships, and student-teacher relationships are the most salient factors that allow the students to develop a personal relationship with the Carver Program. Going beyond the types of activities and relationships at the Carver Program, the program is also unique in the pedagogy it employs. The method and practice of teaching at the Carver Program are very similar to culturally relevant pedagogy. Although the program does

not explicitly mention culturally relevant pedagogy as their method and style of teaching, components of CRP are prevalent throughout the program.

Research Question 2: The Incorporation of Culturally Relevant Pedagogy at the Carver Program

In a traditional science classroom oftentimes African American students have to learn the culture of the teacher in order to understand their teaching (Atwater, 1995), learn the culture of the classroom to be able to function inside the classroom (Atwater, 1995; Atwater et al., 2013), and learn the culture of science to be able to learn the content (Atwater et al., 2013; Parsons, 2008; Simpson & Parsons, 2009). Those processes are very difficult for students to navigate successfully. Culturally relevant pedagogy is one of the many terms used to capture the importance of culture and how culture is incorporated and used to enhance student learning. When Ladson-Billings developed the term, she believed the term described not only student achievement but also created an avenue where students could affirm and be proud of their culture. This type of pedagogy allows students to meet academic demands while also maintaining cultural competence. Three tenets describe culturally relevant pedagogy; they are:

1. Academic success
2. Cultural competence
3. Critical consciousness

As it pertains to CRP, academic success refers to providing the necessary tools to students to improve their academic proficiency. Culturally relevant teachers actively work with students to achieve academic excellence. Academic excellence goes beyond receiving a good grade and helps the student to make connections and to truly understand the content (Ladson-Billings, 1995). To produce academic success, teachers must value the students' skills and abilities they

bring with them to the classroom (Ladson-Billings, 1995a). Beyond academic success, culturally relevant pedagogy also includes cultural competence. Cultural competence is when a teacher utilizes a students' culture as a vehicle for learning, and when students maintain cultural integrity as well as academic success (Ladson-Billings, 1995a). The use of cultural competence is not surface level celebrations of culture such as highlighting certain holidays and cultural figures, but genuinely including the culture of the students in the curriculum, pedagogy, and everyday happenings in the classroom (Ladson-Billings, 1995b). By incorporating cultural competence into learning, teachers can then create an avenue for the development of critical consciousness. Critical consciousness is when teachers help students to develop a sociopolitical consciousness that allows them to critique cultural norms (Ladson-Billings, 1995b). The second research question is: How is culturally relevant pedagogy incorporated into an informal science program? This section of chapter four explores this question.

Emergent Themes

The data analysis identified three themes about the incorporation of culturally relevant pedagogy into the Carver Program. When exploring the different aspects of the program, the themes of relevance, caring, and community emerged from the data analysis about CRP. The three tenets of culturally relevant pedagogy were not explicitly expressed at the Carver Program, but implicitly there were aspects of the program that aligned with the three tenets of culturally relevant pedagogy. The emergent themes are the aspects of the program that implicitly align with culturally relevant pedagogy.

Relevance

Relevance was used explicitly by the director and the teachers, and implicitly by the students at the Carver Program. During the data analyses, relevance was characterized as having

an important, meaningful, and impactful connection. In an interview, Mr. Miles highlighted the importance of relevance and how the Carver Program aims to connect learning for students. He states:

> We are trying to understand what students are thinking, providing opportunities for feedback. We are trying to do learner-centered things where we pay attention to the knowledge and beliefs the learner brings with them to class. We are trying to create a knowledge centered environment where we emphasize sense making and we are trying to align the activities with common challenges in the society. So that's really what connected learning is all about, we have to make this stuff relevant to them (Miles Interview, December 6, 2015).

Mr. Miles presents relevance as it relates to student learning. In addition, during a conversation on student learning at the Carver Program, both teachers also included "relevance" in how they described student learning, Mr. Brown said:

> I think especially with Black kids; science has to be relatable. I also think parents need to push it. I think if parents pushed it and told them why it is important and how it can benefit you then they will understand it. Often Black kids their parents…it annoys me…they think I'm going to the NBA or NFL like uhh…I don't want to say no you're not and you probably have a better chance of becoming the president…so it's just a matter of what their parents expose them to and what they tell them is important. We have to make science relatable to our kids, make it fun and interesting, otherwise we are going to continue to have them wanting to be in the NBA and NFL, and there's nothing wrong with that, we just need more scientists in that group (Brown Interview, December 5, 2015).

Although Mr. Brown used the term relatable, he is referring to students making a connection with the content they are learning. He believes that the content should have personal meaning to the students. Mr. Brown actively makes the content relatable so that the students can understand and improve their knowledge of science. Mr. Clark also emphasized the importance of relevance for student learning at the Carver Program:

> The Carver Program is a good way for students to start developing that love for science. Like I teach the same here as I teach in my high school biology class, but that is not the case with a lot of these kids. The only good experience they have with science is when they come here, so I try to make it relevant to them. I try to connect what we are doing to their lives as much as possible. I want them to see that science does not have to be put in a box, but science is everywhere. When you're talking to your friends on your cell phone, think science, when you're eating dinner, think science, when you're playing sports, think science. I see it all the time; students have a bad experience with science, and they're cursed for life. Think about it, if you had a horrible teacher in science in third grade and continued to have bad teachers, and never experienced science outside of school, why would you like science? Here I try to change that experience for them (Clark Interview, December 5, 2015).

One of Mr. Clark's goals is to change and improve the experience that students have with learning science. When developing the science curriculum for the Carver Program he incorporated ways to make the material relevant to the students. The table below highlights excerpts from the curriculum artifacts that show how Mr. Clark makes the material relevant for students.

Table 4. Curriculum artifacts

Curriculum topic	Excerpt	State Curriculum Alignment
Paper Wind Turbine	"Instead of blowing air, however, turbines catch the air. When the wind blows, it makes the blades of the fan, called rotors, spin around, which moves the turbine. Nowadays, the need for reliable sources of energy has a lot of people talking about wind power. Wind turbines could be a large source of energy in the future. Because of this, many students need to construct wind turbine models for today's presentation. You will determine the turbine efficiency by measuring energy output by using work. Think about how energy is created where you live, is it safe? Cost efficient? Let's think about the environment, what are the benefits to wind turbines? Are there any cons? Before you start the project have a discussion with your group about how your wind turbine project can positively affect your environment.	2.5.5 – Explain how human activities affect air quality
Water Filtration System	"You will create a model of a water filtration system that will demonstrate the procedure that municipal water plants may use to purify water for drinking. We are going to take this project on a larger scale. Think back to Hurricane Katrina and how the people of New Orleans were affected by the hurricane. The goal of this project is to create a filtration system that will be used to help people during natural disasters. How will your filtration system help people? How will people access (how will they find it) your filtration system? How will you market your filtration system? Will it cost? Think about how your filtration system could potentially help people around the world."	2.4.1 – Evaluate human influence on freshwater availability. Water in lakes, rivers, and swamps often contain impurities that make it look and smell bad. 2.3.2 – Explain how ground water and surface water interact.
Attack of the Protista	"Streams or ponds are fascinating for students. There is a natural tendency for both children and adults to be curious about water sites. What are some questions you have about streams or ponds? Think about time you visited a stream, pond, or lake or think about time you saw a stream, pond, or lake in a movie, how was it? Was it clean? Think about your drinking water. Where does it come from? Is it clean? In this project, we will look at water quality. Water quality rating is based on a Pollution Tolerance Index."	2.4.2 – Evaluate human influences on water quality in river basins, wetlands, and tidal environments. 7.1.1 – Compare the structures and life functions of single-celled organisms that carry out all of the basic functions

The curriculum excerpts show that Mr. Clark uses the students' experiences, community, and the environment around them to make connections to the lesson. Mr. Clark is allowing the students to develop a personal relationship with the content so that they no longer view the material as foreign. Throughout interviews and focus group sessions with students, they made it clear that the instruction at the Carver Program was taught in a way that they could understand. In an interview with Aliyah she stated:

> They show us step by step, and he goes around the table and make sure you got it right. I like the teachers because they give us more information that's more useful and not boring. The teachers are more patient, and if we get the wrong answer they don't like really care, they just try and make sure you understand it and try another question (Aliyah Interview #2, December 19, 2015).

As seen above Mr. Miles, Mr. Brown and Mr. Clark explicitly stated the theme of "relevance." The students did not use the actual word relevance, but some of the students referenced relevance in a subtle way. One example is Sierra's experience in a cooking class, a learning opportunity in the program that takes a consumer science approach. The teacher used McDonald's as a reference for one of the lessons. McDonald's is known for being unhealthy, cheap, and accessible. Although Sierra knew that McDonald's was unhealthy, the lesson provided her with actual visuals and explanations about the food in a way that she could understand. This particular lesson was centered on the incorporation of healthy foods into your diet. In an interview Sierra stated:

> I like the cooking class because it's not just us cooking, they teach us about health and eating healthy and stuff. My favorite was when we made pancakes. It wasn't like the regular pancakes that you eat from McDonald's; it was like pumpkin spice and healthy

> for you. I didn't know pancakes could be healthy (Sierra Interview #2, December 20, 2015).

Now that Sierra has a better understanding on McDonald's she chooses not to eat there while also educating her mother on the new knowledge she gained at the Carver Program. In Sierra's second interview she also states:

> She also showed us what's in some of the stuff at McDonald's and now I think about it all the time, I used to go there sometimes, and now I tell my mom no because I know it has bad stuff (Sierra Interview #2, December 20, 2015).

The other students mentioned relevance in the Carver Program when they spoke about the teachers and activities. Caleb shows a great appreciation for Mr. Brown because he makes the content understandable and presents the information in a way that makes sense to Caleb. In his first interview (November 21, 2015) Caleb stated, "Mr. Brown gets me, he like understands me so I like when he teaches because I can understand him, and he makes it so we can get it." Relevance is further explored when Caleb continues to talk about how Mr. Brown makes learning at the Carver Program relevant: "He doesn't use all those hard science words to confuse us and when we learn new stuff he always gives examples." In science, vocabulary can be a deterrent from the learning process. Sometimes the terms used in science texts can be confusing to students. Mr. Brown directly addressed this possible deterrent. In addition to Mr. Brown, Mr. Clark was also recognized by one of the students as making science at the Carver Program relevant. In her second interview, Aliyah talked about the difference between learning science at school and learning science at the Carver Program. She made a clear distinction between the two environments in her statement:

> The science we do here is different because I understand it. Mr. Clark breaks

everything down step by step. And he lets us explain how we explain it; we don't have to use a book definition, and he don't always correct us how we speak (Aliyah Interview #2, December 19, 2015).

Furthermore, the teachers would always begin each session with a community connection as indicated in the observations of project-based science learning activities. Sometimes the teachers would use personal stories or videos to connect the lesson. The teachers also gave the students an opportunity to connect with the lesson by letting them tell personal stories. For example, while introducing the soil composition activity, Mr. Clark allowed the students to talk about soil. Aliyah mentioned that in the past Jaliyah and she searched for worms after it rained, but could not find worms in the dry soil. Mr. Clark used her story to help explain the lesson (observation, December 5, 2015). Another connection that was made was before the water filtration project. The students watched a TED talk to add relevance and connection to the project.

The water filtration project was a way to introduce the students to water quality. Mr. Miles describes the water filtration project and the TED talk below:

> So I was talking with Mr. Clark on how to bring these projects to life. This guy has a TED Talk, Michael Prichard. And he basically created a life-saving water purification bottle that could revolutionize water delivery in disaster-stricken areas, flood areas. So we showed this as an example of what's possible. So the idea is, this guy went home in his garage, and he was an engineer, he worked in water treatment. He figured out how to take the similar process and learned how to put it on top of a coke bottle. Now, that is a solution the world needs and that goes to market. Not only did he introduce a project that can save lives, but also he is going to make a lot of money. So the idea is, if we develop students who can think and spend their time trying to figure out how to create something

> that would benefit the world, you now put them in a position to be successful. If we can work with them in grades K-12, particularly in the earlier grades, introducing them to this type of thinking then ultimately we are going to produce graduates that are thinking like Steve Jobs. So this is an example of why we chose the water filtration project (Miles Interview, December 6, 2015).

The relevance of the filtration project was connected on a global scale for the students to make meaning of the project.

The theme of relevance was seen throughout program artifacts, interviews, focus groups and observations. In addition to relevance, caring was also a theme that emerged from the data.

Caring

The term "caring" was used a few times by the student participants, and the act of caring was witnessed during the observations. From the data analysis, the term was defined as having a sincere and authentic desire for the well-being of an individual. When talking to the students about the teachers at the Carver Program, they mentioned that the teachers care about them and want to see them do well. Caring ranged from helping students, holding students accountable, to complimenting the students. The theme of caring was captured in the first focus group with students. Below is an excerpt from that conversation; the students were talking about the teachers at the Carver Program:

> Aliyah: The teachers here they give us like….they tell us information on the stuff we are doing and that they know will help us finish the job. Like at school our teacher just think we know everything. Here they break everything down if they think we don't know a word they tell us what it mean. They help us with everything.

Caleb: The teachers actually care. Sometimes in school, I write whatever just to get done. I tried that here, and they made me do it over like three times until I got it right.

Sierra: They also tell your parents what you need help in.

Jaliyah: The teachers are nice, they always brag about other people. Like, tell us that our hair is pretty, or we look nice and stuff. They are just sweet and nice.

Caleb appreciates the way the teachers talk to him at the Carver Program; he feels like the teachers treat him with respect. Caleb highlights that the teachers took the time to get to know him and makes sure that he learns the material. Additionally, Caleb likes that the teachers do not embarrass him if he does not know or understand something. Below is an excerpt from Caleb's interview in which he describes the teachers at the Carver Program:

"In school, my teacher is always yelling at us or getting an attitude. Here the teachers take time with us…like even if we don't…like if we don't get it on the first time they don't get mad" (Caleb Interview #1, November 21, 2015).

The theme of caring went beyond the project-based learning sessions at the Carver Program. The teachers at the Carver Program play a major role in the learning experience of the students. In his first interview, Caleb further discusses the care factor when it comes to outside activities:

Sometimes Mr. Brown is at our basketball games and the teachers always ask us what's going on so they can help. Like, Brielle was doing a fundraiser thing, and all of the teachers bought candy, they just do stuff like that all the time (November 21, 2015)

In describing the ways and in what domains the teachers show care, Caleb introduced a cross between caring and relationship. That is, Caleb featured the dialectic nature of caring and

relationship at the Carver Program. The caring the teachers demonstrated and the relationship they developed with the students were inseparable.

Caring extended beyond the teacher-student relationship and was also present between the teachers. In conversations with the teachers, they both mentioned that the success of the Carver Program was partly due to the teachers and the relationships they have with each other. In an interview, Mr. Brown talked about his colleagues and how they collaborate with each other. He mentioned that their relationship helped them to better teach the students. In an interview Mr. Brown made the following statement:

> My co-workers at the Carver Program are pretty laid back, and everybody is extremely helpful with trying to help each other. Uh…if they notice that somebody is going through something tough they'll kind of rally around you and help you out. We really care about each other, it feels like a family as opposed to just work (Brown Interview, December 5, 2015).

The theme of caring was presented by the students and Mr. Brown.

The theme of caring played an important role at the Carver Program. It is one of the reasons why the students respected and appreciated the teachers at the Carver Program. It is reasonable to assert that the act of caring helped to increase a sense of community at the Carver Program. These relationships and connections have a positive impact on the success of the program.

Community

The community was a theme that emerged multiple times throughout the research study. Community was conceptualized as being a connection or relationship with people or things outside of the Carver Program. The Carver Program is unique in that it involves the community

with its programming. Many of the funders of the Carver Program are local business owners and community members. The community was the driver for the creation of the larger initiative (Community Initiative) and the premise of the Carver Program. In an interview, Mr. Miles talked about the creation of the Carver Program. He stated, "If it wasn't for the community we wouldn't be able to operate. Like I said, my wife and I grew up in this community, and we wanted to come back and give back to our community" (Miles Interview, December 6, 2015).

As a way to give back and enhance the community in which he grew up, Mr. Miles decided to start the Carver Program in his old neighborhood. The program was founded on the premise that the community should be involved in all aspects of the program. The curriculum is also based on the community. In the same interview, Mr. Miles stated:

> Our curriculum is based on the community. The curriculum falls heavily on Booker T. Washington's ideas that were embedded in the curriculum at Tuskegee Institute. At the turn of the 21st century, Tuskegee was established to teach and train African Americans during the post-reconstruction era…I believe we should do the same here, not just master the knowledge but market the knowledge. How can you help your community? How can you be an innovator? We have to keep our masterminds in our communities.

One of the foci of the Carver Program is to uplift and utilize the community. During the fall session, local community members helped teach sessions. A parent came in to help lead a cooking class with fruits and vegetables that were brought (some were grown) in the community.

> Today, the students are working with Mrs. O, she is a parent of one of the students. Mrs. O also lives in the neighborhood and helps to run the community garden. She brought some herbs in today that were grown in the community garden and she is teaching the students how to cook a healthy Thanksgiving meal. Talking with the teachers, the

> community garden is located in the back of the housing community where the Carver Program is located. The garden is kept up by certain people in the community. (Research Journal Entry – November 9, 2015)

Knowledge from within the community was used so that the students could relate and have a better understanding of the content. The students were able to understand the lesson because the lesson was brought to them in a manner in which they could relate.

All aspects of the community are important to the Carver Program and important to the success of the program. Each of the project-based learning activities is linked to the community. Mr. Miles created a logic model that he presents to community members and possible funders of the Carver Program. In an initial conversation with Mr. Miles he projected the logic model on a projector and explained the following:

> The value proposition to the community is this….short term for our customers, for our beneficiaries, the customer, the user is our students and parents. The stakeholders are our supporters and volunteers and funders. X number of hours of academic enrichment in the Carver Program should produce X percentage of growth in ELA and math. Plus critical thinking skills. Long term what we are saying is that if you introduce students to this type of engaged learning, and you connect them back to the community they will re-invest in the community much as my wife, and I are re-investing in our community that we grew up in. You increase your tax base with professional knowledge workers and the STEM companies in this area can see that the pipeline is being filled with those knowledge workers. That's it. And we can now develop them for STEM careers and business careers they will be able to move in some instances…families out of generational poverty…in other instances, they will pursue post-secondary careers, and then the by-product is

moving folks out of generational poverty. And other instances, they will no longer be economically impoverished. But they are at the table to take their rightful place as 21st-century leaders. And that is ultimately the goal of the Carver Program.

Mr. Miles is a firm advocate for the community. As addressed by Mr. Miles, although not directly stated to the students, the teachers at the program want the students to be able to rise out of generational poverty, improve their living conditions, and ultimately keep their talents and contributions in their communities to help the following generations.

The three themes of relevance, caring, and community were seen throughout the Carver Program. The themes also have aspects that are connected to the three tenets of culturally relevant pedagogy. Factors of academic success, cultural competence, and critical consciousness were implicitly present in all three themes.

Culturally Relevant Pedagogy and the Carver Program

From the findings presented above, The Carver Program is unique to the students because of the genuine relationships at the program. These unique relationships are connected with Research question 1: What specific aspects of the Carver Program make it unique to African American students? Because of the relevant teaching and the caring and community aspects of the program, the Carver Program and the staff are able to connect with the students. The second research question (How is culturally relevant pedagogy incorporated into the informal science program?) is addressed in the following section.

Academic Success

Academic success is the foundation of the Carver Program. The website, program brochures, and instruction all aim to produce academic excellence. For example, the program brochure states: “The Carver Program features data-driven instruction, laser focused on your

child's specific learning needs, whether enrichment or acceleration. The program offers personalized websites for each student, populated with targeted lessons and activities to meet individual needs" (The Carver Program Brochure).

Academic success is also implicated in program practices. Assessments are given, and student progress is tracked to make sure that the students are excelling in school. In an interview with Mr. Miles, he discussed how the students are assessed at the Carver Program:

> Every few weeks we use Triumph Schools to test our students. Triumph Schools is modeled after their end of grade tests, and it presents questions in the same manner. We use it to track growth from our students and to personalize their lessons. If a student receives below an 80% on a lesson, we add that lesson to their personal file to continue to work on. We then obtain their mock end, of course, test grades from their parents and eventually their final scores to track growth. I told you my daughter went from a grade 3 to a four on her science end of grade test (Miles Interview, December 6, 2015).

The actions of the instructors also accentuated academic success. Beyond helping the students to attain good grades, the instructors at the Carver Program aim to make sure that the students truly understand the content material. A good instance of academic success was presented earlier in the chapter when Sierra mentioned that Mr. Brown came up with a rhyme and rap to help her remember a problem. This is an example of connecting cultural competence and academic success in the Carver Program. Because Mr. Brown developed an authentic relationship with Sierra, he knew how to connect with her in an attempt to ensure that she was successful in learning the content. The rap and rhyme were relatable to Sierra, and she still uses it to help her with her math problems.

The tenet of academic success can also be seen when the teacher made Caleb do the assignment over until he did it correctly. Caleb was used to being able to turn in mediocre work to get credit, but the teachers at the Carver Program held him to a higher standard and expected more from him. This helped to create an environment where academic excellence is not only expected but also required. Beyond the student-teacher relationships, academic success is present in the involvement of the community members as evident in a research journal entry that featured the participation of a community member in an after school session of the Carver Program. The community volunteers devote their time to contribute to the betterment of the students. Although all of the volunteers do not directly teach the students, their sacrifice of time shows a vested interest in the students and their futures.

> Mrs. Jackie comes to the Carver Program on Tuesdays and Thursdays to help the students with their homework. She is a retired math teacher, and she helps with homework and snack time at the program. Today, Mrs. Jackie is helping a few students with their math homework." (Journal entry – December 1, 2015)

Additionally, the community funders contribute to the academic excellence of the students by providing funds. The program brochure and program shirts list the major sponsors of the Carver Program. Also, during an interview with Mr. Miles he highlighted the importance of the funders, he stated:

> We would not be able to operate without community help and help from our sponsors. The big STEM companies in the area sponsor a lot of our projects. This summer we are starting a brand new initiative with [major science company], kind of like an apprenticeship where our middle school students will be paired with a scientist and able

to work in the lab and at the plant with their scientist (Miles Interview, December 6, 2015).

The funds that the Carver Program receives are allocated to supplies, programming, staff, and other necessities to maintain the operations of the Carver Program.

The culturally relevant pedagogy tenet of academic success was intended to improve the success of the whole student, and the Carver Program actively works to ensure that the students excel both personally and academically. In creating an academically successful environment, the Carver Program aims to include lessons that are relevant to the students. This relevancy implicated cultural competence.

Cultural Competence

Research shows academic success is facilitated by cultural competence (Ladson-Billings, 1995a, 1995b, 2000; Dumais, 2002). Cultural competence enables the creation of an environment where students do not need to compromise their culture to learn. When incorporating cultural competence teachers do not dismiss the knowledge and assets that students bring with them to the classroom, but they use this knowledge to enhance learning. When speaking on relevance, Mr. Miles describes a cultural competent environment by trying to understand and value what students think and allowing them to provide feedback. Mr. Miles stated that the program pays attention to the knowledge and beliefs that the learner brings with them to class (Miles Interview, December 6, 2015). Mr. Clark enacted Mr. Miles' sentiments. A vignette from the video data showed how Mr. Clark utilized a students' prior knowledge to help him teach and to help a student complete a lab activity.

During a Saturday session, students worked on soil composition and different types of soil. The lesson started with Mr. Clark addressing the class:

Mr. Clark: What do you know about soil?

Student: I did a plant project in school. In my project, I treated the soil with different solutions to see if it would affect the growth.

Mr. Clark: How did you keep your results of the project, come to the board and show us.

Student: [the student walks to the board and begins to draw a table]

Mr. Clark: I'm going to change this table slightly, and we are going to use this table to write down your observations of the different types of soil.

Mr. Clark used the knowledge the student gained from his science class at school to help teach the other students. Student knowledge was used as an asset and also used to make learning relevant.

Although not explicitly delineated in cultural competence, it is unlikely cultural competence will be applied in science teaching and learning if caring, a theme that characterized the Carver Program, does not exist. If caring is insufficient then it is less probable teachers will make the effort to learn about their students. Caring is related to cultural competence in that the teachers at the Carver Program have a vested interest in all aspects of the students' lives, and they value the students as individuals.

Lastly, cultural competence is embraced at the Carver Program by involving the community into the implementation of the program. Cultural competence is shown by the inclusion of the community in the curriculum development and teachings at the Carver Program. An example of cultural competence at the Carver Program is including the parents and community members into the everyday logistics of the program. By including the experiences and perspectives of those that are close to the students, the program is utilizing the cultural

capital of the students. The Carver Program reaches out to family members of the students to volunteer, and they also encourage community members to help sponsor programming. The program utilizes the cultural capital in the students' communities to help teach them, instead of soliciting help from outside sources that have no connection with the students.

Although the program did not use the term cultural competence, there were many aspects of this CRP tenet present at the Carver Program. The inclusion of aspects of cultural competence makes the Carver Program unique, and it allows for a greater connection to the students. Including culture into the daily workings of the program opens up an avenue where the teachers can incorporate critical consciousness. Out of the three tenets of CRP, critical consciousness is the hardest to enact in the classroom. Although it is very difficult to teach critical consciousness, there were a few instances at the Carver Program where aspects of the CRP tenet critical consciousness were present.

Critical Consciousness

Critical consciousness, critiquing the cultural norms and values of society, was present in a few program activities. One exemplar is the water filtration project. The students were given the opportunity to critique society when creating their filter systems. The TED talk and subsequent conversations allowed the students to engage the world critically and question why certain communities did not have clean water. Video data highlight a conversation a student had with Mr. Clark about the water filtration project. The student stated:

> "If it's this easy to filter water, why do some places still not have clean water? Like in other countries sometimes they don't have clean water, could this help them? (Video Excerpt, November 23, 2015)

The project challenged the students to not only think of their local water systems and how they can help to improve water quality but also to consider how their project would affect the world.

The Carver Program aims to position the students so that they can learn and also give back to their communities. Mr. Clark attempted to develop a critical consciousness in the students by encouraging them to think about the environmental inequities around them. On multiple occasions, the teachers at the Carver Program incorporated the community into their teachings. Mr. Brown used the trees around the building at the Carver Program to help him complete a lesson. Video data show the students used the bark of the trees to make imprints on their paper to later review the diversity of trees (Video Excerpt, November 30, 2015). The students went outside to collect leaves and soil from around the neighborhood to create an eco-column. The lesson explained to the students that even though they walk past these trees every day without thinking of their importance, the eco-column is an example of how much their environment contributes to the society.

Culturally relevant pedagogy is incorporated into nearly all aspects of the Carver Program. The participants did not directly use the language and the names Gloria Ladson-Billings attached to the CRP tenets, but they did encompass the meanings she attributed to the tenets through their own language and actions. At times, the tenets were vividly and directly connected with the Carver Program, and other times there were indirect connections to culturally relevant pedagogy. The above sections explored how the students at the Carver Program connected with certain aspects of the program and how CRP was incorporated into the program.

Research Question 3: Student Perceptions About Science

An additional theme emerged from the data analysis: meaning of science. "Meaning of science" captures how students make sense of science, how they define and describe science, and

how they perceive science. This theme addresses the third research question is: How does the incorporation of culturally relevant pedagogy into the informal science program influence African American students' perceptions about science?

The Meaning of Science

Science was described differently by all of the students and each student had their own idea of what encompassed science. During the second interviews, the students discussed what they thought was science, what science meant to them, and how they defined science. All of the students were puzzled when asked to define science. They were sure they knew what science was, but could not articulate their own definition. Answers ranged from pinpointing one specific topic in science such as ecosystems and trying to explain what that meant to explaining how they learned science, but it took several tries for each of the students to share their own perspective of what is science. Aliyah, Sierra, and Caleb all mentioned that science was about learning and doing experiments.

> Aliyah: Like science is…I think science is all about doing experiments and finding out about new things in life and umm…like …when you're curious about questions you can find them out by doing experiments.
>
> Sierra: Science is learning about living things and doing research and doing experiments.
>
> Caleb: I don't really know the definition of science. I guess the way of learning different like…the way of learning different things according to like ecosystems and elements and earth and stuff like that I guess (Interview #2, December 20, 2015).

Jaliyah did not provide a response. She struggled with trying to gather her thoughts and opted out of answering the question. The other students were not confident in their answers and could not fully explain what they thought science was. A common reply to the question was associating

science with the earth and doing experiments. Beyond this connection, the students could not articulate their definition of science. The students responded more freely when asked about project-based science.

When asked to rate project-based science using the same rating scale they used to rate science (described in Chapter 3), all of the students rated the project-based science learning higher than their earlier ratings of science. The table below shows how the students rated both general science and the project-based science. The table also includes excerpts from the second interview to highlight what the students stated:

Table 5. General Science and Project-Based Learning Ratings

Student	General Science	Project-Based Learning	Interview Excerpt
Caleb	2	4	“Here its different, I would say like a four. But it’s not like the book science so I don’t know”
Jaliyah	2	4	"The project-based learning here is fun, I like it, but it’s not the boring science. Like the two are different. I wouldn't call this science, it’s more like fun stuff."
Aliyah	3	4	"The science here is so cool like I wish my science teacher would teach me like this and I will probably pay attention and pass"
Sierra	4	5	“I like doing the projects. I just like science, and here we have way more supplies so sometimes I can do things more than once, so I really like that”

Compared to the ratings the students gave in the beginning of the study they rated the project-based science higher than the science they do at school. Although the curriculum at the Carver Program aligns with the state science standards as shown in Table 2, there is still a disconnection

between the science the students do at the Carver Program and the science the students do at school. When speaking of science at the Carver Program the students disassociate it from school science because it is not boring, they have great relationships with the program teachers, and they learn. It was hard for the students to make connections between the two academic environments.

Throughout their second interviews, ironically, none of the students mentioned anything that they did in the Carver Program when describing the definition and meaning of science. The students described science as something abstract and not necessarily connected to them as an individual. When asked if any of them wanted to be a scientist, all four students said no. During a focus group conversation, each of the students was asked what they wanted to be when they grew up. The students responded:

Sierra: I want to be an OBGYN doctor.

Caleb: I want to be umm..I guess a baseball player

Aliyah: I want to be a children's doctor

Jaliyah: Me too, I want to be a doctor (Focus Group #1, November 14, 2015).

Because of the disconnection between how they perceive science in school and how they perceive science at the Carver Program, the students associate a career in science with the type of science they do at school. Therefore, a career in science was unappealing to the students.

Even though the students enjoyed the project-based science at the Carver Program, only one student voiced a connection between science and a program activity. In their interviews, three out of the four students mentioned the cooking classes at the Carver Program, but only one of the students, Caleb, connected the cooking class with science. He stated,

" I love the cooking classes. Like I don't cook, but they were fun. It's kind of like science. We had to measure each thing out and follow the directions; it was like doing a lab." (Caleb Interview #2, December 20, 2015).

The other students did not connect the cooking class with doing "science."

In summary, all of the students had their own definition and meaning of science. Each of the students described science differently and expressed their feelings about science at school and science at the Carver Program. Although the students still have their negative perceptions about school science, the Carver Program helped the students develop a different and more positive perception about the science that is implemented at the program. The program did not directly change how the students feel about school science or formal science, but the program broadened the students' perceptions about science in informal environments. Although the students did not make a direct link between the activities they did at the Carver Program to science, they were able to put the activities they participate in at the Carver Program in a category of "fun science." This category had no relationship to what the students do at school, but they were able to make their own positive connection to the activities they do at the Carver Program.

CHAPTER V

The goal of this research study was to explore the perspectives and experiences of African American students in an informal science program. This chapter summarizes and discusses the problem addressed by the study and the study's findings. The chapter concludes with implications for research and practice in science education.

Chapter one presented the problem of STEM education in the U.S. The U.S. is gradually losing its position as the hub for STEM talent in the world. The World Economic Forum ranked the United States 52nd in the quality of mathematics and science education (World Economic Forum, 2011), and there have been concerns about the ability of the U.S. to compete in the global economy. More attention must be given to the early years of STEM education in this country to address the larger overarching issues of the STEM competitiveness of the U.S. Additionally, another problem arises when comparing the science achievement of students from different ethnic and racial groups. Specifically, African American students perform more poorly than their counterparts on science achievement assessments. To better address the learning needs among students from non-dominant backgrounds it is important to place greater attention on the cultural knowledge and resources they bring to learning (Norman et al., 2001; Parsons et al., 2005). Alternative approaches, to the formal classroom setting, have been introduced to interest more students in science. Informal science education is one of the alternative approaches.

In an attempt to shed light on cultural inclusion and science teaching by way of an alternative approach, this study explored the perspectives and experiences of African Americans in an informal science program while using culturally relevant pedagogy as a framework to guide the study. The study addressed the following research questions:

1. What specific aspects of the Carver Program make it unique to African American students?
2. How is culturally relevant pedagogy incorporated into the informal science program?
3. How does the incorporation of culturally relevant pedagogy into the informal science program influence African American students' perceptions about science?

The researcher's positionality in this study as an African American woman influenced the research questions and direction of the study. After conducting the research, it became evident that being an African American woman studying African American children did not make the researcher a complete and automatic insider into the study participants' worlds. Even though the researcher grew up very much like the students in this study, her current positionality as a doctoral student and researcher has somewhat distanced her from the many realities these students face on a daily basis. Throughout the study the researcher recognized that she was continuously adjusting her critical lens in order to genuinely connect with the students to produce research authentic to the participants. Similar to the cultural connections the teachers made with the students to teach them, the researcher had to make cultural connections to adequately do the research. This required, at times, putting down the researcher hat (e.g., priorities, perspectives) and picking up the hat as an African American woman that is not too far removed from the students' neighborhoods of origin. It was important to view the work from the perspective of a community member, sister, daughter, and friend and not solely as a dissertation project conducted by a doctoral student. As a result of this expanded view, the researcher began to make connections with the students which facilitated student receptiveness of and openness to the researcher. Throughout this study, the researcher's positionality was instrumental in navigating many topics with the students.

Discussion

There is research within science education that focuses on African Americans. The problem is that most of this research uses a deficit approach. The research does not highlight the backgrounds of the students as assets to the classroom or their learning. A deficit lens in research on African Americans in science education diminishes the impact and contribution that the research can have in the field of science education and most importantly the society.

The Valuing and Validation of Culture

Interweaving African American culture into the fabric of the program was the first way the Carver Program valued and validated its students. As highlighted in the literature review in chapter two, African American culture was explained by the Black cultural ethos. The Black Cultural Ethos consists of nine themes that are rooted in West African customs and values. Boykin (1986) states that not all African Americans will adhere to the cultural tenets to the same degree, but he believes that these nine cultural themes are deeply embedded in the African-American cultural way of being (Boykin, 1986; Parsons et al., 2005). Boykin (1986) believed that African American children should be allowed to function and perform in learning environments in ways that are congruent with their cultural worldviews. The Carver Program operated in line with Boykin's sentiment by incorporating several elements of the Black cultural ethos into its functioning.

The program featured harmony, connections that exist between human life and what surrounds it, which was captured in the theme relevance. Great efforts were taken to connect science to the students' lives. Not only did the program strive to connect science to the students' lives, but it also strived to enhance the students' connection to science. Movement, having an affinity for rhythm and music, was one cultural vehicle the Carver Program used to facilitate the

previously mentioned connection. Movement was evident in the rhymes and raps Mr. Brown incorporated into his teaching. Movement was also insinuated in the energy-filled environment created in the Carver Program. This energy-filled environment was captured in the theme of fun science. Fun science was related to the type of activities that were performed at the Carver Program. These activities reflected the Black cultural ethos dimension of verve, a preference for high-energy stimuli. These activities often required working together and helping each other, emphases shared by the students and hallmarks of the Black cultural ethos element communalism. Communalism is a preference for and focus on group cohesiveness. African American culture, as conceptualized by Boykin, was seen and embraced by the Carver Program. This valuing and validation of African American culture is one reason why the program is unique to the students, the focus of the first research question, and why the program differs from other informal science programs.

The second way in which the Carver Program valued and validated the students' culture was through their inclusion of the students' communities. The community connections at the Carver Program are very unique. The program did a great job of incorporating various aspects of community life into the daily workings of the program. Many times state funded programs go into under-represented communities perform a service and leave without making a real contribution to the community or fostering any genuine relationships with the community members. The Carver Program used its community as a partner in its development, and as the Carver Program progressed, the community around the program was also enriched. The staff at the Carver Program made it a priority to include community programs and to support the surrounding community throughout the year. The success of the program can be attributed to the great relationship the program has with the community.

According to Ladson-Billings, culturally relevant teachers utilized the students' communities and corresponding cultures as vehicles for learning. Chapter four provided evidence that the tenets of culturally relevant pedagogy were present in the program. The Carver Program allowed the students to embrace their culture and as a result, the students were able to connect genuinely with the program. According to Lee (2004), learning environments that connect the science disciplines with students' cultural practices enable students' to capitalize on their experiences for science learning. It also constructs meanings in ways that relate science to their cultural identities; this is evident in the exploration of research question number three and the students' perceptions of the Carver Program compared to how they feel about the science they do at school.

Caring

Relationships within and with the program that emerged in the findings also distinguished the Carver Program. Through the exploration of these unique relationships at the Carver Program, the theme of caring was revealed. This finding is important in that it supports the existing literature on caring and the success for African American students. The nature of the caring at the Carver Program was reflective of the "warm demander" literature, an aspect of caring exhibited by African American teachers that help African American students to succeed. Vasquez (1988) used the term "warm demanders" to identify teachers who were successful with students of color. The students of color are said to believe that these teachers did not lower their standards, but held them to a higher standard and were willing to help them. Additionally, Irvine and Fraser (1998) used the term to describe teachers who provided no-nonsense, structured and disciplined classroom environments. Warm demander is used to describe effective, culturally responsive teachers (Ware, 2006). Roberts (2010) states that providing a caring classroom

environment is an important part of helping students succeed. The teacher-student connection is one of the most powerful pieces of the academic achievement of students of color (Siddle Walker, 1993), a connection that was highlighted by the Carver Program students and personnel.

Contributions of the Study

To genuinely contribute factual information and insights about African Americans in science education there must be an understanding that the cultural backgrounds of students are extremely important, and they play an influential role in their learning. Informal science education is an evolving discipline, and there is not much research that focuses on African American students learning science in informal contexts. The consensus is that informal science learning can be beneficial to the advancement of science education, but this is a generalization and more research needs to be done to address specifically how informal science education impacts or influences learning for specific populations. This research study addressed certain aspects of an informal science program and its connection to African American students.

The study supports the literature that the inclusion of African American culture is important to the success of African American students. Interviews, observations, and focus groups revealed that the African American students in the Carver Program developed a great connection with the curriculum and the teachers in the program. Previous research has stated that students of color often view the field of science as foreign, distant, inaccessible, boring, irrelevant, and alienating (Basu & Barton, 2007; Lee & Luykx, 2005). The students at the Carver Program felt connected, the content was not foreign, and the teachers with their teaching styles sparked interest in the students. The use of project-based learning helped to achieve the aforementioned.

The project-based learning conducted at the Carver Program differed tremendously from school science in that it was hands-on, the students were able to work in groups with their friends, the lessons were engaging and fun, and the students were able to develop trust in their teachers. The students at the Carver Program felt connected with most of the project-based science learning activities.

The relationships that were fostered by the project-based science activities and teachers at the Carver Program created an environment that promoted trust and respect. This type of environment motivated the students to learn. This finding further supports the literature on African American students in science education. According to Parsons, Travis, & Simpson (2005) science is inherently cultural and to meet students' needs, instruction must incorporate students' unique cultural learning contexts. There was a clear distinction in the students' perceptions about their experiences with school science and their experiences with project-based science learning at the Carver Program. Each of the students felt a personal connection with the curriculum and the program in general. For all of the students, school science seemed distant, boring, and irrelevant to their lives.

The Carver Program is an example of an informal science program that includes cultural aspects and in return, the students have more positive perceptions about the science they engage in the program. The science conducted at the program was extremely different from the science the students were exposed to at school. Because of this difference the students created a barrier between the two; it was hard for the students to associate the science at the Carver Program with their school science. Consequently, their perceptions about school science stayed the same, but they were able to develop an alternative view of science through the Carver Program. This

finding contributes to the science education research in that it provides the perspectives of African American students in informal science settings.

Additionally, this study revealed that teacher-student relationships in the informal science program were important to both students and teachers. Currently, there is limited research that focuses on the student-teacher relationships in informal learning environments for African American students. The students perceived the teachers in the program as people that genuinely cared about them and their well-being. Students spoke about their teachers at the Carver Program with a sense of pride and admiration. Teacher-student relationships played a role in how students learned at the Carver Program. According to the students' comments during interviews, variations in teaching style and unique relationships with the teachers were two of the driving forces for student success in the Carver Program.

The original conception of culturally relevant pedagogy introduced by Gloria Ladson-Billings and her exceptional teachers of African American students are seen throughout the Carver Program. Although the Carver Program teachers did not specifically state the three tenets of culturally relevant pedagogy, aspects of the framework existed throughout the program. This study supports Gloria Ladson-Billings original conception of culturally relevant pedagogy, and it further supports the need and importance for culturally relevant teachers.

Often in the literature, the culture and experiences of African American students are not acknowledged. This study provides a space to highlight the perspectives of African American students as it pertains to science and informal science programming. This study is a step in the right direction to change the experiences of students of color, specifically African Americans. The assertions made from this research study have implications for informal science education, and they also present areas warranting more research.

Implications

Previous research has noted that many African American students experience a disconnection in the science classroom due to such things as a mix of cultures, style of teaching, and content material to name a few (Basu & Barton, 2007; Lee & Luykx, 2005; Malone & Barabino, 2009). These students view the science classroom as foreign; they tend to lag behind other students in relation to assessment data (Lee & Luykx, 2006; NAEP, 2011). The results of national science assessments show that African-American students are performing more poorly than their counterparts (NAEP, 2011; Atwater, 2000; Brickhouse & Potter, 2001; Carlone & Johnson, 2007; Carlone et al., 2011; Rascoe & Atwater, 2005). A dire state still exists even though new reform policies and alternative teaching styles have been introduced to try to address achievement of African Americans in science (Bell, Lewenstein, Shorise, & Feder, 2009; NAEP, 2011). This research study explored an informal science program, an alternative approach presented in the literature and an avenue that may lead to achievement success for African American students in science education.

This study offers several insights that have implications for practice and research in informal science education. Firstly, this study's findings implicate culturally relevant pedagogy as a useful framework to guide programming for African American students in informal science environments. Even though more research needs to be conducted on the relationship between culturally relevant pedagogy and informal science learning, this study's findings show that this line of inquiry is not only important for African American students, but it can also be informative for the science experiences of other underrepresented groups like Latino/as. As stated in chapter one, the population of Latino/a students is on the rise, and they experience some of the same

challenges with science education as African American students (National Research Council, 2013; U.S. Census Bureau Data, 2012).

Secondly, informal science education with a purpose is an avenue for African-American students to explore science while having fun and learning. Often informal science learning is linked to students learning freely with no direction (Crane et al., 1994; Falk & Dierking, 1992). The Carver Program is an example of informal science learning with a purpose. The learning is structured and purposeful and caters to the needs of the students. Directed relevant inquiry activity can be beneficial to learning. Within the literature, there are numerous studies on museum visits and field trips (Borun, Chambers, & Cleghorn, 1996; Hofstein & Rosenfield, 1996; Ramey-Gassert & Walberg, 1994), but more research needs to be done on semi-structured informal science learning environments where students are doing inquiry-based activities with intentional purposes that include cultural inclusion.

Thirdly, the curriculum setup of the Carver Program proved to be successful for its students. The students revisited content in a cyclic fashion. The students were given multiple opportunities throughout the year to build on their science knowledge. Informal science programs can use this method to help enhance science learning. Instead of teaching topics in isolation, a connected approach is useful in creating meaning for students.

Fourthly, the study's relationship findings have several implications for science learning. Relationships developed in the Carver Program were beneficial to the success of the program and may also be beneficial for formal science classrooms. Teacher-student relationships were important to the success of the Carver Program. The teachers spent time getting to know the student as an individual and also getting to know them as a learner. Both in school and out-of-school teachers can use this approach to impact learning. The student as an individual may very

well be different from the student as a learner and by developing genuine relationships with students, teachers can impact their lives in more purposeful ways. The relationship between informal and formal science is also important. As mentioned in chapter two, children's life experiences both in and out of school have profound effects on their achievement in school and their functioning in society (Resnik, 1987). This research study highlighted the disconnection between informal science learning and formal science learning. Future research needs to focus on how to combine effectively the two. Examples of this could include aligning the curriculum of formal science and informal science education so that students are constantly building on and learning about science content together instead of in isolation. Classroom teachers can learn a great deal from what goes on in the informal science contexts and vice versa with informal science teachers. It is also possible that the experiences of classroom teachers who also work in the informal science setting could be leveraged in the school setting. An example of this would be the two teachers at the Carver Program. Both Mr. Brown and Mr. Clark worked in the school setting and informal science setting, and they were able to use their experiences to enhance their teaching.

Future research needs to explore further the impact and influence of informal science learning for African American students. Most of the research conducted about African American students is in the formal science context, mainly the traditional school classroom. This study contributes to the effort of exploring informal science education as a means for engaging more African American students in science education, but more efforts are warranted.

Beyond the classroom, this study can help to shed light and influence new policies in science education. Year after year there are new policies and initiatives passed to help improve science education for students. The majority of these initiatives only have a small subset of

research and information geared towards informal science education, and out of this small group, cultural relevance is almost non-existent. More research on culturally relevant informal science teaching is needed to help improve new policies and to improve the quality of science education in the United States. This recommendation is also important for our teacher education programs, pre-service teachers, and current teachers. In most teacher education programs, informal science education is not a major focus and research on this subject is not a part of the major research agenda of the university. More research on culturally relevant informal science education can potentially better prepare science teachers for the classroom. This is an important topic that science education researchers need to address more critically. The more research we have on culturally relevant science teaching, the better we can influence policy practice in K-12 science education.

APPENDIX A: STUDENT INTERVIEW GUIDE

Hello,

My name is _____ and I am a graduate student at the University of North Carolina at Chapel Hill. I am conducting a study to research the science perspectives and experiences of African American students. In this interview I will ask you some questions about how you feel about science. Please feel free to honestly answer the questions. I will audio tape (upon your consent) our discussion so that I can reference it while I am doing my data analysis. At anytime during the interview you can choose not to answer a question or participate. The information disclosed during this interview will be confidential. You will not be identified or connected with the information you chose to give. During the interview I will take brief notes.

Before starting the interview, I would like to get verbal consent to audio tape our conversation. Do I have consent (permission) to record the conversation?

(Start audio-recording)
Interview start time: _____

1. Do you like science? (depending on answer, follow up with why do you like science, or why do you dislike science?)

2. Can you remember a particular time when you began to like/dislike science?

3. What do you like most about science? (most enjoyable, or most fun to do)

4. Outside of school, do you do any science related activities? (if so, further explore the types of activities, if not ask students the types of science activities they would like to do)

5. Explain how you best learn science.

6. If you could choose a way to teach science to your classmates how would you teach science?

APPENDIX B: TEACHER INTERVIEW GUIDE

Hello,

My name is _____ and I am a graduate student at the University of North Carolina at Chapel Hill. I am conducting a study to research the science perspectives and experiences of African American students. In this interview I will ask you some questions about science education and The Smart Academy. Please feel free to honestly answer the questions. I will audio tape (upon your consent) our discussion so that I can reference it while I am doing my data analysis. At anytime during the interview you can choose not to answer a question or participate. The information disclosed during this interview will be confidential. You will not be identified or connected with the information you chose to give. During the interview I will take brief notes.

Before starting the interview, I would like to get verbal consent to audio tape our conversation. Do I have consent (permission) to record the conversation?

(Start audio recording)

1. How did you become involved with the Carver Program?

2. How long have you been a science teacher?

3. How would you describe your teaching style?

4. If you had to describe your favorite part about the Carver Program, what would it be?

5. How would you describe your relationship with the students at the Carver Program?

6. What do you think are the 3 most important factors to an effective science classroom?

7. What impact if any do you think the Carver Program has on the students' lives?

8. If you could create the perfect science class for students, what would that class look like?

APPENDIX C: FOCUS GROUP GUIDE

Hello,

My name is _____ and I am a graduate student at the University of North Carolina at Chapel Hill. I am conducting a study to research the science perspectives of African American students. I would like to further explore how you feel and think about science. In this focus group I will pose questions to the group. Please feel free to honestly answer the questions. I will audio tape (upon your consent) our discussion so that I can reference it while I am doing my data analysis. At anytime during the focus group you can choose not to answer a question or participate. The information disclosed during this focus group session will be confidential. You will not be identified or connected with the information you chose to give. During the focus group I will take brief notes.

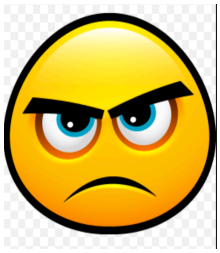
Before starting the focus group, I would like to get verbal consent to audio tape our conversation. Do I have consent to record the conversation?

(Start audio-recording)
Start time of focus group: _____

Thank you for agreeing to be a part of today's focus-group. Before answering a question, please remember to say your name first, I will remind you of this throughout the focus group. I will ask you some questions about how you feel about science. This will be an open conversation so feel free to participate at any time. You do not have to raise your hand or wait to be called on to participate, whatever comes to your mind please share with the group. I would like to begin by getting your view on science.

1. Describe how you feel about science
2. If you had to rate how much you like science on a scale from 1-5, 5 being the highest "I strongly like science" how would you rate science? Explain why you chose this number
3. Let's talk about the SMART Academy. What are some things that you like/dislike?
4. How do you feel about the science activities/experiments you do at the SMART Academy?
5. If you had to choose your favorite activity, which activity would you choose?
6. If you had to choose two things that you like doing in science, what would those two things be?
7. Describe your school science class?
8. If you had to describe your perfect science class what would it look like? (talk about the environment, teacher, activities, etc.)
9. How do you best learn science? For example do you like group projects, textbook assignments etc.
10. What would you like to do when you grow up?
11. If you had the opportunity to tell your past or future science teachers anything, what would you tell them?

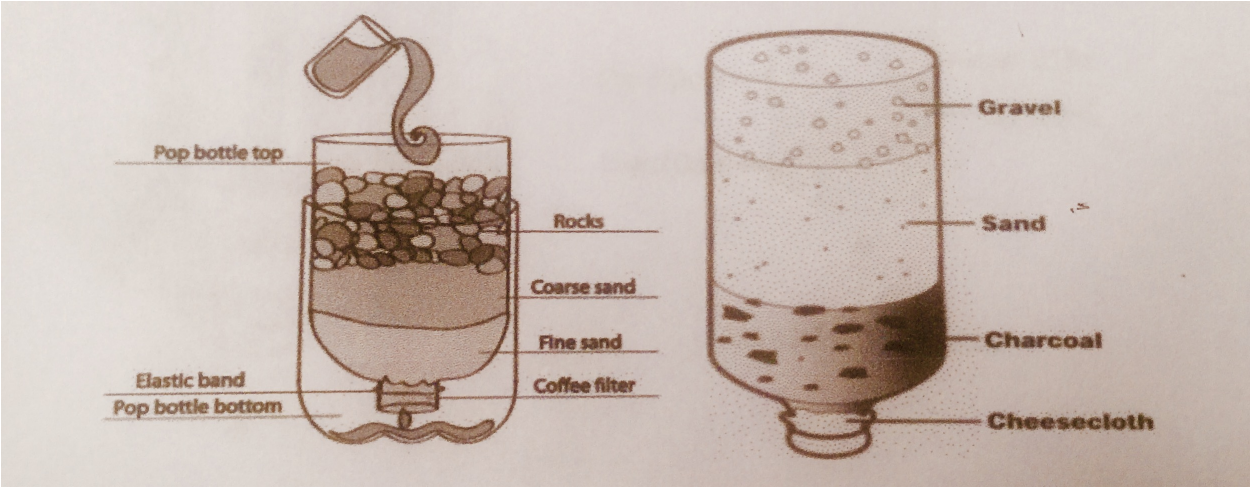
APPENDIX D: STUDENT SCIENCE RATING

1	2	3	4	5
				
I REALLY dislike science.	I dislike science	Neutral – sometimes I like science, sometimes I dislike science	I like science	I REALLY like science

APPENDIX E: SAMPLE CODING CROSS-CHECK

Transcript Excerpt	Code	Cross-Check Code by Graduate Student
"Mr. Brown gets me, he like understands me so I like when he teaches because I can understand him, and he makes it so we can get it"	Connection with students Makes learning understandable	Student Connection Relevant Learning
Mr. Miles describes project-based learning as "engaging in learning that makes sense, learning with a purpose. Project-based learning is allowing students to have a deeper understanding and mastery of a subject. It allows them to have hands-on experience and creates an environment for discovery."	Approach to teaching Teacher knowledge	Teacher pedagogical approach Teacher construction of knowledge
"I can't remember a time where I wasn't interested in science. It's like its genetically engrained. I have uncles and aunts and my father is a doctor. My parents pushed science."	Science influence Self-belief Science perception Family influence Family Engagement Relationship	Self belief/ self-perception regarding ability or interest Family influence/ Family relationship Family level of engagement with science learning
"I like the Carver Program because I get to work on projects with my sister. I get to sit with my sister, I learn better with her. I work better with my sister, because she's strict and mean and helps me to stay on task. She helps me when I need it."	Relationship Community Family influence Accountability Relationship	Community Building/ Family influence, family engagement with learning

APPENDIX F: WATER FILTRATION DIAGRAM



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