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The purpose of this study was to examine the potential of a High School Health Science Career Academy to support African American students' science career trajectories. I used three key theoretical tools—critical science agency (Basu, 2007; Calabrese Barton & Tan, 2008), power (Nespor, 1994), and cultural production (Carlone, 2004; Eisenhart & Finkel, 1998) to highlight the intersections between the career trajectory implied by the Academy (its curriculum, classroom activities, and clinical experiences) and the students' pursued career trajectories. Data was collected over five months and included individual student interviews, group interviews, parent and administrator interviews, field notes from a culminating medical course and clinical internship, and Academy recruitment documents.

The results of this study suggest that participants pursued a health science career for altruistic purposes and the Academy was a resource they drew upon to do so. However, the meanings of science and science person implied by the Academy hindered the possibility for many participants' to advance their science career trajectories. While the Academy promised to expose students to a variety of high-status health care roles, they were funneled into feminine, entry-level positions. This study adds to previous underrepresentation literature by contextualizing how identity-related factors influence African American students' career attainment.

ACHIEVING EQUITY THROUGH CRITICAL SCIENCE AGENCY: AN ETHNOGRAPHIC STUDY OF AFRICAN AMERICAN STUDENTS IN A HEALTH SCIENCE CAREER ACADEMY

by

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CHAPTER I

INTRODUCTION: THE RESEARCH PROBLEM

African Americans' Underrepresentation in Science Careers

Historically, science and science-related careers are reserved for the elite in society (AAAS, 1998; Aikenhead, 2006). Educational practices such as tracking, ability grouping, and standardized testing (Atwater, 2000; Kahle, Meece, & Scantlebury, 2000; Seiler, 2001) limit African American students' access to a quality science education. Consequently, these practices prevent many African American students from reaching their potential in school science and attaining science or science-related careers. Despite calls for equity, only small percentages of African American students realize academic success in science or become scientists.

The discussion surrounding science education reform highlights the need to provide equitable opportunities for all students to learn science (AAAS, 1989, 1998; DeBoer, 2000; NRC, 1996). The *American Association for the Advancement of Science* (1998) maintained:

> although Americans are committed to the principles of fairness, equality of opportunity, and justice that are at the heart of democracy, that commitment exists alongside clear evidence that some groups of Americans are more likely to participate and be successful in science than others. (AAAS, 1998, p.1)

Science education reform documents such as the *National Science Education Standards* (NRC, 1996) and *Project 2061*: *Blueprints for Reform in Science, Mathematics, and Technology* (AAAS, 1998) both name *equity* as a goal for science education reform.

These documents suggested that through reform-based curricula and teaching practices all students will achieve a certain level of scientific literacy and achieve equitable outcomes in science. However, this reform movement has not yet translated into closing the achievement and underrepresentation gaps for African American students.

Achievement data demonstrate the depth of the achievement gap. The U.S Department of Education reported the science achievement gap surfaces in elementary school and persists throughout middle and high school (National Assessment of Educational Progress [NAEP], 2008). In 2005, only 4% of African American fourth graders, 4% of African American eighth graders, and 2% of African American twelfth graders scored at or above a level of proficiency in science (NEAP, 2008). What is more, the achievement gap widened for grade twelve students from 2000 to 2005 (NAEP, 2008) despite national calls for equity. Thus, African Americans' underachievement in school science is a pervasive problem throughout all grade levels.

The representation of African Americans in science and science-related careers is just as dismal. In 2006, African American students represented only 8.3% of the students obtaining Bachelor degrees, 6.6% of the students earning Master degrees, and 2.5% of the students obtaining Doctoral degrees in one of the science and engineering fields (National Science Foundation, 2010). Additionally, African Americans only comprised 4.5% of the nation's physicians (ETS, 2004). Clearly, African Americans' underachievement in science is mirrored in their subsequent underrepresentation in science and science-related careers. After two decades of science reform initiatives, the landscape of African Americans' achievement and career attainment remained virtually

unchanged. African American students have not realized equitable experiences or outcomes in science.

The literature surrounding the underrepresentation issue identified several factors related to African Americans' science and science-related career attainment—negative attitudes about science and low student self-efficacy (Maple & Stage, 1991; Post, Stewart, & Smith, 1991), inadequate career guidance and preparation in science (Powell, 1990, Oakes, 1990), and low teacher expectations for African Americans' science achievement (Gilbert & Yerrick, 2001; Griffin, 1990;). This line of research translated into interventions aimed at increasing African Americans' access to higher-level science coursework, better instruction, and improving students' interest (Hrabowski, 2003; Lewis, 2003; Russel & Atwater, 2005). This approach to equity looked for deficiencies in both the system and the students and sought to eradicate those barriers that hindered career attainment.

However, Tate (2001) argued that these equity efforts mostly focused on "macro-level considerations" (p. 1018) and only resulted in the opportunity for African American students to share the same space with white students. That is to say, achieving equity meant providing African American students' access to higher-level science courses previously only available to their white counterparts. He called for reframing equity in science education to consider science education as a civil right so that actions are devoted to increasing the scientific competencies of African American students (paraphrasing Tate, 2001, p. 1018). Reform efforts should not just concern providing physical space to

students but rather a genuine commitment to increasing their opportunities to learn science. Tate (2001) stated, “I believe this shift in discourse is an open invitation to the science education community to engage in social justice issues and to treat the opportunity to learn science as a civil rights construct” (p. 1016). For Tate, allowing African American students to take higher-level science courses was not enough. He advocated for an in-depth look at more nuanced factors that prevent students from engaging with and excelling in science.

Science Equity through a Social Justice Lens

Using a social justice lens to view the underrepresentation problem shifts the equity issue from just eradicating deficits in the system and students to also include a consideration of how science (knowledge and skills) *itself* can facilitate African Americans’ struggle for equal representation in school science, science or science-related careers, and society. Lee Anne Bell (1997) proposed that the goal of achieving a socially just education is to achieve equal participation by all groups in society. Social justice suggests action and envisions a society where individuals are able to act upon or give meaning to their world in ways that impact the conditions of their lives and/or others (Bell, 1997; Calabrese Barton, 2005).

Science knowledge holds a powerful place in our society and one way to think about science and social justice is to view the use of science knowledge and skills as a way to give significance to our lives (Calabrese Barton, Ermer, Burkett, & Osborn, 2003; Sleeter, 1996). Sleeter (1996) suggested “it is crucial that oppressed peoples gain as much

access to scientific knowledge as possible and learn to employ that knowledge to address their own needs and problems" (p. 184). Sleeter's statement is significant when considering a socially just science education because oppression can limit who we become and our power to act within society (Bell, 1997). For example, science knowledge allows individuals to make informed medical decisions, voice their concerns and opinions about key environmental issues, and enter into high-paying professions. Science education, grounded in a social justice perspective, maintains that African American students must be provided with the knowledge, skills, and experiences to use science as a tool for personal, social, political, and economic empowerment.

Science education can support the goals of social justice in many ways. For example, Basu and Calabrese Barton (2007) sought to understand the connection between the resources urban youth brought to science and the development of their sustained science interest. They conducted in-depth case studies of middle school students in an after-school program and found three common themes that suggested "youth developed a sustained interest with science when: (1) their science experiences connected with how they envision their own futures; (2) learning environments supported the kinds of social relationships students valued; and (3) science activities supported students' sense of agency for enacting their views on the purpose of science" (Basu & Calabrese Barton, 2007).

For example, Neil, a student in the study, found a strong connection between science and the career he desired as an artist. He used science content and projects to get ideas for

designing realistic cartoons. Neil exhibited sustained engagement when he was able to connect science to his long term aspirations of becoming a cartoonist. Likewise, Anna created a healthy candy bar because it aligned with her desire to improve the health of others. Anna used science to support her social goal of building strong relationships with others. Overall, all students in this study demonstrated a sustained interest in science when they could use science to advance their own goals and act on issues they valued.

Next, science knowledge can be used to identify and act upon injustices in society (Gutstein, 2007; Sleeter, 1996). For example, Sleeter (1996) discussed how communities of color and poor communities are disproportionately targeted as sites for toxic waste. "Those with the greatest vested interest in addressing toxic waste sites—people of color and people from poor communities—are, however, least likely to receive an education that will prepare them to do so" (Sleeter, 1996, p. 185). Hence, African Americans, with access to science knowledge and skills, can express their political voice in science or science-related societal issues.

Finally, science education for social justice can provide opportunities for both social mobility and economic stability. The *Science and Engineering Indicators* (National Science Board, 2008) predicted a trend toward the development of a more knowledge-intensive economy where science knowledge will play a central role in the future. Over the last decade jobs in science and science-related careers increased sharply (National Science Board, 2008). However, the United States relies largely on foreign-born and foreign-educated individuals to keep up with the demand for science and technology

skills. In fact between 1980 and 2000, the reliance on these individuals quadrupled (National Science Board, 2008). The United States looks outside of the country to fill the demand in science, instead of paying attention to the pool of untapped talent here at home. Moreover, the nation is experiencing a shift toward jobs that require science and technical knowledge. From a civil rights perspective, African Americans must have the knowledge and skills needed to compete for these jobs (Tate, 2001; Russel & Atwater, 2005). In this way, access to science is related to combating social and economic oppression.

My study is concerned with understanding how science education can support a more socially just science education for African American students by providing the experiences and resources that allow them to use science as a tool for social and economic mobility. However, we know little about the kinds of contexts, curriculum, and experiences that might support students in this way. In the next section, I suggest that recently developed high school career academies are one such context to support science for social justice. I discuss the nature and potential of career academies below.

Career Academies as an Avenue toward Science for Social Justice

Plagued by high dropout rates, low attendance, poor achievement, and unfavorable school climates (Balfanz & Legters, 2004) many large high schools recently implemented comprehensive reform initiatives to address these issues (Castellano, Stringfield, & Stone, 2003; MacIver, 2007; McPartland, Balfanz, Jordan, & Legters, 1998). One reform model relevant to this study establishes small learning communities by breaking large

high schools into smaller career-focused academies. Often, career academies are designed around science-related themes such as medicine, health sciences, biotechnology, and engineering (Gott, 2007; Gran & Krudwig, 2007; Maxwell & Rubin, 2000). Career academies combine a rigorous academic curriculum with work-based experiences that lead to postsecondary education (Castellano, Stringfield, & Stone, 2003).

Research on career academies suggests their potential to support aspects of a socially just science education for African American students, specifically related to social and economic mobility. First, students found the career focus made schooling more interesting and relevant to their lives and goals (MacIver, 2007; McPartland, Balfanz, Jordan, & Legters, 1998). Career academies increased access to postsecondary opportunities for African American students and also increased their wages and job stability (Kemple & Scott-Clayton, 2004; Kemple & Snipes, 2000). For African American students to advance toward college level-science or enter into science-related careers, they must participate in rigorous curricula and have experiences exposing them to future career options (Russell & Atwater, 2005). Career academies have the potential to provide these resources and experiences. However, we know little about how career academies specifically support African Americans' science and science-related career trajectories. In what ways can a career academy context support goals of social justice and impact the underrepresentation gap? Overall, the career academy context has the potential to define a science-related career trajectory and advance African American students toward career attainment.

With only a handful of recognized scholars (Atwater, 2000; Brown, 2004; Calabrese Barton, 2007; Lewis, 2003; Lewis & Connell, 2005; Parsons, 2008; Rascoe & Atwater, 2005; Russell & Atwater, 2005; Tobin, Elmesky, & Seiler, 2005) who study issues of access and equity surrounding marginalized African American students, there remains a scant body of literature in this area, and these issues deserve continued attention. Further, much of the literature focusing on the underrepresentation issue are overly concerned with getting students interested in science or facilitating their participation in science learning communities (Brown, 2004; Tobin, Elmesky, & Seiler, 2005; Maple & Stage, 1991). This leaves unexamined the students who are already interested, capable, and motivated to pursue a science or science-related career. Thus, this study fills these gaps by understanding the potential of a career academy to attract and support African American students' science-related career trajectories. Specifically, I examined a high School Health Science Career Academy.

Research Questions

Below I list the primary research question and supporting sub-questions that guided this study.

Primary Research Question:

1. What is the potential of a High School Health Science Career Academy to support African American students' critical science agency and science-related career trajectories?

Sub-questions:

a. What were Academy students' personal science histories?

b. How did Academy students describe their science related futures?

c. How did the High School Health Science Career Academy define its potential in regard to Academy students' futures?

d. What were the meanings of science and science person produced in everyday practices in the Academy's culminating medical course and clinical internship?

- What meanings of science and science person supported Academy students' critical science agency?
- What meanings of science and science person truncated Academy students' critical science agency?

e. How did Academy students make sense of their experiences in the High School Health Science Career Academy?

Summary of Chapter I

In this chapter, I described the state of affairs regarding African Americans' underrepresentation in science and science-related careers. I reviewed several factors identified in the literature that contributed to this issue. Next, I presented a science education grounded in commitments to social justice as an avenue to equity. Finally, I introduced career academies as one possible context with the potential to promote a more

socially just science education by providing students with necessary experiences and resources to realize social and economic mobility.

In the next chapter, I develop a conceptual framework that informs my research questions. The inequitable issues in school science faced by African American students is discussed in further detail as well as a discussion highlighting practical interventions used to mitigate equity issues. The notion of how science education and career academies can be transformative for the lives of African American students is also discussed in detail.

Key Terminology

Below, I define some of the terms I used in Chapter II. I also explained each term within the text of the chapter.

Critical Science Agency - "…implies that students: (a) gain a deep understanding of science and the processes, skills and modes of inquiry associated with the content of science; (b) identify themselves as experts in one or more realms associated with the content of science; (c) and use science as a foundation for change, such that their identity develops, their position in the world advances, and/or they alter the world towards what they envision as more just" (Calabrese Barton & Tan, 2008, p. 6).

Cultural Congruence - addresses the mismatch between the values, beliefs, and practices promoted in school and those valued in students' homes and communities (Parsons, 2008)

Legacy of Traditional School Science – science curriculum and classroom practices that advocate canonical science content meant to prepare students for the next level of science and eventually to enter into formal disciplines of science (Aikenhead, 2006)

Relevance – The significance students ascribe to their science experiences.

CHAPTER II

REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

The purpose of this study was to examine the potential of a Health Science Career Academy in supporting African American students' science-related career trajectories as a way to address their underrepresentation in science and science-related careers. In this chapter, I provide a review of science education literature relevant to the underrepresentation problem and then discuss the theoretical constructs that guide this study.

To contextualize the underrepresentation problem, I draw upon three main bodies of literature: (1) school science reform literature—to situate the underrepresentation problem in a historical context; (2) sociocultural/science equity literature—to provide a cultural perspective on the underrepresentation problem and to identify gaps; and (3) career academy literature—to make a case for why a career academies context has potential to address the underrepresentation problem.

Finally, I present three theoretical tools—critical science agency, cultural production, and power—that I used to investigate the potential of a Health Science Career Academy for attracting and retaining African American students.

Historical Perspectives on School Science

As Aikenhead (2006) contended, a myriad of social, political, and economic influences gave rise to "powerful ideologies that guide and sustain school science today"

(p. 14). Historically, societal and political fears over national security, economic competition, and a preoccupation with corporate profits by way of technological advancements motivated and shaped three major school science reform initiatives (Aikenhead, 2006; DeBoer, 2000). In this section, I trace the historical establishment of today's traditional school science. This historical perspective is important to understand the ideology underlying school science and how this ideology contributed to the underrepresentation of marginalized African American students in science.

Science as a School Subject

Science was first introduced in the late 1750's as a new school subject for secondary students and for younger students in the latter part of the Eighteenth century (Atkin & Black, 2007; DeBoer, 2000). At this time, school science encouraged students to develop an understanding about the natural world. It focused on aesthetic attributes of science and gave limited attention to formal laboratory science.

In 1893 with new scientific breakthroughs and understandings, *The Committee of Ten* standardized the high school curriculum in an effort to implement college admission requirements. This document placed science in a much more prominent status within the school curriculum. Science education was considered "intellectual training" (DeBoer, 2000, p. 583) as opposed to the previous emphasis on appreciating and understanding the natural world. Aikenhead (2006) pointed out that as a result of these changes in the curriculum— mainly serving the interests of the scientific community—many viewed school science as an elitist pursuit. About this same time, however, another movement

influenced school science with the goal of situating school science in broader social purposes (Aikenhead, 2006).

Early in the 1900's school science introduced *Nature Study* that reflected this social movement (Atkin & Black, 2007). This curriculum highlighted rural life and aimed to foster a love for nature. At this time, the United States experienced rapid growth in many cities and ushered in many social ills such as corruption, crime, and disease. The thinking at the time was that *Nature Study* would combat these social ills by discouraging people from leaving rural areas and moving into the cities (Atkin & Black, 2007).

During the 1930's and early 1940's, the publication of the *Yearbooks* shifted the focus from the natural world to the application of science (DeBoer, 2000). The school science curriculum focused more on the production of scientific knowledge, science content, and problem-solving (Atkin & Black, 2007). The influence of the *Yearbooks* dominated school science until after World War II and set the stage for the first wave of systematic reform in science education.

Wave I: The Launching of Sputnik

Shortly after WWII, the U.S. population held a "growing perception that scientific and technological developments were an important resource for national security" (DeBoer, 2000, p. 585). Rapidly growing technological advances made apparent the role science would play in the United States' future economic and political landscape. Thus, school science's charge was to produce technically trained scientists (Rudolph, 2002) who could contribute to the nation's status.

However, some still called for a science education that engendered a science-for-everyday-life focus emphasizing the appreciation of the natural world and civic responsibility (Aikenhead, 2006). But, perceived threats to the political and economic stability of the nation squashed these more "liberal education themes" (DeBoer, 2000, p. 585). The launching of the Russian satellite—Sputnik—in 1957, sparked a national panic about the status of the United States compared to other nations—in terms of technological advances, economic competition, and national security.

These political occurrences initiated new school reform focused on the production of more scientists. School science was the engine that channeled the most promising students into science and engineering degree trajectories and careers. This ideology is referred to as "pipeline" science (Aikenhead, 2006). As a result, school science categorized only the "best and brightest" as science students and potential scientists and left others at the margins of school science.

Wave II: Fixing Education

In 1983, the National Commission on Excellence in Education published *A Nation at Risk: The Imperative for Educational Reform* that described the "devastating" state of education in the United States. This publication sparked the second wave of school science reform. The report used low math and science scores to argue that the United States' academic standards were lacking and as a result our students lagged behind other countries students. Politicians linked these poor test scores to the economic instability

plaguing the nation and called for more stringent standards to be enforced through assessment and accountability measures (DeBoer, 2000).

Shortly after, the American Association for the Advancement of Science (AAAS) responded to the call and published *Science for All Americans*. This publication outlined a "set of recommendations on what understandings and ways of thinking are essential for all citizens in a world shaped by science and technology" (AAAS, 1989, p. xiii). This document recommended all citizens attain a level of scientific literacy such that they: (1) develop scientific habits of mind, (2) understand key concepts of science, and (3) develop an appreciation for the natural world. *Science for All Americans* served as the foundation for the third wave of science education reform.

Wave III: Achieving Equity

The third wave of reform focused on *equity* in science for *all* students. At this time, the public support for science waned (DeBoer, 2000). In an attempt to increase public support for science education and to address the ineffectiveness of the previous reforms, the National Science Foundation established a statewide reform program beginning in 1990 (Kahle, 2007). This reform targeted the improvement of classroom practice and science achievement. This initiative marked the third and current wave of reform and prompted the publication of the *National Science Education Standards* (NSES) in 1996. This publication established a set of national goals for the teaching and learning of school science. The NSES stated the promotion of scientific literacy as a major goal and defined scientific literacy as the "knowledge and understanding of scientific concepts and

processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (NRC, 1996, p. 22). Increasing scientific literacy was, in part, a solution to underachievement in science and underrepresentation in science or science-related careers.

National discussions regarding science education reform shifted from the preparation of the next generation of scientists to achieving scientific literacy for all citizens. As a result, researchers, educators, and politicians alike are concerned with creating a more equitable school science and increasing marginalized students' representation in science and science-related careers. While the latest science reform privileges equity, some science education scholars have critiqued the *National Science Education Standards*.

For example, Eisenhart, Finkel, and Marion (1996) pointed out that despite the "science for all" rhetoric the goal "to produce more people with better knowledge of key concepts… prepared to act like "real" scientists" (p. 268, emphasis in original) "remains virtually unchanged" (p. 268). Further, Rodriguez (2001) argued that the "Science for All" initiative implied that marginalized students, including African Americans, were "lacking" and must catch up with their more successful white, suburban counterparts. Thus, this deficit perceptive places the lack of achievement on the individual students and leaves unexamined institutional factors that contribute to achievement and underrepresentation gaps. Both of the critiques leveled here directs our attention to the institution of science—historically reserved for the privileged—to better understand African American students' lack of achievement and underrepresentation in science.

Turning attention away from the individual student, allows us to examine and critique how historical influences on science education contributed to inequities experienced by some African American students. Influenced by pressures like economic competitiveness and national security, science education created and perpetuated a legacy that serves the privileged in society and prevented access to a socially just science education for many African American students. Despite decades of science education reform this legacy of school science looms heavily on science classrooms and African American students.

The Legacy of Traditional School Science

Until recently, reform focused on enculturating the best and brightest (DeBoer, 1991) into formal science trajectories. Carlone (2004) explained that "science carries a powerful sociohistorical legacy and is reproduced as an objective, privileged way of knowing pursued by an intellectual elite" (p. 394). This larger historical meaning of science is reproduced within everyday activities (labs and lectures), through texts, and tools that evoke certain notions of *what science is* and *who does science*. The legacy of elitist science contributed to the underrepresentation and low achievement of marginalized students in two ways: (1) by promoting stereotypical images of science and scientists (Rahm, 2007; Rahm & Charbonneau, 1997; Osborne & Collins, 2001; Scantlebury, Tal, & Rahm, 2007) and (2) by perpetuating a subculture of science that is perceived as a foreign culture by many marginalized students (Aikenhead, 1996, 2006; Calabrese Barton, 2002; Costa, 1995). I discuss this literature in detail here.

Images of Science and Scientist

Students hold stereotypical images of science and scientists and make visible the power of science's sociohistorical legacy. These images often depict "geeky" white males wearing lab coats and working in laboratories (Rahm, 2008; Rahm & Charbonneau, 1997; Scantlebury, Tal, & Rahm, 2007). Aikenhead (2006) argued that the school science curriculum reproduces these "dishonest and mythical" (p. 27) images. Students' participation in school science requires they *identify with* and *value* an image of science that is "socially sterile, authoritarian, non-humanistic, positivistic, and represents absolute truth" (Aikenhead, 1996, p. 11). Not only are these images inaccurate; but, many students do not identify with these images and, as a consequence, opt-out of school science (Basu & Calabrese Barton, 2007; Calabrese Barton & Yang, 2000; Osborn & Collins, 2001).

Rahm's (2005, 2007) work with urban youth revealed the stereotypical images of science and scientist that youth construct. In her study, these images influenced youths' decisions to take up certain positions within science learning communities and, at times, prevented students from engaging with science. For instance, Rahm (2007) shared how students' perceptions of science and scientist determined the positions they took up during a summer science program. Cianna, an African American student, shared her aspirations to become a doctor but she separated her desire to pursue a science-related career from her participation in school science. Her image of school science positioned her at the margins of science. Her ethnicity did not align with her perceptions of who "can" or "should" do school science and prevented her from taking up an "insider" status

as a science student or future doctor. Conversely, a white boy in this study positioned himself as someone who liked science and wanted to pursue a career in medicine; he easily participated within the science learning community. He easily identified with image of school science—the same images that excluded Cianna. Through this work, we see how images of science prevent some African American youth from participating in and pursuing science.

Additionally, Brand, Glasson and Green (2006) investigated sociocultural factors that influence African Americans students' experiences in school science Students held many stereotypes about African American students in science and included: "Black males are more prone to being dropouts, Blacks are intellectually inferior, only smart people take honors courses" (Brand et. al., 2006, p. 231). The authors provided four assertions that describe how these negative stereotypes affected these students:

- Students struggled to prove or distinguish themselves from negative stereotypes.
- Students struggled to prevent stereotypical images from affecting their self-esteem.
- Science and mathematics are perceived as subjects that only smart people can succeed in.
- Negative stereotypes discourage minority students from choosing science and mathematics careers. (Brand et al. , 2006, p. 231)

Evident in this study are how the stereotypical images and ideas about science influenced their ability to pursue science.

Both studies, I discussed above are examples from a larger body of literature that focused on the experiences of African American students in science. They demonstrate

how the legacy of science carries with it certain images that contributed to the exclusion of African American students from science. The next section discusses other related ways science and the science classroom hinder African American' participation.

Cultural Conflict in the Subculture of Science

Aikenhead and Jegede (1999) described the school science classroom as a "subculture" representing white, middle/ upper-class values and perspectives. The discipline of science has particular norms, values, beliefs, expectations, and ways of talking and behaving shared across the science community and are reflected within the school science classroom. For example, science is portrayed as logical, rational, devoid of emotion, and separated from spirituality (Aikenhead & Ogawa, 2007). For some students, learning science requires them to cross cultural borders—or move from the subculture of peers and family to the subculture of school science (Aikenhead, 1996; Aikenhead & Jegede, 1999). This movement causes cultural conflict for some students. For example, the science classroom forces students to talk or reason in ways that are not congruent with their home cultures.

Aikenhead & Ogawa (2007) offer a nice example to contextualize the nature of these cultural differences. They contrasted the characteristics of science knowledge from the perspective of the First Nations peoples in Canada with that of a Western perspective of science knowledge—often promoted in school science. First Nations peoples communicated scientific knowledge through modeling, storytelling, singing, dancing, and participating in spiritual ceremonies that reflected their cultural experiences and

subjectivities. In contrast, Western science depends on more formal written communication (often under the critique of peers), seeks truth through experimentation and verification, and assumes an objective reality; subjectivity is not desired in Western science. This work details how many facets of Western science are discontinuous with others' ways of knowing and understanding science. These differences cause conflict for some students in the science classroom and interfere with their identification with and participation in school science. The study discussed next explains the nature of African American students' conflict in the science classroom.

Brown's (2004) study examined African American students' assimilation into the science classroom. Using an identity lens, he looked at the process by which students "appropriate the culture of the science classroom (p. 824)" through the lens of discursive identity. Discursive identity "reflects an understanding that speakers select genres of discourse with the knowledge (tacit or implicit) that others will use to interpret their discourse as a signal of their cultural membership" (Brown, Reveles, & Kelly, 2005, p. 783). That is my "talk" signals (or not) my membership within a particular cultural group.

Brown (2004) explained how the technical science terminology required in the science classroom thwarted some students' participation. Drawing from Ogbu (1992), Brown (2004) identified four different domains of discursive identities: (1) oppositional status, (2) maintenance status, (3) incorporation status, and (4) proficiency status. For instance, Brown characterized one group of students as exhibiting "Opposition Status" because they avoided using the "science talk" promoted practice in the classroom and

acted as if they did not know the answer or did not take advantage of opportunities to talk in class. Brown suggested that students took up an oppositional identity as a means to maintain their ethnic identities.

This micro-level analysis exemplified how taken for granted ways of participating (i.e. using science talk) poses challenges for African American youth as they attempt to identify with or access the domain of science. This study provided an in-depth cultural example of how many African American students experience conflict in the science classroom. The promoted science discourse was a primary source of conflict for students.

Norman, Ault, Bentz, & Meskimen (2001) argued that to more completely understand achievement gaps for African American students it is important to consider how cultural orientations influence the achievement gap. Their work offers a more macro-level look into the "underlying reasons for the conflict and alienation" (Norman et al., 2001, p. 1102) experienced by many African American students.

> Such understanding renders the problem tractable in school settings, providing an escape from the temptation to dismiss elimination of the gap as impossible until social and economic barriers have completely disappeared ("blaming society"). Even more important, such understanding undermines pedagogies that respond to the achievement gap with attempts to remediate supposed behavioral and cognitive deficits among marginalized victims ("blaming the victim"). (Norman et al., 2001, p. 1102)

Norman et al. (2001) argued that historical positions and experiences in society contribute to the marginalization of African American students in school science. Utilizing a historical analysis, the researchers compared the achievement between African Americans and other ethnic groups over the last 100 hundred years. They found

that at the turn of the 20th century Black Americans outperformed certain ethnic immigrants (e.g. Polish, German, and Italian immigrants). They traced the gap over time to show that African Americans' gains diminished and disappeared as the social status of these immigrant groups improved. As the economic status of Black Americans declined so did their achievement as a group. These findings indicate the relationship between social/economic gaps and school science achievement gaps. The examples I discussed above centered on African Americans' marginalization in school science. However, they face many of the same difficulties in schooling in general and I discuss these next.

African Americans and Schooling

Drawing from critical race theory, Lynn (2006) asserted that "the history of education for African Americans is not a story of liberation and prosperity but one of struggle and disappointment" (p. 116). The purpose of schooling for African Americans was not about liberation, but instead the purpose was to establish and perpetuate oppression and to support unequal systems of privilege that benefited whites within society. Lynn (2006) borrowed Carter G. Woodson's (1933) words to communicate the reality of how the educational system historically served African Americans.

> Taught the same economics, history, philosophy, literature, and religions which have established the present code of morals, the Negro's mind has been brought under the control of his oppressor. The problem of holding the Negro down therefore is easily solved. When you control a man's thinking, you do not have to worry about his actions…he will find his "proper place" and stay in it. (p.118)

Lynn (2006) explained how schools sanctioned white culture and values that effectively established oppressive political, social, and economic conditions for African American and sustained dominance of whites in society. In effect, schooling for African Americans served as an extension "of the slave master" (Lynn, 2006, p.118) through transmission of Eurocentric values and beliefs. The work described next places African American students' schooling experiences within the context described here by Lynn and helps to further explain the underachievement and underrepresentation issue.

Ogbu's (1994, 1999) anthropological work focused on the education of African American students and sought to explain, from a historical and cultural perspective, "persistent black-white inequality in general and in education" (Ogbu, 1994, p. 291). Ogbu argued that larger systemic forces such as social stratification put up barriers to equality for African Americans in the United State. Ogbu explained that social stratification is "an arrangement of social groups or social categories in a hierarchical order of subordination and domination in which some groups so organized have unequal access to fundamental resources of society" (Ogbu, 1994, p. 266). In our stratified society, white Americans have virtually unlimited access to societal resources (such as jobs, housing, or quality education) whereas many African Americans are essentially denied access to the same societal resources This differential access is based upon an individual's socioeconomic status.

Different types of social stratification exist in society (e.g. social class, gender, and racial). Ogbu (1994) explained racial stratification and defined it as "the hierarchical organization of socially defined "races" or groups […] on the basis of assumed inborn

differences in status honor or moral worth, symbolized in the United States by skin color" (p. 269). He contrasted this with class stratification where individuals are able to move from one class category to another based on accumulated wealth.

Ogbu argued that factors associated with racial stratification contribute to how whites treat blacks and how blacks perceive and respond to their social positioning and to their education. He provided examples regarding the treatments of black Americans by whites in the United States that included both formal and informal statutes and practices such as: limiting black Americans' access to jobs, prohibition of intermarriage, residential and social segregation, and forcing children born of black and white parents to affiliate with black social groups.

Ogbu's (1999) work draws our attention to how black Americans' response to racial stratification has implications for how they experience school. In response to their positioning, some black Americans develop an *oppositional frame of reference* (Ogbu, 1999). He explained that because involuntary minorities or cultural groups came to the United States unwillingly they have a historical suspicion and distrust of schooling. Thus, school privileges particular language practices that are reflections of white dominant society.

These language practices include the use of particular vocabulary and grammar as well as knowledge of cultural rules associated with speaking (e.g. when to speak, using verbal cues). Black Americans perceive these language practices and their participation in them as a form of oppression. Parents and children reported these language conflicts negatively impact student learning. Moreover, parents suspected language requirements

were set up in ways that caused Black children to have problems in school (Ogbu, 1999). Ogbu argued that because Black Americans were deprived of their original languages many involuntary minorities developed opposition or resistance to the sanctioned white culture, values, and practices.

Ogbu's (1994, 1999) work emphasized how institutional forces (i.e. social and racial stratification) shape the more micro school experiences of minority students. The historical perspectives leveled above helped to explain the disparities African American students experience more generally in the education system. Similarly, Parsons (2008) argued that African Americans are continually denied access to society's resources (e.g. science knowledge or access to science careers) because of their oppressive positioning—a group with the largest percentage of individuals living in poverty. As such, resource-deprived science environments and unqualified science teachers available to many African American students are reflections of their oppression and contribute to their underachievement and underrepresentation. Next, I discuss Parsons' (2008) work, like Ogbu's, draws our attention to how racial factors influence science education for African American students. Thus, African Americans' struggle against societal oppression coupled with the elitist legacy of science make their inequities in science ever-more pronounced. In the next section, I provide practical interventions aimed to increase African Americans' access to an equitable science education.

Challenging the Legacy

Aikenhead's (2006) framework for relevancy provides a way to challenge the elitist legacy of school science. Aikenhead's alternative to today's school science promotes humanistic perspectives on science and celebrate it "as a human endeavor" (p. 1). Humanistic perspectives focus on social responsibility and on connecting school science to students' communities and cultures. It broadens the "pipeline" trajectory into a school science trajectory that "animates students' self-identities, their future contributions to society as citizens, and their interest in making personal or utilitarian meaning of scientific and technological knowledge" (Aikenhead, 2006, p. 2).

In arguing for a humanistic approach to science, Aikenhead (2006) urged us to pay attention to the issue of relevance and offered many different views on relevance. He suggested that to look critically at science curriculum we must ask, "For whom is this science curriculum relevant"? "Is it the student, academic scientists, or someone else"? For Aikenhead, relevance must be defined from the perspective of the student and the student's local community and he offered seven categories based on these criteria. I summarize these categories in Table 1.

Table 1. ***Aikenhead's categories of relevance in science education***
(Aikenhead, 2006, pp. 31-44)

Type of Relevance	Summary of Category
Wish-They-Knew Science	• Relevant for academic scientists • Emphasis on science content for the purpose of college
Need-To-Know Science	• Relevant for the general public • Emphasis on every-day uses of science
Functional Science	• Relevant for people in science-related careers • Content is secondary to problem-solving skills, teamwork, and initiative
Enticed-To-Know Science	• Relevant for motivational value • Often involves sensational images of science in the media and internet • Event centered
Have-Cause-To-Know Science	• Relevant for experts who interact with the public on issues of social or common concern • Focuses on socio-scientific decision making
Personal-Curiosity Science	• Relevant to students themselves • Builds on interests and experiences of individuals
Science-as-Culture	• Individuals in a local context decide relevance based on aspects of the local, national, or global culture • Could include science from each of the above categories depending on students' community and culture

The *Science-as- culture* category encompasses characteristics from several of the other categories of relevance. Aikenhead (2006) suggested that "science-as-culture serves, in part, as a superordinate category to need-to-know, functional, enticed-to-know, have-cause-to-know, and personal-curiosity science" (p. 43). The *science as culture* category suggests that scientific knowledge and thinking have the potential to be relevant and motivating in many different ways and to many different individuals. Overall, Aikenhead's (2006) framework for relevancy highlights the complexity of the relevance construct.

Providing a relevant science education for all students does not solely involve the acknowledgement of the contributions made by women or African Americans to science. You must consider—"For what purposes does an individual engage with and use science in their lives"? For example, *functional* science highlights science content and skills that are applied and used in career contexts such as medicine and biotechnology. *Need-to-know* science involves understanding issues with food safety such as contamination or genetically manipulated foods. Thus, the "science as culture" perspective pushes us to consider the *multiple* ways scientific knowledge and ways of thinking are relevant for students. The science-as-culture approach to science education challenges the status quo of traditional school science that historically shuttled students into formal scientific disciplines because this approach has the potential to broaden the pipeline trajectory.

This more nuanced perspective on relevance is helpful for the examination of African American students' experiences in a Health Sciences Career Academy (an innovative science learning site). In paying attention to students' meanings of the

Academy (i.e. In what ways do they view their Academy science experiences as relevant or not?), I can move beyond surface-level explanations to understand the enabling and constraining features of the context. This is a fairly major gap in the current literature about African American youth and science. Currently we know little about how African American students attribute relevance to particular contexts (i.e. career academies). Rahm's (2007) study about how youth construct images of themselves in relation to the world of science and scientists is one of the few studies that used youth's perspectives to push back on what we (science educators) consider to be relevant in school science. The youth in this study articulated their position toward science and scientists. They revealed "how their identity as poor African American youth who were staked out for labor" (Rahm, 2007, p. 530) and limited their career choices in science. Viewing science "as culture" also means that creating empowering science learning settings might involve building cultural bridges between students' cultural worlds and the culture of science (e.g., the practices, ways of acting, and talking). The next section talks about practical interventions that have been used to create cultural bridges.

Bridging the Divide with Practical Interventions

Many examples exist in the science education literature of practical interventions intended to mitigate conflict and promote cultural congruence between students and science. Cultural congruence addresses the mismatch between the values, beliefs, and practices promoted in school and those promoted in students' homes and communities (Parsons, 2008). This approach focuses on ways to bridge the world of science and the

world of students in empowering and relevant ways. A major assumption, undergirding the studies in this section, is that students' resources they bring to the science classroom can be activated and built upon to increase their success.

The Role of Capital

The two studies discussed in this section examine how students' cultural resources are used to promote cultural congruence between African American students and science. First, Elmesky and Tobin's (2005) work underscored the role capital played in African Americans experiences in school science. Further, Gale Seiler's (2001) work provides an example of how African American students' cultural resources were used to make science curriculum more relevant and accessible.

Capital (cultural or social) as a theoretical lens provides one way to understand how institutions such as schools and science classrooms reproduce inequities. The researchers in the following studies conceptualized cultural capital as one's knowledge, dispositions (i.e. behavior and values) and skills (e.g. language) that are developed through social interaction (Bourdieu, 1986; Madigan, 2002). Social capital involves the social resources and networks that allow individuals to access resources and support such as career mentors or school counselors (Schneider, 2002; Stanton-Salazar & Dornbusch, 1995).

Using critical ethnography, Elmesky & Tobin (2005) examined how African American students' cultural resources (e.g. social interaction patterns, body movements, oral expression) from other contexts (i.e. students' home and community) influenced their experiences in school—particularly school science. They found the notion of *respect*

to be one such resource that influenced these urban youth both in and out of school. The authors defined *respect* as a form of symbolic capital or "a means by which one's status or the identity others attribute to you can be built, lost, or exchanged for other forms of capital (e.g. social and/or cultural)" (Elmesky & Tobin, 2005, p. 814). Symbolic capital was used to gain or display a certain status with others. Using students as researchers, Elmesky and Tobin explained how symbolic capital was built and exchanged for other types of capital (e.g. social or cultural). For example, challenging the rules in school (e.g. fighting, or using forms of argumentation) was one way to earn symbolic capital or gain status with particular groups. This symbolic capital then could be used to gain group membership that would provide safety within the neighborhood.

So what does this mean for the science classroom? Participation in many of the practices promoted in a science classroom put students in jeopardy of losing their symbolic capital. In Elmesky and Tobin's (2005) study this occurred when students conformed to rules—such as a dress code—or when teachers' expectations forced them to talk and act a certain way. In contrast, behaviors that could gain students symbolic capital included refusing to participate and arguing or "fighting" in class. Elmesky and Tobin viewed these instances as forms of resistance that allowed them to gain capital but at the same time prevented their engagement in school science. For historically marginalized African American students, maintaining symbolic capital is more important than abiding by school or science classroom norms. So, expectations and norms required for participation in a science classroom (i.e. using particular vocabulary or accepting the teacher as authority) actually jeopardized their symbolic capital.

Similarly in her work with a science lunch group, Seiler (2001) sought to understand how to capitalize on African American students' knowledge, interests, and motivations to promote school science in ways that improved their experiences in school science. Students within this lunch group were allowed to exercise their voice by determining what science content they learned as well as how they learned the content.

Starting from students' interests and experiences, Seiler designed science experiences that investigated relevant topics. She essentially allowed science to emerge from the lives of the students. For example, she capitalized on students' cultural experience of drumming and the hum of barber shop clippers to design lessons about the frequency, vibration, and pitch of sound. Thus, she built on students resources—things that were relevant and familiar to their lives outside of school to teach science content. In essence, she used these resources to bridge school science and students' lives.

Both of these studies highlight the depth of cultural knowledge and skills that exists in the lives of African American students and, when accessed, become a powerful way to bring African American students into the world of school science. The goal was to mitigate cultural conflict and promote cultural congruence by drawing on African American students' resources.

Culturally Congruent Instruction

Parson's (2008) work sought cultural congruence through instruction. Parsons developed an instructional intervention targeted at incorporating aspects of African American students' participation structures into the science classroom. She

conceptualized participation structures as the ways students and teacher interact through speaking, listening, and contributing. Parsons argued that an emphasis on students' home culture can enhance achievement and the classroom must provide opportunities for individuals to use existing competencies or cultural dispositions developed at home. This study utilized a mixed method, non-random control group design to examine the impact of a classroom intervention on student achievement.

Drawing from the work of Boykin (1994), she designed a classroom context that supported physical movement and social interaction. Parsons (2008) explained that, often times, inquiry in science classrooms is too task-oriented and prescribed. Students generate questions and devise procedures to answer the questions; inquiry happens in a linear fashion. This linear, structured participation pattern does not align with African Americans' cultural dispositions (i.e. use of movement). She argued that promoting science inquiry in this way discourages movement because students are confined to lab stations and are even disciplined for rhythmic movements or tapping (Parsons, 2008, p. 670). From a cultural perspective, then, downplaying movement and discussion may discourage African American youth from participation.

Parson's (2008) intervention encouraged "the building of social relationships by permitting side talk, playfulness, and socializing of sorts" (Parsons, 2008, p. 670). Instead of promoting inquiry as task-oriented, inquiry was allowed to happen in a circular, back-and-forth manner. Findings indicated the classroom that facilitated physical movement and social interaction showed an increase in African American students' standardized test scores. In contrast, the classroom that did not stress culturally congruent instruction

actually showed a decline in achievement for African-American students. Parsons' (2008) findings urge us to seek additional contexts and learning experiences that promote cultural congruence and allow African American students to enter the world of science.

Finally, Varelas, Becker, Luster, & Wenzel's (2002) study provided another example of how culturally congruent instruction bridged cultural gaps between African American students and science. They drew on youth genres in the form of plays and hip-hop lyrics to promote cultural congruence. Varelas and colleagues explained that genres are "both the tools by which we make sense and perform in the world, in concert with others, and a product of this activity" (p. 581). Teachers built bridges for African American students by allowing youth genres to be accessed and expressed within the science classroom and the researchers suggested that this facilitated students' scientific understandings. They concluded the invitation for students to express themselves in unconventional ways within the science classroom provided the space to "work out their scientific understandings in connection with major tools of sense making that they have already achieved" (p. 600)—through their youth genres.

The studies discussed in this section are relevant to this study in three ways. First, these studies eschewed the deficit perspective and highlighted the depth of cultural knowledge and skills that existed in the lives of urban students. When accessed, these resources are a powerful way to bring African American students into the world of school science. Next, these studies looked specifically at African American students as a distinct group characterized by a particular history and experiences in society—as my

study does. Finally, these studies provided examples to further our thinking about how to bridge cultural gaps between scientific ways of thinking and other cultural ways of thinking. By capitalizing on students resources and cultural knowledge, science curriculum and instruction can mitigate cultural conflict and promote cultural congruence. My study extended the idea of bridging cultural gaps to explore how science, *itself,* can serve as an empowering tool for African American students. In the next section, I explain the conceptual framework guiding my study.

Conceptual Framework

The studies discussed in the previous section provided insights into the ways African American students experience conflict in school science and strategies to mitigate their conflict. Each study adds to our understanding of how to improve African American students' school science experiences by, for example, building on the knowledge and skills that students bring to school or by allowing students to use movement and social interaction as privileged practices in the science classroom. The cultural congruence construct was born out of concerns of marginalization and oppression and was helpful for examining practical ways to bridge the worlds of students with the world of science. The above scholars and projects placed equity at the center of their inquiries. However, I want to push the equity framework within science education even further.

In the past, science education literature viewed equity from the perspective of providing space and resources with the intention of increasing equity within science. Former conceptions of equity privilege the local classroom but do not explicitly connect

science to the "larger sociopolitical context of society" (Gutstien, 2006, p. 13). For example, cultural congruence as an analytic tool leaves under-examined how macro level forces (i.e., traditional legacies of science, poverty) enable and constrain African Americans' experiences in science at the local (i.e., classroom) level. Practically, it does not examine how science can be promoted as a tool for empowerment.

After Gutstein (2006), I argue that pushing the equity framework requires that we acknowledge science as way to critique and rectify structural inequities that contribute to African Americans' marginalization in science and society. Pushing the equity framework in this way draws our attention to the ways local classroom science practices empower students to address and challenge deep-seated inequities in society (i.e. social, economic, and political forms of oppression) (Carlone, Enfield, Haun-Frank, Johnson, & Kimmel, 2009; Gutstein, 2006). To better understand the underrepresentation problem, I utilized an equity perspective that centered both the local context (career academy) and macro-level structures (sociohistorical legacy of science, economic oppression). A dual focus allowed for a better understanding of how local contexts and experiences are shaped by oppressive institutional structures (e.g. the elitist legacy of science) and also how individuals act (i.e. construct new meanings) to contest those structures. To maintain a dual focus on the micro/macro dialect and also foreground equity, I framed this study with these three key concepts (1) critical science agency, (2) power, and (3) cultural production. Below, each concept is discussed in more depth and a graphical representation of my conceptual framework is provided in Figure 1.

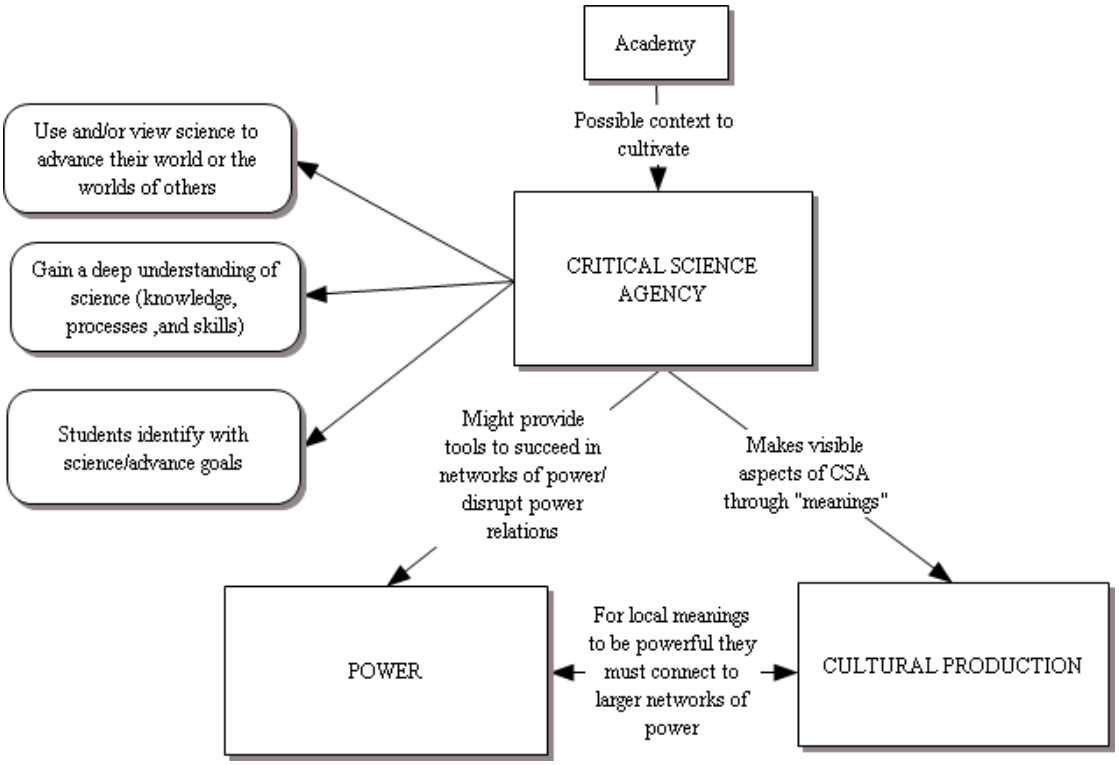

Figure. 1 ***Graphic of conceptual framework***

Critical Science Agency

In their work, Calabrese Barton and Tan (2008) maintained that many students' experiences in science are "fraught with issues of power and positionality" (p. 3). They questioned what it meant to learn science for the urban, low-income students. For them, learning science was more than just learning science content—it was also learning how "to challenge norms and to take a stance through discourse and action within the discipline" (Calabrese Barton & Tan, 2008, p. 4). They suggested that a focus on agency, or the ability to take some action, is helpful for understanding how learning contexts can not only mitigate cultural conflict but how science can be promoted in empowering and relevant ways for marginalized youth.

They utilized the construct of *critical science agency* and implied "that students: (a) gain a deep understanding of science and the processes, skills and modes of inquiry associated with the content of science; (b) identify themselves as experts in one or more realms associated with the content of science; (c) and use science as a foundation for change, such that their identity develops, their position in the world advances, and/or they alter the world towards what they envision as more just" (p. 6). The researchers used this construct to explore how low-income, middle school students participated in a voluntary summer science program.

Through in-depth ethnographic case analysis, Calabrese Barton and Tan (2008) inferred that the summer science program developed and supported critical science agency by allowing students to create or take up identities that may not be available in more traditional science settings. Through an investigation of the urban heat island phenomenon within their community, students created video documentaries and presented them to local scientists, educators and engineers. These case studies showed how the youth positioned themselves as *community science experts* to know science, communicate their science ideas to others, and use this knowledge to take social action.

By allowing students to be producers and critics of science content, processes and skills, the students in Calabrese Barton and Tan's (2008) study appropriated and applied agency in ways that transformed their engagement with science. Calabrese Barton and Tan (2008) claimed that a deep understanding and engagement with science, as evidenced by these youth, were dependent upon facilitating a critical stance towards their

communities and an understanding about how science can play a role within their world. The critical science agency construct highlighted the ways that science can be transformative for urban youth.

Critical science agency provides a way to think about how learning science can provide possibilities for empowerment. The development of critical science agency may allow African American students to challenge power structures not just within the science classroom but also in their own lives. From this perspective, understanding the underrepresentation problem requires that we clearly define a trajectory for students and make explicit connections between school science and their future goals. Perhaps, if we cultivate this kind of agency African American students will find science and a science-related career more relevant and attainable. The next section presents career academies as one context that has the potential for developing critical science agency.

Career Academies as a Context to Support Critical Science Agency

As part of comprehensive urban high school reform, many schools recently adopted reform models that break large schools into smaller academies. For example, the reform model relevant to this study is the Talent Development High School (TDHS) model (Castellano, Stringfield, & Stone, 2003; MacIver, 2007). The TDHS model is structured as a ninth grade academy where small interdisciplinary teams of four or five teachers share the same 150 to 180 students, often on a block schedule. The upper grades are then divided into career themed academies combining a combination of college preparation courses with career applications. School districts often design career academies around

science-related themes such as medicine, health sciences, biotechnology, and engineering (Gott, 2007; Gran & Krudwig, 2007; Maxwell & Rubin, 2000). The goal of the Talent Development model is to create smaller learning communities, to promote more personalized learning environments, to provide students with a link to postsecondary education, and to provide career mentoring. The small body of research concerning career academies and the TDHS model is promising. Next, I discuss representative studies relevant to this study.

MacIver (2007) conducted a longitudinal case study of an urban high school that implemented the TDHS model. Reform at this particular school aimed at improving attendance, dropout rates, and scores on state tests. For example, one in five students dropped out of this school each year and three out of every ten students were absent on a typical day. Qualitative interview data suggested students found that a career focus made content more relevant and interesting. Quantitative data revealed that attendance rose by almost ten percent during the first year of implementation. Additionally, students made significant gains on student achievement measures and the dropout rate dropped nearly sixteen percent. MacIver concluded the small learning community approach and the career theme made school more relevant for these students and as a result increased attendance, dropout rates, and test scores.

Similarly to the school just discussed, McPartland, Balfanz, Jordan, & Legters (1998) conducted a mixed method study in an urban high school in Baltimore that also implemented the TDHS model. Reform at this school was aimed at addressing many of the same issues—student attendance, graduation rates, tests scores, and school climate.

The authors described the school, before adoption of the TDHS model, as chaotic and unsafe. Students roamed the halls during instructional hours and fought in the cafeteria and hallways. Teachers and staff characterized students as apathetic about their studies and students saw little connection between their own personal goals and interests and school. Using both interviews and quantitative data (attendance rates, promotion rates, test scores, school climate survey), the researchers found significant improvements in school climate; student attendance, promotion rates, and test scores after implementation of the TDHS model.

Faculty and student interviews and school observations indicated positive effects of the Talent Development model. During class time, the halls were now clear of students and one teacher commented that “We have a real school now, not like the playground it used to be” (McPartland et al., 1998, p. 347). Quantitative results indicated that student attendance increased, more students were promoted to the next grade level, and a larger number of students passed their state-mandated exams. Additionally, on the school climate survey students reported increased interest in their futures, learning about careers and/or college preparation.

As the above examples suggest, the career academy approach is successful in making school more interesting and relevant for students. However, we know little about how science education is implicated within these comprehensive reform models. I am intrigued by science learning contexts that may exhibit potential to develop critical science agency for African American students. However, studies of such contexts are

limited in the science education literature. Do career academies provide African American students with the knowledge, skills, and experiences enabling them persist toward a science-related career? I argue that career academies might be a context with potential to support African American students' *critical science agency* and science-related career trajectories.

Power

Central to the concept of *critical science agency* is the notion of *power*. As I stated earlier, "learning science involves not only learning the content of a discipline or even how to participate within the negotiated boundaries of a discipline, but also learning how to challenge norms, and to take a stance through discourse and action within the discipline" (Calabrese Barton and Tan, 2008, p. 4). Critical science agency foregrounds power and allows us to think about how science content and skills can be used to disrupt or contest marginalizing or oppressive power structures (e.g. sociohistorical legacy of science, poverty).

In a career academy, science content and practices are situated within the context of a science-related career. For example, students may learn about the science of the circulatory system, learn to take blood pressure, and use blood pressure to monitor or diagnose patients. Promoting science content in this way provides students with the resources and tools to be successful in many ways: to become knowledgeable about health care content, to use and apply this knowledge to care for others, to improve their personal health, or to pursue a high-paying career. The career context allows science

content to become more contextualized and meaningful and provides an alternative to the promoted meanings of science in traditional science courses (e.g. a de-contextualized body of facts to memorize). The next section further explores connections between power and science.

Science and the culture of power. Lisa Delpit's (1995) construct the *culture of power* is helpful to highlight the duality between micro and macro-level forces at work in producing meanings of science for African American youth. Delpit suggested that the *culture of powe*r represents a set of values, beliefs, and ways of speaking or acting. These sometimes unspoken rules and codes are part of the dominant culture and unfairly elevate some groups to positions in society. Membership in the dominant culture allows for easy access to money, social status, and political power. The *culture of power* maintains the status quo and denies certain individuals access to this power. Further, Delpit believes that marginalized individuals must have access to the *culture of power* in order to transform their lives.

In her book *Other People's Children: Cultural Conflict in the Classroom,* Delpit (1995) shared many stories about students and parents of color who rejected more progressive approaches to teaching and learning. She explained that progressive approaches to education only benefited those children that are already part of the dominant culture.

> But for parents who don't function within that culture often want something else. It's not that they disagree with the former aim; it's just that they want something more. They want to ensure that the school provides their children with discourse patterns, interactional styles, and

> spoken and written language codes that will allow them success in the larger society. (Delpit, 1995, p. 28)

As Delpit explained, students and parents recognized that in society marginalized individuals must have access to dominant discourses in order to possess social, political, and economic power. One parent stated, "My kids know how to be black—you all teach them how to be successful in the white man's world" (Delpit, 1995, p. 29).

Perhaps a relevant science education for African American students is one that allows them to use science to acquire social, political, and/or economic capital. As Russell and Atwater (2005) assert, "increased participation in science or science-related careers (i.e., medicine, dentistry, and engineering) can offer African American students opportunities for both social and economic mobility, especially as many of these students are disenfranchised, oppressed, and marginalized as a large part of this nation's lower class" (p. 691). Career academies have the potential to connect economically disadvantaged African American students to high-status and high-paying jobs.

For example, a physician's perceived status holds valuable capital in society. As Calabrese Barton and colleagues (2003) reminded us:

> To know science-and to be deemed as one who knows science-is a uniquely powerful stance. Science education is political. It promotes particular images of power, knowledge, and values by rewarding particular forms of individual and institutional behavior. (p. 68)

Whether through economic stability or social status, career academies have the potential to offer a more relevant school science by providing students with the tools necessary to access the *culture of power* that exists in society.

Next, I discuss Nespor's (1994) construct, *networks of power*. This construct builds upon the culture of power construct because it draws our attention to how local practices *get* connected to larger networks of power.

Career academies: Connecting students to networks of power. Nespor (1994) used the construct *networks of power* to explain how power is reproduced and maintained through relationships as people participate in particular contexts. For Nespor, contexts such as classrooms are not bounded, but instead connected to larger more powerful networks. He conceived of learning and knowledge as "organizations of activity in space and time" (p.1) that are the products of social practice. Learning and knowledge are not processes that occur within individual's heads nor are they just about engaging in communities of practice (Lave & Wenger, 1991). Instead, Nespor suggested that we think of schooling as trajectories that move students along and connect them to disciplinary networks of power. The discipline of science, the field of medicine, or an environmental activists' group are all examples of different disciplinary networks of power.

A network contains people (or actors), materials (e.g. books) and practices (e.g. a strategy for solving a physics problem) that recruit, connect, and mobilize students to bring them into contact with powerful networks. Connection to powerful networks occurs when we change or reorganize the spaces and times that we occupy. Nespor (1994) suggested that:

> Students enter into disciplinary practices when they begin to move along trajectories that keep them within the narrow range of space-times and distributions that constitute the discipline: when they're physically mobilized through networks of physical settings, and when they begin to construct worlds through discipline-based systems of representation. (p. 11)

Nespor (1994) studied the network of college physics to explain how students become connected to the discipline of physics. He explained as college physics students interacted with physics texts, physics problems, and physics equipments they simultaneously connected with the physics discipline (Nespor, 1994). The organization of activity within the physics program created certain relationships and connections to larger power structures (the field of physics). Nespor's construct allows for the examination of the Health Science Career Academy's potential to connect students to powerful networks within health science.

Cultural Production

Cultural productions are meanings produced as individuals participate in daily activities (Carlone 2004, Eisenhart & Finkel, 1998). The cultural production construct makes visible critical science agency and power. One way to "get at" these constructs is by examining students' meanings—aspirations, motivations, values and images—regarding science and the Academy and by examining the meanings of science and science person produced within the Academy. I define the term *science practice* as "the concrete, everyday tasks and social relationships in which scientific information of some kind is used" (Eisenhart & Finkel, 1998, p. 11). Carlone (2004) maintains:

> A focus on cultural production provides us with a different way to think about settings of science learning. It promotes a critical examination of how the local meanings of science and scientist vary depending on the social organization of the classroom and the context in which the classroom is positioned. Thus, we might examine the ways new (more libratory, transformative) meanings of science emerge in new school science contexts. (p. 396)

Carlone (2004) cautioned that meanings are not solely influenced by the local context but are also influenced by larger, more macro level influences such as the elite legacy of school science. Practices such as performing verification labs, teachers lecturing about science content, or students memorizing de-contextualized technical vocabulary reproduce the perception that science is meant to funnel students into formal disciplines of science. The cultural productions construct makes visible the struggle between agency and larger structural constraints (power). The next section discusses cultural production within the context of a Health Science Career Academy.

Career academies and cultural production. Claxton (2002) posited the purpose of education should be to "equip young people with the knowledge, capabilities and dispositions, which they will need to cope well in the world" (p. 23). From a sociocultural perspective, learning science is accomplished through participation in daily activities where individuals are inducted into certain ways of knowing, talking, and participating within a community (Aikenhead, 1996; Lave & Wenger, 1991; Lemke, 2001). These activities imply certain knowledge, values, and identities (the meaning of scientist) that are socially available to members of the community (Carlone, 2003, 2004; Eisenhart & Finkel, 1998). As students take part in the normative social practices of the community, they construct meanings about science, careers, and themselves. The context, in part, influences these meanings. That is, the meaning a student constructs about a science-career is influenced by how science is promoted within the context. For example, if science is promoted as a body of content to be memorized students may not find it relevant.

Troubled by the conditions, stereotypes, and conflict African American students confront in science education, I am concerned with understanding students' meanings of science, science-related careers, and themselves. I am also concerned with understanding the meanings of science and science person produced within a health science career academy and the potential of these meanings to support students' critical science agency.

Following from other practice theorists (Carlone, 2003, 2004, 2008; Eisenhart & Finkel, 1998), a focus on meanings is an effective way to attend to both the local classroom practices and larger networks of power. Examining cultural productions make visible the sometimes salient issues of power that influence African American students' experiences with school science and society. It allows us to understand how the context supports (or not) new meanings of science that may contest the meanings of science that are promoted and taken up by African American students in traditional school science contexts. Also, the dual focus allows for a richer understanding of how students' meanings, as they engage in local science practices, reproduce, transform, or reject historical models of science and science person that often position African American students as outsiders to the world of science (Brickhouse, 1994; Carlone, 2003, 2004) . Finally, focusing on students' meanings allows insights into the ways students view or use science in critical ways and how students see themselves in relation to science.

I utilized critical science agency, power, and cultural production, to examine the following research questions.

Primary Research Question:

1. What is the potential of a High School Health Science Career Academy to support African American students' critical science agency and science-related career trajectories?

Sub-questions:

a. What were Academy students' personal science histories?

b. How did Academy students describe their science related futures?

c. How did the High School Health Science Career Academy define its potential in regard to Academy students' futures?

d. What were the meanings of science and science person produced in local everyday practices in the Academy's culminating medical course and clinical internship?

- What meanings of science and science person supported Academy students' critical science agency?
- What meanings of science and science person truncated Academy students' critical science agency?

e. How did Academy students make sense of their experiences in the High School Health Science Career Academy?

Summary of Chapter II

In this chapter, I provided a historical summary of science education which provided the context and background for understanding how the legacy of school science hindered African American students' achievement and career attainment. I reviewed examples of empirical research that examined interventions aimed at creating cultural congruence between students' worlds and the world of science. I used this literature to build an argument for examining career academies as a way to promote a more meaningful and transformative science education. Finally, I presented three theoretical tools-critical science agency, power, and cultural production to examine the possibility that a Health Science Career Academy is a context that has potential to support African Americans' science-related career trajectories.

CHAPTER III

METHODOLOGY

In this chapter, I discuss how I operationalized the theoretical constructs discussed in the previous chapter. I then describe the overall study design, research site, participants, sources of data, and methods of analysis. I end this chapter by addressing validity issues and limitations to this study.

Operationalizing Theoretical Constructs

In Chapter 2, I argued that the cultivation of critical science agency is one way to support African American students' science and science-related career development and a High School Health Science Career Academy context has this potential. Below I list the primary research question and supporting sub-questions that guided this study.

Primary Research Question:

1. What is the potential of a High School Health Science Career Academy to support African American students' critical science agency and science-related career trajectories?

Sub-questions:

a. What were Academy students' personal science histories?

b. How did Academy students describe their science related futures?

c. How did the High School Health Science Career Academy define its potential in regard to Academy students' futures?

d. What were the meanings of science and science person produced in everyday practices in the Academy's culminating medical course and clinical internship?

- What meanings of science and science person supported Academy students' critical science agency?
- What meanings of science and science person truncated Academy students' critical science agency?

e. How did Academy students make sense of their experiences in the High School Health Science Career Academy?

I constructed these research questions to specifically examine students' trajectories as they were related to science and science-related careers (Brickhouse, Eisenhart, & Tonso, 2006; Lemke, 2001). In Figure 2, I illustrate how I conceptualized students' science trajectories.

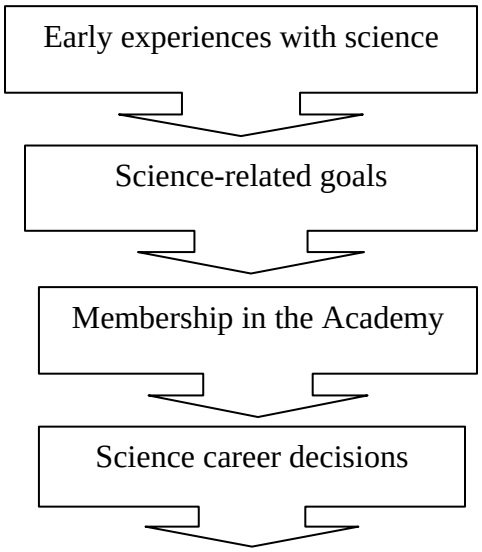

Figure 2. ***Framework for examining students' science trajectory***

It was important to examine students' science trajectories to understand the Academy's potential for attracting and retaining African American students. I applied the critical science agency (CSA) and power lenses along the entire trajectory continuum. This allowed me to better discern the Academy's role in supporting (or not) students' science-related career trajectories. Since I examined the "potential" of the Academy, I had to know whether students had an interest in science or science-related careers prior to their Academy membership. Did the Academy *draw* students interested in other careers toward science-related careers or were students interested in science-related careers prior to the Academy? Did the students perceive the Academy as providing an alternative to "traditional school science" that seemed more relevant to their goals? In what ways were students' histories and the perceived potential of the Academy aligned? Answers to these questions allowed me to understand the Academy's potential in attracting students' interest and/or sustaining students' interest in science-related careers. Additionally, this approach allowed me to understand how the career trajectory implied by the Academy intersected with students' trajectories.

As I discussed in Chapter 2, *cultural production*—or the meanings produced as individuals participate in daily activities (Carlone 2004, Eisenhart & Finkel, 1998)—make visible the CSA and power constructs. One way to "get at" these constructs is by examining students' meanings—aspirations, motivations, values and images—regarding science and the Academy, and by examining the meanings of science and science person produced within the Academy. See Figure 3 for a graphical representation that explains the relationship between CSA, power, and cultural production.

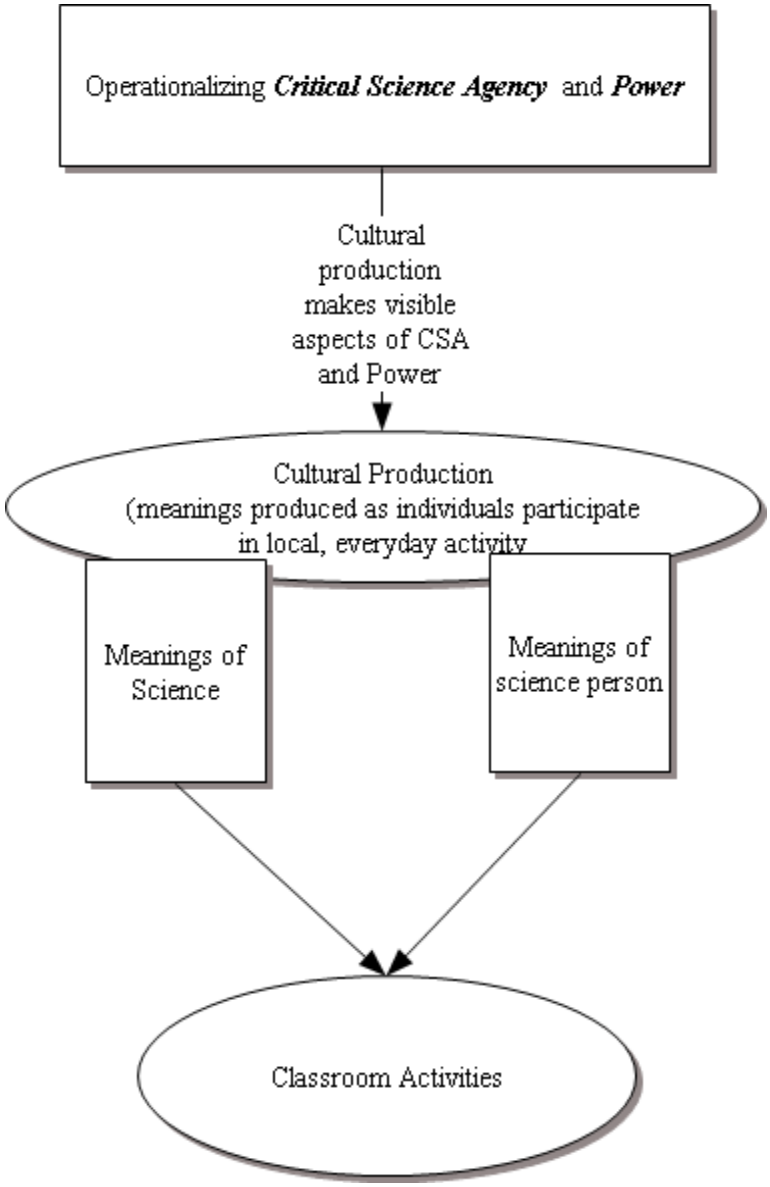

Figure 3. ***Relationship between theoretical constructs***

Nasir and Hand (2006) posited that "accounts of power and social structure need to be considered within a treatment of local practices, for it is in these local contexts that broader forces, such as social structure and power distribution, play out" (p. 455). Thus a treatment of power must focus on both the micro (e.g. students' future goals or

participation in classroom activity) and macro (e.g. class, state mandated curriculum, racism or socioeconomic status). As I discussed in Chapter 2, *cultural production* allows for a focus on power by understanding how larger social structures influence the production of local meanings and how students reproduce, contest, or transform those meanings (i.e. an expression of agency) (Carlone, 2004). To "see" how meanings are "produced" requires attention to shared practices (Cobb, 2000), opportunities for participation (Gresalfi, Martin, Hand, & Greeno, 2009), and ways in which individuals use tools and language (Carlone, 2000; Spradley, 1980). Thus, power, meanings, and local activity are intimately related. Table 2 describes how I operationalized "meanings" promoted in the classroom and clinical contexts.

Table 2. ***Relationship between local activity, meanings, and csa/power constructs***

<table>
<tr>
<td rowspan="2"><u>An examination of classroom activities, tools, and talk</u>

What are students doing?
• Nature of the content students engage with
• Skills and tasks made available/held accountable for
• Products or artifacts produced
What tools and technologies are students using?
• Nature of tools
• Purposes for tool use
What are students and teachers saying?
• Nature of questions (asked by teacher/student)
• Career discussions
• Student references to self in relation to science and science-related career
• Communication of expectations/role of student</td>
<td rowspan="2">Leads to locally produced definitions of</td>
<td>Science
What do the content, skills, tools, and talk imply about what it means to do science?</td>
<td rowspan="2">Allows for interpretation of</td>
<td rowspan="2">CSA and Power

What was the potential of the Academy for supporting CSA and students science-related career trajectories?

In what ways did the meanings of science and science person support/ truncate CSA?

How did students make sense of their experiences in the Academy?</td>
</tr>
<tr>
<td>Science person
What do the content, skills, tools, and talk imply about what it means to be a science person?</td>
</tr>
</table>

A focus on the promoted meanings of science and science person helped me understand the ways in which the Academy supported or thwarted students' critical science agency and ultimately how both shaped students' science trajectories. Additionally, focusing on meanings allowed me to "see" other aspects of CSA along students' trajectories—such as the "critical" ways students envisioned using science in their futures. I discuss this in more detail in Chapter V. Next, I discuss the overall study design.

Qualitative Study Design

Lewis and Collins (2001) argued that research methods traditionally employed to understand African Americans' underrepresentation in science and science-related careers focused on the isolation of variables—student efficacy, parent involvement, social support, and achievement in math and science coursework—and largely used quantitative measures. This approach gave little voice to African American students or the meanings they attributed to their science experiences. It leaves under-examined how the context of school and issues of class and race influence African Americans' science and science-related career attainment (Lewis, 1999; Lewis & Collins, 2001). For example, we know little about why students choose to pursue science (including a science-related career), contexts that may support or thwart their science trajectories, or the nature of their experiences along the way. Merriam (2009) explains that qualitative researchers:

> are interested in how people interpret their experiences, how they construct their worlds, what meaning they attribute to their experiences. The overall purposes of qualitative research are to achieve an understanding of how people make sense out of their lives, delineate the process (rather than the outcome or product) of meaning-making, and describe how people interpret what they experience. (p. 14)

Since my intent was to understand participants' meanings they attributed to science and the Academy, I employed a qualitative research design. A qualitative approach also adds a more nuanced perspective to the underrepresentation literature.

Culturally Sensitive Research Approaches

Culturally sensitive research approaches focusing on African Americans recognize ethnicity and culture as a central focus for all aspects of the research process (Tillman, 2002). From this perspective, African Americans' individual and collective knowledge, understandings, meanings, perspectives, and lived experiences are privileged. Tillman (2002) pointed out that:

> Although there appears to be a shift toward more culturally engaged research approaches within the field of qualitative research, educational research specific to African Americans represents only a small segment of the research that appears in mainstream journals. In addition, the knowledge and experiences of African Americans is often subsumed under the categories of minorities, people of color, and women and minorities. These issues suggest that there is a need to consider research frameworks that can help researchers to more fully capture the experiences of African Americans—their struggles as well as their successes. (p. 3)

Further, this approach emphasizes the relationship of the researcher to the research community. Honoring the voice of participants generates practical, emancipatory, and theoretical knowledge specific to African Americans. Tillman's (2002) framework for culturally sensitive research suggested the following premises relevant to this study.

- Qualitative methods provide holistic and contextual descriptions of the social, political, economic, and educational experiences of African Americans.
- These approaches "attempt to reveal, understand, and respond to unequal power relations that may minimize, marginalize, subjugate, or exclude the multiple realities and knowledge bases of African Americans" (Tillman, 2002, p. 6). The realities of the participants who experience the social, political, economic, and educational aspects of society are privileged over assumed knowledge of the researcher or theoretical dominance.
- Culturally sensitive research informs theory and practice that address the circumstances of African Americans with the purpose of educational change.

My study incorporated theses premises in the following ways. First, I employed an interpretive paradigm intended to get at students' meanings of science and to understand the meanings of science and science person produced in the Academy. As I discussed earlier, the power lens allowed me to pay attention to how their meanings were influenced by macro structures such as the legacy of traditional school science or oppressive social or economic forces. Thus, this approach will yield a picture of how macro level influences shape how African American students experience science and either hinder or support career attainment. Additionally, using critical science agency and

power as central theoretical constructs, I was able to understand the possibility for the Academy to disrupt power relationships that continue to marginalize African American youth in science.

Ethnographic Design

An ethnographic design is concerned with culture and allows the researcher to understand the shared behavior, beliefs, and language of a culture-sharing group (Creswell, 2005; Spradley, 1980). Creswell (2005) outlines the following key characteristics of ethnographic designs relevant for this study:

- Cultural themes
- A culture sharing group
- Shared patterns of behavior, belief, and language
- Fieldwork
- Description, themes, and interpretation
- Context or setting
- Researcher reflexivity (p. 442)

Culture. Ethnographers are concerned with studying the culture or the cultural themes that are produced and/or taken up within a group (Creswell, 2005; Spradley, 1980). Eisenhart (2001) cautioned that "when culture is used in a research design, its meanings must be clear so it can inform the research methods that will be employed" (p. 16). She proposed that one way to think about culture is through cultural productions or shared meanings constructed by individuals as they participate within particular practices.

Eisenhart explained that cultural productions are often produced locally but shaped and influenced by other contexts (i.e. students' home environments) or larger historical structures (i.e. sociohistorical legacy of science). Breaking from anthropological tradition, Eisenhart (2001) suggested that contemporary

> ethnographies will have to include ways of exploring the connections among sites that together make up the arenas of social practice, such as among the households, schools, extracurricular activities, personal relationships, TV shows, video games, and transportation networks that connect up or intersect to form the contemporary contexts of youth activity. (p. 22)

The above quote identifies future directions for ethnography that are guided by more "contemporary views of culture" (Eisenhart, 2001, p. 22). Methodologically, Eisenhart pointed out that for ethnography to account for these multiple influences researchers may rely heavily on interviews and less heavily on participant observation that has traditionally been associated with conventional ethnography. For this study, I was concerned with not only how the immediate context of the Academy influenced their meanings of science but also how students' lived experiences (i.e. social, political, and economic realities) shaped those meanings. Because of resource limitations (i.e. I was the sole researcher.) I was not able to follow participants into the numerous contexts the participants occupied outside of school; instead, I depended upon their descriptions and stories to understand their meanings. This was also consistent with an interpretive orientation (Merriam, 2009) because it privileged participants' voice and meanings.

Role of the researcher. Researcher reflexivity describes the "give and take" relationship between the researcher and participants and is important to acknowledge for

ethnographic work (Creswell, 2005; Maxwell, 2005). As Heath & Street (2008) explained, the "ethnographer is the ultimate instrument of fieldwork" (p. 57). Therefore, it is necessary that I share my experiences, my assumptions, and biases regarding science.

My interest in the Health Science Career Academy stemmed from my work with this program as the previous Academy director. While working for this school district, I observed that the Academy held status within the school, students, parents, and community. While I was skeptical about the way science was promoted (as a means to a job) and the fact students went to college too early, I soon began to understand how the students and parents attributed different meanings to this program. I remember parents commenting on the need for their students to get a good job and how parents closely monitored their children's' progress. I worked most closely with students during their transition to college during their senior year. Parents often thanked me for helping them navigate this transition because many parents and students were unfamiliar with college culture—how to register for courses, get textbooks, or how to communicate with instructors. Overall, I perceived that parents and students considered the Academy a valuable resource.

As a teacher who worked in both urban and rural school settings, I observed first-hand a lack of interest and participation in school science across many ethnic and gender categories. Through my readings and experiences as a doctoral student, I continued to understand the persistent barriers and marginalization faced by many African American students in school science. This prompted me to explore African American students' experiences as members of a Health Science Career Academy.

I entered this study with certain biases about school science. In particular, I believed that school generally promotes a narrow conception of science (Aikenhead, 2006; Eisenhart, Finkel, & Marion, 1996). Like other equity scholars in the field, I saw the purpose of school science as primarily concerned with the enculturation of the best and brightest students into the formal disciplines of science (Aikenhead, 2006; DeBoer, 1991). I also saw how school science carried a very masculine and emotionless image of science that alienated me as a science student. Like Aikenhead (2006), I believed that school science should be based on something more than "pipeline ideology" aimed at preparing the next generation of formal scientists. School science should be concerned with the preparation of the next generation of citizens who may decide to pursue a science-related career, to participate as informed citizens capable of decision-making, or use scientific knowledge and practices to take social action.

I envisioned a school science that supported students' capacity to understand their worlds in critical ways and to use science for social transformation. This could include individuals using science knowledge to advocate for or against an environmental issue within their community. This could also include the development of science competency that—when applied to a science-related career—could provide them with economic or social mobility. With these stated biases, I entered this study open to learn what science, a science career, and the Academy meant to them.

Consistent with an interpretive paradigm, I must make my personal goals, experiences, and subjectivities transparent to ensure validity and reliability (Peshkin,

2000; Maxwell, 2005; Merriam, 2009). The topics and issues that I valued guided my choice of research questions, methods, and how I made sense of the data. For me, a personal goal was to transform education—particularly science education for marginalized groups. My personal experiences and position as a white woman from a working class background no doubt influenced these goals. I grew up in a rural area and lived with three other siblings in a single-parent home. Due to my gender, social, and economic status, I often felt marginalized in school and particularly in school science.

My background and experiences provided a unique perspective and allowed me to relate to individuals who struggle with some of these same difficulties. With that said, I also recognized how I benefited from a *legacy of privilege* as a white woman (Howard, 2006). Thus, my privilege contributed to my upward social and economic mobility and influenced how I approached this study and interpreted my data. Because I did not share the same historical, social, and political histories as the participants in this study, it was important to provide the space for participants to craft and tell their own stories (Delgado & Stefancic, 2001). I took the stance that their stories were truthful and realistic reflections of their particular struggles, experiences, and understandings. I recognized the rich sources of knowledge, experiences, and perspectives that participants brought to this study. They held their own notions about the role that education (and science education) should and did play in their lives. Their perspectives were vital to understand what a more socially just education for historically marginalized individuals might look like.

School and Career Academy Context

I collected data from students enrolled in an Early College Health Science Career Academy that was part of a larger comprehensive high school. Edgeview High School (a pseudonym) was located within a mid-sized urban city located in the south east of the United States. The school population was 75% Black, 14% White, 6% Asian, 4% Hispanic, and less than 1% American Indian students. I chose this site for several reasons—the population was largely African American (relates to my research problem); the Academy context offered different experiences than many traditional school science contexts (career-specific connections); the Academy context is becoming more prevalent in urban schools across the country, so it is a timely context with which to study African American students; and I had access as I previously (three years prior to study) served as an Administrator for the district's Early College Academies.

Edgeview High School experienced high administrator and teacher attrition, low academic performance, and high student drop-out rates over the last six years (administrator interview). The school was designated by the state as a low-performing school for the 2004-2005 and 2005-2006 school years with less than 50% of students performing at grade level as measured by standardized test scores. During the 2005-2006 school year, Edgeview High School was assigned a state "turn around" team. The purpose of this team was to work with administrators and teachers to improve the school climate, instruction, and student achievement. During the 2005-2006 school years, Edgeview High School began implementation of the Talent Development High School

reform model (Castellano, Stringfield, & Stone, 2003). This model required that the school be broken into smaller, career-focused academies over a three year period. In other words, this school faced enormous external pressures to teach and organize the curriculum and students in certain ways.

Health Science Career Academy

The Health Science Career Academy began in 2003 to increase the number of students who attended college and to encourage diversity within the school (Administrator interview). The Academy was considered a "school within a school". The students, classrooms, and teachers were not physically separated or bounded from the larger high school. Instead, the Academy students took a prescribed sequence of courses often with other non-Academy students who participated in the same courses. The Academy served grades nine through twelve with forty seats available each year for each grade level. From the total seats available, twenty were reserved for students within the Edgeview attendance zone and the remaining twenty seats were available to students anywhere in the county. Five of the students in this study lived outside of the Edgeview attendance zone.

Students were required to submit a formal application and acceptance into the program was competitive. Students submitted their achievement records (middle/high school grades and district/state mandated test scores) and wrote an essay regarding their future career goals. Acceptance to the program was based on a combination of grade point average (minimum of 3.5 on a 4.0 scale for math and science course work), scores

on district/state mandated tests in math, science, and language arts/English (minimum score of 3 on a scale of 1-4), score from a required essay, and teacher/administrator recommendations. Students were required to maintain a "B" average to continue membership in the Academy.

Informational brochures described the curriculum as "rigorous". Students took a combination of Honors (n=7) and Advanced Placement (n=8) level course work during their ninth, tenth, and eleventh grade years. Students' electives consisted of additional science (e.g. Anatomy and Physiology, Forensic Science) courses and medical courses. The Academy students completed all of their district and state graduation requirements during their first three years of high school and had the option of attending a local university, private college, or community college during their fourth year of high school. Some students decided not to take college courses during their senior year and some students chose to only attend college on a part-time basis. In these situations, students enrolled in courses at Edgeview high school during their senior year. Students who took college courses met all admission requirements set forth by these higher education institutions. During grade twelve, students were considered dually-enrolled as high school students and college students and typically enrolled for one to four courses per semester. The district paid for students' college tuition and textbooks. To date, there are not any data about the effectiveness of this program regarding graduation rates, attainment of career goals, or students' perceived relevancy of science as it is promoted in this program.

Classroom. The medical course was housed in the basement of the high school next to the wood working and auto-mechanic shops. The classroom was filled with medical instruments and materials. A few tables and chairs were arranged in the center of the room and many computer stations flanked the sides of the room. Hospital beds, medical mannequins, wheel chairs, lifts, and cabinets with bed linens were set-up in the back of the room. A curtain hung from the ceiling and could be closed to conceal this area. The front of the room displayed models of the human body and stainless steel trays filled with various medical instruments including stethoscopes, blood pressure cuffs, thermometers, bed pans, and nail care instruments. At various areas around the room, book cases shelved anatomy textbooks and drug reference books. The walls of the classroom were adorned with vision charts and posters highlighting different body systems (e.g. eye, ear).

Clinical sites. As part of the culminating medical careers course, students were required to participate in a clinical internship at various health care facilities—an adult day care center, a nursing home, a rehabilitation center, and a hospital. Each facility was located within the same community as Edgeview High School. The clinical experience totaled fifty-six hours. Students spent approximately twenty hours each at the nursing home and rehabilitation center, ten hours at the adult day care center, and six hours at the hospital.

The fellowship hall of a local church housed the adult day care facility. The patients at this facility had minor physical disabilities or mild mental health conditions which rendered them unable to be alone during the daytime. The facility served approximately twenty patients per week. Staff at the center consisted of a licensed practical nurse (LPN)

and two certified nurse assistants (CNA's). Several community members volunteered to help with recreational activities such as bingo and art and crafts.

The nursing home was located within one mile of the participants' high school. This facility offered assisted living services as well as skilled nursing care. The majority of the patients were ambulatory but not able to live on their own. For example, many could not prepare meals or bathe themselves. Other patients suffered from diabetes, mental health disorders, or physical disabilities and required more skilled care. Most of the patients had private rooms adorned with their personal furniture, family pictures, televisions, and radios. Residents were often out of their rooms, walking or wheeling through the halls, visiting other residents' rooms, or sitting within recreational areas.

The rehabilitation center was similar to the nursing home in that it offered assisted living services but also offered extensive rehabilitation services. It served patients who suffered strokes, cardiovascular events, or physical traumas and they received physical therapy, occupational, and speech therapy on either a short or long-term basis. The patients at this facility typically required more care than the patients at the nursing home. This facility had more of a hospital "feel". Patients' rooms contained "facility issued" furniture and did not contain many personal belongings. I saw very few residents out in the hallways and recreational areas.

The hospital was a four hundred bed facility that offered in-patient and out-patient services and many specialty centers including: heart center, cancer center, neuroscience center, rehab center, wound care center, sleep lab, joint replacement center, women's center, vascular health center, and a behavioral health center. The first day students

received a tour of many specialty areas and the second day they shadowed in one of these areas. I discuss students' participation in the clinical settings in more detail in Chapter V. Next, I discuss the participants.

Participants

Creswell (2005) defined a culture-sharing group as "two or more individuals who shared behaviors, beliefs, and language" (p. 443). The culture-sharing group in this study was African American students who were members of an Early College of Health Science Career Academy. Additional participants included administrators, teachers, and parents. In this section, I provide a description of the participants and how I selected them for participation.

Administrators

The school principal and the Academy director both participated in this study. The school principal was responsible for the daily leadership of both Edgeview High School and the Academy. She served as the Principal at Edgeview for the past four years. The Academy director oversaw several Academies within the district and was responsible for curricular implementation, general administrative leadership (including determining admittance into the program), and maintaining relationships with the partner universities and colleges.

Students

Fourteen African American students who were members of the Academy participated in this study. I used purposeful sampling to select students. Purposeful

sampling is of then used in qualitative research designs because researchers can select participants and research sites that best inform the phenomenon under investigation (Creswell, 2005). I selected African American students because I wanted to better understand their underrepresentation in science and science-related careers. In table 3, I provide a list of students (all names are pseudonyms), their grade level, and anecdotal information provided by their Academy teacher, school administrators, and friends.

Table 3. ***List of student participants by grade level***

Participant	Grade level during study	Anecdotes from teacher and administrators
Brittany	11	She lived with two sisters and her mother. She was described by as hard-working. An administrator shared that her mother struggled financially.
Ebony	11	She was very social and talkative in class. She lived in an area of town that her teacher described as plagued by crime.
Serena	11	She was very involved with her church and enjoyed cheerleading in school.
Ashley	12	She played three different school sports. She was described as polite, willing to help others, and a dedicated student.
Jada	12	She lived with her mother and grandmother. She was described by her teachers as determined and a social butterfly.
Roxanne	12	Her presence in class was very reserved and cautious. She lived with her grandmother and did not have a relationship with her mother or father.
Natalie	12	She was described as very mature and hard-working. She worked at a local restaurant each day after school.
Sasha	11	She was very quiet in school and did not participate in any extra-curricular activities (except for campus beautification

		days). She volunteered at a local shelter in her free times.
Will	12	He was described as very popular. He was crowned the homecoming king his senior year in high school. He played football and was described as a talented athlete. His friends described him as “phat”.
Marcus	12	He was described as a very hard worker and a deep thinker by his teachers. He lived with his father, mother, and younger brother. Teachers shared that his parents struggled economically. They added that his parents were very involved in his education and they had high academic expectations.
Antonio	12	He was described by his teachers as very intelligent. He was the high school poet laureate during his junior and senior years. He was the only student in the study with parents who had a college degree.
Joel	12	Teachers described him as a “good” kid. He held a job after school and was not involved with any after-school activities.
Dante	12	He was described as positive and willing to help others. He was very involved with community theatre. He was very expressive in his dress and appearance.
Curtis	College Sophomore	The school (teachers, administrators, counselors, and friends) referred to him as Dr. Curtis. In high school, he was very involved with student council and school leadership. In college, he was involved with several political science groups and volunteered in his spare time.

I planned to use ethnicity, grade point average, and students' career goals as criteria for sampling. However, as I entered the research site, I discovered that there were only fifteen African American Academy students in grades eleven and twelve. Fourteen of those student consented to participate in this study. I chose to bound the focus of this study to participants in grades eleven and twelve for the following two reasons.

First, the Academy's structure during the ninth and tenth grade years reflected a traditional high school curriculum. Students took a culminating medical course and participated in a clinical internship during either grade eleven or twelve and this experience was touted as a distinguishing and innovative feature of the Academy. Again, I felt that this feature of the Academy offered a different experience for students compared to how they might typically experience school science (i.e. the explicit career connection).

Second, the varied sample (by grade level) allowed me to gain insights into students' career trajectories as they progressed through the program toward their career goals. That is, eleventh grade students represented "newcomers" to the Academy (Lave & Wenger, 1991) while the twelfth grade students had completed their medical career and internship coursework and were enrolled in college courses. They represented the "old-timers" (Lave & Wenger, 1991). Sampling from these different grade levels offered varied perspectives across the trajectory of participation in the Academy, which is consistent with an ethnographic approach informed by practice theory (Lave & Wenger, 1991).

Parents

I invited all the parents to participate in this study. I sent the parents letters and consent forms that described the study and their responsibilities for participation. In the end, only four parents agreed to participate in an interview. Other parents indicated that they were interested but their children shared with me that they were just too busy--even though I offered several possible times and places to meet.

Academy Teacher

Mrs. Mahoney (a pseudonym), the Academy teacher who taught the culminating medical course and clinical internship, participated in the study. She taught this course for the previous five years. Before teaching, she worked as a registered nurse for over thirty years. She grew up in a neighboring city but lived in the Edgeview high school community for the last three years. She attended a local church and knew many of the students and parents outside of school.

Data Collection Procedures and Analysis

Ethnographers collect data by spending time with participants within the naturalistic settings—where they live, work, and learn. As Spradley (1980) suggested, ethnographers attempt to capture the "patterns of behavior, artifacts, and knowledge that people have learned or created" (p. 86). Thus, my goal was to gain an *emic*, or insider's, perspective to illuminate the taken-for-granted meanings produced as students and teachers participated in the Academy (Creswell, 2005; Spradley, 1980). Spradley's (1980) approach for understanding meanings required that I make cultural inferences by giving attention to: (1) what people do (cultural behavior); (2) things people use and make (cultural artifacts); and (3) what people say (speech messages). In this section, I discuss my role as a participant observer, the kinds of data I collected, and the methods I used for data analysis.

Participant Observer

Many different types of participation are possible as an observer in ethnographic research. My participation included what Spradley (1980) classified as moderate participation and active participation depended upon what was acceptable for a particular context. For example, within the classroom, I often participated in the same activities as the students. As an active participant, I practiced taking blood pressures, transferring patients, and posing as a patient for the purpose of role playing. During this time, my objective was to experience what the students experienced or as Spradley (1980) explains "to learn the cultural rules for behavior" (p. 60). At other times it was more appropriate for me to only act as a moderate participant. For example, during the clinical experience, there were times when I was not able to participate because I was not an instructor, employee, or student. In these cases, I was present, observed, asked questions, and took field notes. Next, I describe the kinds of data I collected as a participant observer.

Data Sources

I collected data for a total of seventeen weeks from February, 2009 to June, 2009. Edgeview High School operated on a block schedule. The medical course was scheduled as a double block so that students could go out to the clinical sites during the school day. Thus, each class period was three hours in duration. During this time, I took field notes, interviewed participants (both formally and informally), and collected relevant documents. Next, I describe each data source and how they related to my research

questions. Table 4 provides a matrix of how each data source supported my research questions.

Document reviews. I collected and reviewed several documents associated with the Academy which included the medical course curriculum, recruitment brochures, and newspaper advertisements. I used these sources of data for two purposes: (1) to understand the how the Academy marketed itself to students and parents, and (2) to understand the meanings of science and science person produced in the culminating medical course and clinical experience. These documents represented the "official" discourse that was put out there by the school institution (Gee 2000-2001). I used this discourse to establish what the Academy pledged to do for students. This allowed me to see how this "official" discourse actually played out in the Academy and to see whether or not the Academy lived up to its potential.

Fieldnotes. I took fieldnotes during the district magnet fair, an Academy open house, during the culminating medical course and associated clinical internship. The purpose for observing at the magnet fair and open house was to understand how the Academy marketed itself to students and parents. I focused my observations on the kinds of information communicated to students and parents as far as coursework, career exposure, and clinical experiences. During these events, I recorded my observations in a journal.

While in the medical classroom, I typically sat near the back of the room and took field notes on my laptop computer unless I was participating. In that case, I recorded my experiences and impressions afterward. After each class, I would read through my field notes and add details, personal feelings, hunches, and questions about what I experienced.

I used an observation protocol that focused on classroom/internship activities, tools, and talk. See Appendix A for an example of my observation protocol. As the study progressed, I further focused my observations as suggested by Spradley (1980). For example, while looking over my field notes, I noticed that students were mostly learning about how to care for the elderly and that the teacher often referred to the students as certified nurse assistants. During my next visits, I made a concentrated effort to document each practice and skill the course made available to students and the frequency of each practice. This focused observation helped me understand the meanings of science and the kinds of identity roles produced locally in the classroom.

In the clinical settings, I would either follow the teacher or particular students. I used my general observation protocol (activities, tools, and talk) but focused my observations as we progressed through the clinical experience. For example, I was struck by the nature of students' required tasks and roles during our first day in the nursing home. Largely, students engaged in certified nurse assistant work which I describe in more detail later. On subsequent visits, I gave attention to the kinds of tasks students engaged in, people they came into contact with, and their exposure to health care roles. While in clinical, I recorded my observations, reactions, and questions in my journal. Taking fieldnotes in these settings proved difficult at times. First, students were "all over the place" because they were assigned to different patients in different areas of the facilities, and I tried to keep-up with everyone. Also, because of patient confidentiality, I was careful not to be too intrusive. For example, when students were bathing patients, I could not enter the room and instead I depended on students to "re-tell" their activities.

Interviews. I interviewed students, parents, administrators, and the medical course teacher, both formally and informally. For the formal interviews, I utilized a semi-structured interview format which consisted of open-ended questions related to specific domains of interest (Schensul, Schensul, & LeCompte, 1999). The semi-structured format (Schensul et al., 1999) allowed me to probe or ask for clarity or additional information.

When I first entered the classroom, I had several informal conversations with students. This allowed me to build rapport with them before I conducted more formal interviews. I made a record of many of these informal talks in my journal. I began formal interviews with students during the middle of the study and continued until the end of the study. The purpose of student interviews was to "get at" students' meanings of science and science career, reasons for applying to the Academy, meanings of science and science person produced in the Academy, and the sense they made of their experiences. I conducted one formal interview for each student participant. For some students these interviews had to be broken into two or three sessions because of time constraints. I audio recorded and transcribed each formal interview. See Appendix B for the interview protocol for the individual student interviews.

After formal interviews with students, I asked follow-up questions for clarification. These informal conversation took place during class/clinical and on the bus ride to the clinical settings. After class, I would sit in the library to work on my fieldnotes and begin initial data analysis. Students would often come into the library during their lunch period and sit with me. This was a great way to get to know the students and follow-up on some of my hunches. They often asked me questions about college, courses they should take,

my dissertation, and what I liked to do in my free time. I asked them questions about the Academy, what they liked and disliked, teachers, their futures, and other interests outside of school. I made notes about these conversations in my journal. I really enjoyed this time with the participants.

At the end of the study, I conducted three informal focus group interviews with small groups of students (3-5 students). Flores and Alonso (1995) explained that "focus groups are an important way of discovering what interviewees think about a concrete theme – what feelings, attitudes, reactions, and doubts they have concerning it – in a situation in which they can contrast their opinions" (p. 84). The purpose of the focus groups was twofold. First, focus groups provided an opportunity for me to ask students any lingering questions from my initial data analysis. Wilson (1997) explored adult perceptions of their lifestyle options and relied solely on focus groups. She found that the use of focus groups allowed her to gain a deeper understanding of the participants' perceptions because this technique encouraged the participants to interact, agree or dispute each others' comments and assertions. Wilson reported that by listening to the participants interact in this way she was able to develop a more complete picture of the participants' perceptions than through individual interviews alone. I was able to better understand their experiences, perceptions, and beliefs about science and the Academy through group interaction.

Second, I used focus groups as a member-checking technique (Creswell, 2005). I asked students about particular themes that emerged from my initial analysis. For example, students talked about their desire to help others, make a difference, or change their life during the individual interviews. During the focus groups, we further discussed

these themes. I explained my interpretations to students and they confirmed, gave me more information, and refuted my assertions. Through member checking, I ensured that my interpretations were valid representations of participants' meanings. I audio recorded and transcribed these informal group conversations.

Administrator interviews. I conducted one interview with the school principal and the Academy director. The purpose of these interviews was to obtain general information about the Academy and to elicit their perspectives about its role in the students' lives. These conversations were also helpful to gather additional general information about students and their families such as their socioeconomic status or interests outside of school. These interviews were audio recorded and transcribed. See Appendix C for the interview protocol I used with the administrators.

Parent interviews. I conducted four parent interviews. I used this data to understand students' meanings of science, a science career, and their future goals from the parents' perspective. The parents, as members of the community, talked with me about what the Academy meant to them and the community. This allowed me to understand their perceptions of the Academy. These interviews were audio recorded and transcribed. See Appendix D for the interview protocol I used for the parent interviews.

Table 4. ***Relationship between data sources and research questions***

RESEARCH QUESTIONS	DATA SOURCES						
	Document Analysis	Observations/ Field Notes	Student Interviews	Administrator Interviews	Parent Interviews	Teacher Interview	Informal Group Conversations
a. What were Academy students' personal science histories?			X		X		X
b. How did Academy students describe their science related futures?			X		X		X
c. How did the High School Health Science Academy define its potential in regard to students' futures?	X		X	X	X	X	
d. What were the meanings of science and science person produced in everyday practices in the culminating medical course and clinical internship? • What meanings of science and science person supported students' critical science agency? • What meanings of science and science person truncated students' critical science agency?	X	X	X			X	X
e. How did Academy students make sense of their experiences in the Health Science Academy?		X	X				X

Data Analysis

I used Spradley's (1980) method for analyzing ethnographic data called semantic structure analysis to look for patterns of shared meanings across all participants. I used the following three stages for analysis: (1) domain analysis, which meant I identified categories of cultural meaning (e.g., ways to describe science/science-related careers, kinds of promoted science practices), (2) taxonomic analysis, which involved looking for relationships among the data under each domain, and (3) componential analysis, which allowed me to determine the patterned nature of emerging themes. While Spradley (1980) outlined this method in three stages, I used the three stages in an iterative nature that involved using one stage to inform others. Next, I discuss each stage and provide examples from my analysis.

To begin domain analysis I read through my transcripts and field notes and looked for categories of cultural meaning or domains. Cultural categories are made up of three elements which are the cover term, included terms, and semantic relationship. The cover term is the name of the domain (e.g. tools). Included terms are the names for the smaller categories within each domain (e.g. Blood pressure cuff). Finally, the semantic relationship links the categories together (blood pressure cuff *is a kind* of tool). I used my conceptual framework and observation protocol as guides to look for semantic relationships. Spradley (1980) provided many universal semantic relationships and suggested that researchers use them to begin analysis of cultural domains. I provide examples of how I used these universal semantic relationships in Table 5.

Table 5. ***Examples of semantic relationships used for domain analysis***

RELATIONSHIP	FORM	EXAMPLE
1. Strict inclusion	X is a kind of Y	Certified Nurse Assistant (is a kind of) science person.
2. Rationale	X is a reason for doing Y	Exposure to various roles in health care (is a reason for) applying to the Academy.
3. Function	X is used for Y	Science content (is used for) care of the elderly
4. Means-end	X is a way to do Y	Getting a science-related job (is a way to) express altruistic goals.
5. Attribution	X is an attribution (characteristic) of Y	Altruism (is a characteristic of) future career/identity

Examples of other domains that emerged from analysis included: meanings of science career, ways to characterize self, reasons to pursue a science-related career, ways to participate in clinical, kinds of questions asked, kinds of skills used in clinical, and kinds of health care roles represented in clinical. This stage of analysis resulted in thirty two domains.

Next, I used *taxonomic analysis* to break down each domain into smaller subcategories. For example, "ways to characterize self" was broken into (1) personal qualities, (2) future images of self, and (3) relationship of self to science/science career. I then looked for relationships among subcategories. This sometimes resulted in moving subcategories and creating new domains. For example, "future images of self" and "relationship to science/science career" were moved to a new cultural domain which I

named “altruistic identities”. Later altruistic identities was moved to a larger theme—“reasons for pursuing a science career”. Thus understanding the relationship between categories helped me understand students’ future goals in terms of who they wanted to become. I used *QSR NVivo 8*, a software application, to manage these domains. See Appendix F for an example of my taxonomic analysis.

For many of the domains, I conducted a *componential analysis* where I compared cultural categories to look for instances of contrast within and among domains. Continuing with the same example, the cultural meaning of “altruistic identity” had contrasting aspects for males and females. Thus, this final stage helped me make sense of what an “altruistic identity” meant for different members of the group. I used this last stage of analysis for other domains to further examine the major themes that emerged. See Appendix G for an example of my componential analysis.

Once I parsed the data using these three analysis strategies, I looked for the patterns in the subcodes. I rearranged and collapsed subcategories into larger themes. To ensure that my themes were robust, I used frequency counts for subcodes within each theme. For example, twelve out of fourteen participants described themselves in some way as “a science person”. This process allowed me to focus on only the most robust themes. Throughout my analysis, I used concept mapping to show the relationship between themes and used these maps to construct a storyline that I used to write Chapters IV and V. See Appendix H for an example concept map.

In this section, I discussed my role as a participant observer and what that looked like during data collection. I then explained the three sources of data I collected—documents,

fieldnotes, and interviews—and how I used them to answer my research questions. Finally, I provided several analysis examples from my data to demonstrate how I applied Spradley's (1980) semantic structure analysis. Next, I discuss how I considered issues of validity for this study.

Validity

Maxwell (2005) used the term validity "to refer to the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account" (p. 106). A key concept for thinking about validity is the validity *threat* or possible ways that you could be wrong (Maxwell, 2005). Maxwell explained that validity is a part of the research process where you attempt to identify and rule out any possible threats. Two broad types of validity threats for qualitative research include *researcher bias* and *reactivity* (Maxwell, 2005).

As Maxwell (2005) explained, validity in qualitative research is not concerned with trying to eradicate the differences in values and theories that researchers bring to their work. Instead, qualitative researchers must make their biases transparent. Earlier in this chapter, I detailed my prior experiences with science and my prior relationship with the research site as Academy director. I also made my intentions transparent to the participants regarding the purpose of the study and my personal motives. For example, I shared that I was concerned about the underrepresentation of African Americans in science and that I was interested in findings causes and solutions to this problem. Additionally, Maxwell (2005) posited that minimizing reactivity, or the effect the

researcher has on the participants, is a meaningful goal for ensuring validity in qualitative research. I attempted to minimize reactivity in several ways. First, through spending an extended time with students during class, clinical internship, the bus ride, and lunch period, I built a level of trust and rapport with students. This mutual trust enabled students to be more forthcoming about their feelings, perceptions, and beliefs during interviews. Also, I ensured that the research questions were open-ended so that my line of questioning did not lead participants to a desired answer. I was careful not to express my personal reactions or judgments regarding what I observed or what participants shared with me. Table 6 lists other possible validity threats to this study and the ways that I addressed them.

Table 6. ***Possible threats to validity***

Possible Threat	Address of Threat
Research Design	• Ensured that data collection and analysis techniques are appropriate for the research questions (Eisenhart & Howe, 1992). • Used many sources of data to address research questions (Creswell, 2002; Merriam, 2002)
Inaccurate interpretations/conclusions	• Member checked through informal groups discussions (Creswell, 2002; Merriam, 2002) • Searched for cases to disprove researcher inferences (Eisenhart & Howe, 1992). • Extended the data collection period (Eisenhart & Howe, 1992).
Researcher assumptions and biases	• Ensured the field notes clearly indicated personal interpretations of observations (Eisenhart & Howe, 1992). • Made my biases, relationships, and interactions with the participants transparent (Merriam, 2002).

Generalizability	• Provided a detailed description of the context, participants, methods, analysis, and theoretical approaches and made them public to others (Anafara, Brown, & Mangione, 2002; Eisenhart & Howe, 1992).

Generalizability and Limitations

External generalizability refers to the ability to apply the findings from this study to other individuals and contexts (Maxwell, 2005) and "in the statistical sense cannot occur in qualitative research" (Merriam, 2009, p. 224). However, this does not mean that we cannot learn from these qualitative findings. Citing Lincoln and Guba (1985), Merriam (2009) explained that qualitative researchers are concerned with *transferability*. Here the investigators job is to provide sufficient descriptive data so that the person, seeking to apply this information, can do so to their situations. I have robust accounts of the environment and others in similar contexts may recognize aspects of their own situations represented in how I described and interpreted my findings. Thus, my findings offer practitioners and researchers robust descriptions so they can make choices about how these findings apply to similar contexts or participants. I operated from a critical orientation and my intent was for this research to be transformative for the participants, however, the participants in this study did not receive immediate transformative effects that I could discern by the end of the study.

Summary of Chapter III

In this chapter, I explained in detail the methodology that guided this study. Drawing from interpretative and critical paradigms, I collected and analyzed data that helped me understand the potential of a Health Science Career Academy to support students' critical science agency and ultimately their science-related career trajectories. In Chapter IV and V, I discuss the findings from this work.

CHAPTER IV

STUDENTS' SCIENCE HISTORIES AND FUTURES

The findings presented in this chapter address research sub-questions (a) and (b). I address the remaining research sub-questions in Chapter V. Below, I list the primary research question and supporting sub-questions that guided this study.

Primary Research Question:

1. What is the potential of a High School Health Science Career Academy to support African American students' critical science agency and science-related career trajectories?

Sub-questions:

a. What were Academy students' personal science histories?

b. How did Academy students describe their science related futures?

c. How did the High School Health Science Career Academy define its potential in regard to Academy students' futures?

d. What were the meanings of science and science person produced in everyday practices in the Academy's culminating medical course and clinical internship?

- What meanings of science and science person supported Academy students' critical science agency?

- What meanings of science and science person truncated Academy students' critical science agency?

e. How did Academy students make sense of their experiences in the High School Health Science Career Academy?

The findings I present here tell the story of how fourteen African American students acted as agents (Basu, 2007) to appropriate science in ways that aligned with their career goals, future identities, and altruistic convictions. I begin with a discussion of students' meanings of science as well as their early science experiences. This is followed with a description of participants' visions for their futures, meanings of a science career, and reasons for applying to the Academy. This chapter provides a context to better understand the role the Academy played in supporting (or not) students' critical science agency.

Research Sub-Question (a): Students' Personal Science Histories

Meanings of Science and Descriptions of Self as Science Person

To understand the potential of the Academy to support African Americans' science-related career trajectories, I examined students' science histories. This approach was one way to rule out other possible theories that explained students' career-related decisions and allowed me to understand the Academy's potential. For example, did the Academy play a role in students' career-related decisions, and if so, how? Did the students have other critical experiences that influenced their career choices?

Additionally, the examination of science histories provides a profile of the kinds of students who are attracted to career academies and to the pursuit of a science/science-

related career. Were these students considered "good" science students? Did they have lots of career exposure prior to the Academy? Answers to these kinds of questions will provide a context to explain the Academy's potential in attracting students' interest and/or sustaining students' interest in science-related careers. Finally, an examination of students' histories allows for an understanding of the intersections between the career trajectory implied by the Academy (its curriculum, classroom, and clinical experiences) and the students' pursued career trajectories.

I began student interviews by exploring what science meant to these students and how they saw themselves in relation to science. This portion of the interview protocol required students to recall experiences with science before they entered the Academy. Their responses represent the story they told themselves. This was the narrative that made sense to them at the time, even if it wasn't representative of their "actual" feelings a couple of years prior. The fact that these recollections were constructed post-hoc could be viewed as a limitation in terms of the data's validity. However, this line of investigation proved very helpful as it provided a context to understand the students' perceptions of science, careers, and their future goals and it allowed me to map out their pursued career trajectories. Even if their "recollections" did not match their actual pre-Academy feelings about science exactly, their recollections became the narrative that allowed them to make sense of their science selves. I took the stance that their stories were truthful and realistic reflections of their particular struggles, experiences, and understandings.

Students expressed remarkably similar recollections of science. Their stories implied very positive images of science and of themselves in relation to science. All students had

rich science experiences in and out of school. Next, I discuss two meanings of science shared by the group.

Science as wonder and discovery. All students expressed sustained interest, engagement, and enjoyment with science. They described science as discovery, wonder, and a way to learn new things because "…science doesn't stay the same, it always changes" (Ashley, FI1).

Other examples:

> It's really about exploring new things and figuring them out. (Will, FI1)
>
> To me science is like the motivation to just discover the unknown. No one knows everything so what you can learn is never-ending. (Jada, FI1)
>
> I just love it- like--technology and developing new technology. Science is always developing and changing. (Sasha, FI1)
>
> Science is fun and exciting. I never get bored. There is always something new to find out about. (Serena, FI1)

These examples reflect typical ways all fourteen participants described science. They emphasized the creative, problem-solving, and inquisitive nature of science. I was somewhat surprised at students' meanings of science because examples from the literature describe how African American students often find school science irrelevant or perceive themselves as relative "outsiders" (Aikenhead, 2006; Brickhouse, 1994; Brown, 2004). However, this was not the case in this study. Students did not describe any negative perceptions about science or themselves; they liked science. This is significant because a prevalent argument used to explain the underrepresentation of African American students in science suggests that they are just *not* interested in science and

science-related careers (Jayarante, Thomas, & Trautmann, 2003). A counter argument to the "interest" explanation suggests that underrepresentation is not just about getting students interested; but, rather, it is a problem of persistence (Carlone & Johnson, 2007; Lewis & Collins, 2001). That is, there are many African American students who already find science exciting and who see themselves as individuals well suited for science—as was the case with students in this study.

Scientists as inquisitive. I asked students to describe how they saw themselves in relation to science before the academy. Twelve out of fourteen participants described themselves in some way as "a science person" (Natalie, FI1) or as individuals who have "always been into science" (Will, FI1). When I probed to further understand their meanings of "science person", students described personal characteristics they felt aligned with science.

> I don't know. I think I have always been the type of person who literally dreams. It is always- you know -the things that seem the most crazy or the most outrageous that always attracted me. Like when I was a kid, daydreaming was my thing. My mama had to snap me out of that because all day when I was in school that is what I did; I day dreamed. But it was the Frankenstein thing. Could I really create another type of person? And science is the closest thing that I can come to that because they are things that you will never hear about. They do amazing things in labs you know. (Antonio)

Evident in this quote is the imagination and creativity that Antonio saw in science. Antonio was curious, he asked questions, and enjoyed learning new things. For him, these personal characteristics exemplified a scientist.

Other students cited the following characteristics: inquisitive, desire to discover new things, good problem solver, and persistent in solving problems. These self descriptors

highlighted the ways students saw their interests and personal characteristics as well suited for science. Two of the female participants, Jada and Serena, stated they were "more into math than science" (Serena, FI1) during elementary school. But, they qualified these statements and explained how they were always interested in science and performed well in elementary school science. Overall, these girls considered themselves "good" science students. Students' histories revealed that their *interest in* and *identification with* science was well established before they entered the Academy. Next, I describe students' early experiences with science both in and out of school. Their recollections shed light on how they came to see science and themselves.

Early Experiences with Science

Students described many rich science experiences during their early childhood and were excited to talk about these early science memories. Every student shared numerous positive memories of science in elementary school. For example, they enjoyed hands-on activities, experiments, and projects such as hatching chicken eggs and dissecting worms or owl pellets. Many participants even credited their interest in science to good science teachers who "led me toward science" (Jada, FI1). Dante described how his elementary teacher would design "little investigations that would always keep us wondering" (FI1).

Ten of the students remembered participating in school science fairs. Three of the female participants were chosen during elementary school to participate in a summer program for accelerated science students at a local university. Taken as a whole,

participants' interest in science persisted throughout elementary and middle school and had a bearing on their future career goals.

Students also engaged with science outside of school and were involved in several informal science experiences. As students told their stories about science outside of school, I could hear how these experiences piqued their sense of wonder and discovery.

> There was this one time that I wanted to know why is it that when you put pepper in water and you take soap on your finger it disperses. So I just wanted to find out why it did that. So I was just sitting there looking at it for an hour or two trying to figure it out. (Marcus, FI1)
>
> Yeah, I was always outside playing with dirt…to see what I could find - and planting flowers with my mom. (Ebony, FI1)
>
> Me and my brother--we would have a tape-recorder like this [points to the recorder used for the interview] and once it stopped working - that was even more fun because that meant we could just take it apart. That was fun. (Antonio, FI1)
>
> I used to just wander off to play with the little animals and stuff, if you consider that science. I was always looking for stuff and digging for worms. (Dante, FI1)

These examples show the ways students centered science in their free-choice activities at home. Additionally, students shared fond memories of visiting museums and zoos with their family or church organizations. For example, Antonio lived in the city and had a museum within walking distance of his home.

> My mom, she always liked going to aquariums and zoos and stuff. The science museum was right by my house. So we were always going somewhere. I guess—because I had four brothers and sisters so we had to keep busy. My mom wanted to keep us busy. (Antonio, FI1)

Dante explained how, in an effort to keep him "out of trouble" and "safe", his mother

encouraged him to get involved with a youth program at their neighborhood church (FI1). He explained how the church group provided opportunities to visit the zoo, learn about gardening, and go camping. Overall, ten of the participants mentioned visiting a science center, zoo, or museum as a child. Seven students specifically mentioned church as a resource for informal science opportunities. For example, Brittany learned about growing plants by working in flower gardens at her church. Curtis, Marcus, Sasha, and Jada all took church trips to the zoo. Serena described visiting the elderly in nursing homes when asked about informal science opportunities with her church. In sum, students held fond memories of school science and rich out-of-school science experiences.

Students' stories presented here counter deficit perspectives often used in the educational literature to examine and explain schooling experiences for students of color (Solorzano & Yosso, 2001). One prevalent argument for African American students' disenfranchisement with science emphasizes their lack of interest, linguistic repertoire, culture, and quality formal and informal science experiences (Calabrese Barton & Lang, 2000; Fadigan & Hammrich, 2004; Jayarante, Thomas, & Trautmann, 2003; Kahle, & Meece, 1994; Lee & Fradd, 1998; Oakes, 1990). This argument blames individual students for their underachievement and underrepresentation. However, participants' stories presented throughout this section provide a counter-story (Tate, 1997) to the deficit perspective. Participants' narratives were filled with examples of their rich science histories. The data presented in this section allow for African American students' voices to shed light on their lived experiences with science. In all, participants' experiences resulted in their desire to engage with and pursue science. The next section, I discuss how

students envisioned science and their future careers.

Research Sub-Question (b): Students' Science-Related Futures

In this section, I discuss how students envisioned their futures. I first lay out participants' intended careers prior to the Academy and the meanings they attached to those careers. Then I explain how their career goals intersected with both science and altruism. Students saw science fitting in with *who* they wanted to become and *what* they wanted to accomplish in their futures.

Understanding students' visions for the future is important when examining critical science agency. Conceptions of agency imply elements of both imagination and taking action. For example, Holland and colleagues (1998) view agency as a modification, "of one's environment with the aim, but not the certainty, of affecting one's own behavior" (p. 38). Further Basu (2007) argued that agency has two phases. First individuals must consider agency by setting goals or imagining a possible action intended to bring about some change. Second, individuals take action to bring about the change. These actions are considered "critical" when they are aimed at social or personal transformation. Thus understanding students' intentions surrounding their future career and science will provide insights into how the Academy either supported or not critical science agency. Drawing from Basu's (2007) work, I focused my data analysis on instances where students stated their future goals, desires, and visions of themselves as future health care professionals. I then examined these instances for "critical" intentionality—ways students

intended to use science for change. In the next section, I present the major themes that resulted from my analysis.

Students' Meanings of a Science-related Career

I operationalized the agency construct through an examination of students' meanings—aspirations, motivations, values and images—that buttressed their career decisions. When asked why they chose to pursue a career in the health sciences, students' responses fell into the following three categories: (1) they had an interest in science, (2) they wanted to improve their personal economic and social conditions, and (3) they held images of becoming altruists.

Interest in science. Students were interested in the content of science and enjoyed taking science courses in school. Every student mentioned "interest" when asked why they decided to pursue a science-related career. As Brittany offered, "I was really excited every time that I looked at my schedule and saw something with science" (FI1). Participants' expressed interest centered on the science content related to anatomy, biology, and chemistry. Students explained how the human body captivated them and they wanted to learn more about how it worked.

> I'm very fascinated by it, you know. It's kind of amazing how like, um, how we reproduce, other species reproduce, you know. How everything in the body is tied to each other to make everything go." (Jada, FI2)

Participants' career choice was connected to their interest in science. But also, their career choice was spurred by their personal and social aspirations that they envisioned possible with a science-related career.

Economic stability and mobility. When discussing their futures, students often couched their responses within a socioeconomic context. Overall, ten participants referenced how a future science-related career would either provide them with economic stability or mobility.

> Doctors and nurses are really needed with the shortages and everything. (Natalie, FI1)
>
> Because science is really needed—there are a lot of good jobs. (Brittany, FI1)
>
> It prepares you for careers that are in need. (Serena, FI1)
>
> It [science] will play a big part in everything, as far as people's jobs --that you can get. (Ashley, FI1)
>
> The medical field is going to always be around. It's always going to be around and that's a guarantee with the job. I want a steady job. I don't want to, you know, be worrying about finding a job and stuff like that. So, I want a job in the medical field, you know--because that's going to be around." (Jada, FI1)
>
> A big variety--you get to pick from ten or eleven jobs that pay better. (Antonio, FI1)
>
> And that is another reason that I look toward the medical field because it is always a guaranteed job. Business and housing and stuff like that are fine and all but the way that the market is falling they might not be that good of a choice. There is a big demand for males [in health science careers] and they get paid at least twenty dollars an hour. (Dante, FI1)

Participants' future careers in health care symbolized stability because these careers were in demand and offered high pay. Their concern for job stability was connected to

their personal experiences. Students and parents referred to instances of recent job losses by family members, friends, and community members, and it was apparent how hard economic times had touched their lives.

Participants described how their future career had the promise for economic mobility. Students shared very personal stories of how their parents struggled to support and provide for their families and they did not want to experience the same struggles. In the excerpt below, Dante talked about his father's economic struggles.

> I am taking a different path than him. What he did took him to where he is today. So, I need to make sure that what I am doing is going to get me in the right place and I need to be successful. (Dante, FI2)

Dante witnessed first-hand the difficulties his father experienced in life. Dante was certain that he would find success through a medical career and end his personal history of struggle.

Roxanne also shared how her personal and family circumstances compelled her to pursue a dental career.

> I am not going to say-well my family background-I do not come from a real, real poor family and I do not come from a rich classy family. But my Grandma, she works hard for our family-her kids, her grandkids and her great grandkids. Then as I was growing up, I look at my uncle and he has struggled and struggled. He was a barber and he used to make good money. But now there are so many of them [barber shops]. It is a lot harder to make it. Someday I feel like I will make it and I will be at a point where our family does not have to struggle. (FI2)

For Dante, Roxanne, and others, a career in health science signaled hope for a better life.

> It gives me a big head start--because we do not make much [money]. Now, I can get that first year and then I can go straight to college and then a good job. (Brittany, FI1)
>
> I have seen the houses that doctors live in…and then look at where I live. (Will, FI1)
>
> If you have the education and the--you want to learn--you can go far. If you want to go to college you can have a different life. [In medicine] there are so many jobs-good jobs-that you can pick. (Ebony, FI1)

Evidenced by these examples, students perceived a science-related career as a means to improve the conditions of their lives and the lives of their families. Their words hint at the potential for college and a science-related career to lead to future economic transformation. Parents also expressed how they wanted a "better life" (Barb, parent interview) for their children. Parents, like their children, believed a health science career could provide both economic stability and mobility (Tonya, parent interview; Shelly, parent interview).

Students' reasons for pursuing a science-related career are examples of critical science agency. Embedded within their responses were feelings of hope for a better future. These intentions were "critical" because they sought to improve their economic conditions. Students perceived a science-related career as a means to that end and they appropriated science in hopes of transformation. Next, I discuss how students envisioned science as a way to change more than their *personal* economic circumstances.

Future selves. Students saw a science and a science-related career as a tool for agency. A science-related career represented an avenue for them to act upon their altruistic goals. Their futures visions painted a picture of individuals who used science in

ways that impacted the lives of others. I present here a description of how students imagined themselves and their futures in relation to science.

To remind the reader, identification is a central component of critical science agency—whereby students' identities develop within their world and/or the world of science. Thus, understanding the nature of students' future identities is necessary to recognize the ways in which the Academy supported (or not) these identities. In his book, *Communities of Practice: Learning, Meaning, and Identity*, Wenger (1998) outlined how images of ourselves and of our futures are important components for identity formation. For Wenger (1998), *imagination* characterizes the process by which new images and new relations over time become part of the self. He argued that:

> […] identification depends on the kind of picture of the world and of ourselves that we can build. It depends on the connections we can envision across history and across the social landscape. Through these connections, identification expands through time and space, and our identities take on new dimensions. (Wenger, 1998, p. 194)

Imagination proved to be a useful concept during analysis. I looked for instances in interview transcripts that captured elements of students' imagined selves and how those images were related to science or a science-related career. Students' "imaginings" illuminated the intersections between students' pursued career trajectories and the Academy's trajectories. To explain how the Academy supported (or not) the identity aspect of CSA, I carefully examined these intersections. I discuss the Academy trajectory in more detail in Chapter V. Next, I present students' intended careers upon entering the Academy and then discuss how students described their future selves.

Intended careers upon entering the Academy. Students wanted to become doctors, nurses, medical researchers, and dentists. Table 7 lists the variety of careers students intended to pursue upon entering the Academy.

Table 7. ***Students' intended career trajectories upon entering the Academy***

Student	Career
Brittany	Pediatrician
Ebony	Physician or Nurse
Serena	Physician
Ashley	Physical Therapist
Jada	Optometrist or Ophthalmologist
Roxanne	Dentist
Natalie	Nurse
Sasha	Research Scientist (Medical research)
Will	Engineer (Biomedical)
Marcus	Physician
Antonio	Physician or Hospital Administrator
Joel	Physician or a career in Astronomy
Dante	Physician or Psychologist
Curtis	Pediatrician or Obstetrician

The majority of the participants (12 out of 14) made their choice to pursue a science-related career during middle school or grade nine. However, two students, Natalie and Dante, expressed the desire to pursue a health science career as early as elementary school.

> Yeah, ever since I have been in Kindergarten. I used to draw pictures of nurses and stuff. I always wanted to be a nurse. (Natalie, FI1)

Below, Dante talked about a doctor kit that he received as a young child.

> Yes, my cousin got it for me. She used to work at a gas station and I saw it. It has everything in it and I wanted it so bad. She finally got it for me. I just remember going home and I would steal my sister's baby dolls just to hold the ear piece and take their temperature. And then, my dad -I would put something under his arm and say, 'I am just taking your temperature now.' I used to put band aids on him and everything. (Dante, FI1)

Dante shared how this toy sparked his interest to become a doctor.

Even at an early age, Natalie and Dante were interested in pursuing a science-related career. That is, their goals were present before they entered the Academy. Thus, the Academy did not influence these *initial* career choices and imagined identities. Participants were drawn to these careers because they represented an avenue to express their altruistic goals.

Altruists. Students imagined their future selves as individuals who would use science in the service of humanity. With a science-related career, students sought to change the conditions of their lives and the lives of others. All fourteen students held altruistic aspirations centered upon helping others or giving back to their community in some way. The following representative examples provide insight into how students saw themselves and their future contributions to society.

> I have always been the type of person who likes to help people out. So I feel like being a doctor is a great way to see first-hand how you are making a difference or making a change. Also giving back to my community, I have always been

> interested in the need for better healthcare for underrepresented populations. (Curtis, FI2)
>
> I think this career [Ophthalmology] is a way for me to help others by improving their sight. (Jada, FI2)
>
> I want to be a pediatrician so I can help them [children]. It is not just that I want to help them. I want to start a program for single parents-that need help- and help them out with money and financial situations. You know, if they need to go to the doctor. (Brittany, FI2)
>
> Everybody needs a dentist and I could be helping other people. (Roxanne, FI2)
>
> So, I mean helping people--I think is the only thing that-- I think when I lay on my death bed and I think about all the things that I did that is going to be the thing that makes me proud and lets me be at peace. (Antonio, FI1)
>
> I want to be able to give back to someone else….make an impact on my community. (Serena, FI1)
>
> I just like helping people and I that's just the bottom line. I think this job [as a physical therapist] —with this job I can do that [help people]. (Ashley, FI1)

Participants shared their future intentions with an unmistakable passion. A health science career aligned nicely with students' altruistic aspirations; they all shared a concern for humanity. For example, they wanted to provide free health care or begin a program for single mothers.

As students discussed their future intentions, they often cited health care injustices they had witnessed personally or within their neighborhoods.

> I have been to visit people in my family and I see the way that they treat the patients and it is not all that great. (Antonio, FI2)
>
> My grandmother she needs heart surgery because her arteries are clogged. Now, the thing about this operation is that she does not have the money for it. So, she cannot get the surgery because she cannot afford it. To me that is like murder-almost. (Marcus, FI2)

For Dante, a very personal experience motivated his altruistic goals.

> A couple of years ago, I had a hip surgery. My hip bone had broken and I just got surgery on it. The doctors told me that I was not going to be able to walk again. But you look at me now and I am walking and I lost a lot of weight. So, my think was, if I can recover from something like that well maybe it is my job--for my community--to go back and to encourage other people. Because when I went through my surgery, there was no one there to encourage me. No one cared. (Dante, FI1)

Participants experienced these injustices first-hand and were determined to make a change.

In the next examples, Roxanne and Philip reflected on the health care conditions within their community.

> You know some of the doctors accept Medicaid and Medicare. But some say that some insurance is not good enough and they only accept cash. They do not care about that [some people cannot afford to pay]. You know people need their health and some people cannot afford to get cared for. Their body is in need and it should not be that way. It should not be that way. I understand that you have to keep a business running but I also think that you should help out those that are in need. (Roxanne, FI1)

> Doctors--they should not be charging them to treat them. They just can't [pay]. (Philip, FI2)

As evidenced above, students were aware of health-related issues and struggles faced by marginalized members of society. In all, participants were determined to improve the health care within their neighborhoods and the larger world.

One participant's career goal was inconsistent with other data. Joel was not entirely sure about a career in health care when he entered the Academy. He had a strong interest in Astronomy since childhood. However, Joel believed it was necessary to find a career

that would allow him to give back to his community. The altruistic nature of a health science career appealed to him. Needless to say, Joel decided to apply to the Academy because of his strong humanitarian commitments. He was compelled to make his community a better place (FI1). Even with his uncertainty about health science, he was sure about his imagined altruistic identity.

The centrality of altruism in students' science-related goals is a significant finding. It adds to a small amount of literature that has looked at the science career trajectories of historically underrepresented individuals in science. For example, the women of color in Carlone and Johnson's (2007) study cited an interest in humanity and altruistic career goals as reasons for pursuing and persisting in a science or science-related career. Similarly, Lewis and Collins (2001) found that activism and helping others were significant goals that undergirded African American students' science-related career decisions. Many people informally cite "altruism" as an important career goal for African Americans; yet, there is surprisingly scant literature that mentions this as a finding.

African American students' inclusion of altruism as a prominent motivator for their science-related futures is better understood when we consider the collective history of the African American community. During the 1930's, in an effort to address the oppressive economic, social, and political conditions of African Americans, W. E. B. DuBois advocated for communalism within the African American community (Alridge, 1999). He proposed that the African American community come together and strengthen their economic and social networks to uplift the collective. He believed this was necessary to bring about social, economic, and political change in the larger society.

Similarly, Carter G. Woodson (1933) called upon African Americans to commit to service for their community.

> If we can finally succeed in translating the ideas of leadership into that of service, we may soon find it possible to lift the Negro to a higher level. Under leadership we have come into the ghetto; by service within the ranks we may work our way out of it. Under leadership we have been constrained to do biddings of others; by service we may work out a program in the light of our own circumstances. (Woodson, 1933, pp. 118-119)

The writings of DuBois (Alridge, 1999) and Woodson (1933) bring to the fore how the importance of community and the imperative to help one another is deeply embedded within African Americans' collective history. Situating the findings of this study within a historical context sheds light on why all participants' shared altruistic goals and viewed health science as a way to realize these goals.

In all, participants' intended altruistic aspirations were part of the science identity roles they desired for themselves in health care. Students considered science (and a science-related career) as a way to participate in society in new and different ways. However, salient differences did exist in the ways male and female students imagined their future altruistic identities. Figure 4 provides a graphical representation of the contrasting aspects of their altruistic identities.

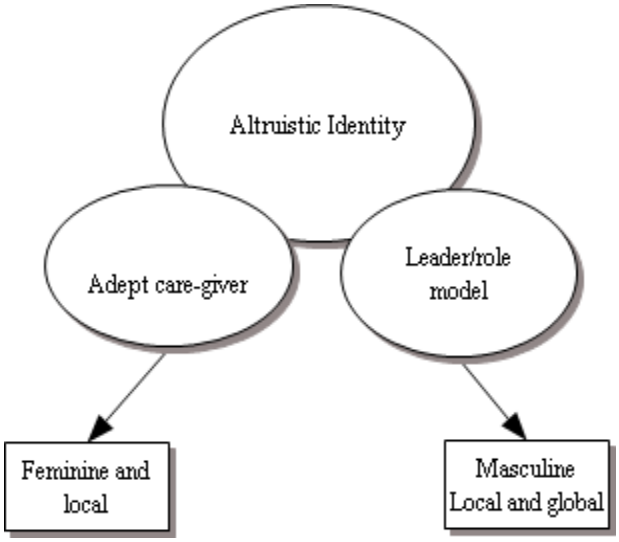

Figure 4. ***Gendered aspects of altruistic identity***

Adept care-giver: Having the "blue blood". Female participants imagined themselves as adept care-givers. They hoped to help others by providing health-care in a very hands-on fashion. I probed female participants to provide examples of how they wanted to help others through a health science career.

> I want to learn the different diseases and the cures for them and helping patients. (Brittany, FI2)
>
> I plan to give back by providing services for children that have no medical eye coverage. (Jada, FI2)
>
> Because some people cannot afford to go to the dentist - I feel that if I keep going in dentistry then I can maybe help people out those that cannot afford it [dental care] and have my own business. (Roxanne, FI2)
>
> You know-seeing all the people get hurt and rehabilitation-and-I like I like doing that kind of stuff. (Ashley, FI1)
> I love kids. I want to work with kids because it's more --you feel more helpful to people that aren't—like--able to take care of themselves. They are innocent. Most of the things that happen to kids, it's not normally their fault. I can help them. (Sasha, FI2)

> I want to help others--basically to help others live to be healthy--So that people can be built up and not torn down (Serena, FI1).

As these representative examples demonstrate, female participants' future images of self centered upon giving care directly to patients. Roxanne wanted to own her own dental business to provide affordable dental care to her community. Natalie wanted to become a competent and compassionate nurse and improve the quality of care available in her community.

Female participants often highlighted how their personal characteristics aligned well with their imagined future selves. For example, Ebony explained how she "fit" with the image of working in health care because, "I'm a social person. So I like to be around new people, different people, everyday—you know—get to know them and their life story" (FI1). Sasha admitted that she has "the blue blood for it" (FI2), borrowing the term "blue blood" from her mother, who worked as a certified nurse assistant. Her mother explained to me what it meant to have the blue blood:

> Blue blood is something that you need to have to work in the health field. If you have the blue blood- you know- you'll stay there 12 hours. If you're on call, you will go back to that hospital no matter how tired you are. You don't give up until you're satisfied with a patient's condition. You know that you're giving your best. You are giving them [patients] the best medicine-the best that's humanly possible. (Barb, parent interview)

Female participants exhibited caring and compassionate traits; they were nurturers. They felt that these traits were essential for an adept caregiver identity. The way females aligned themselves with a feminine altruistic identity is important to understand how they made sense of their Academy experiences.

Female participants envisioned their future selves as individuals who acted locally. When females talked about helping others and giving back, they referred to their immediate community. I did not see a global element in their descriptions of future selves. For example, they did not refer to African Americans' health care concerns on a global scale. Instead, the females wanted to improve conditions locally, in their own neighborhoods.

One female participant, Sasha did allude to having a more global perspective. Sasha was very interested in medical research and wanted to improve children's health through her work. She wanted to make a contribution to the medical field by researching and finding cures to childhood diseases such as diabetes. Her intentions had a global reach. She referenced children, in general, not only children in her community. As I discuss in the next section, males imagined a much different altruistic identity.

Leaders/Role models: "Obama is in da' house". Males imagined themselves as leaders and role models for the African American community. The males were compelled to change the social and economic conditions of the African American community through leadership. As Marcus explained, "…leadership is definitely important" (FI2) in the African American community. When males talked about their future selves, they mentioned prominent black leaders such Jessie Jackson, Gandhi, and President Obama. Dante felt it was his duty, as a young African American male, to "…inspire other people to do better and to strive to be better. Otherwise there won't be another Obama in da' house" (FI2). Each male participant recognized a certain status associated with a science-

related career. They drew on very accessible masculine models of "success" to take on leadership roles within the African American community.

They were very aware of society's negative perceptions of African American males and wanted to use their status to combat racial stereotypes. For example, Dante shared that young black men in today's society are labeled automatically as someone who, "must have a bunch of kids or an STD" (FI2). Additionally, Will gave insights into his lived experience as an African American male.

> For me—when people see me, they see my size and my skin tone. So what happens is that I am already in one category. My job is to exceed their expectations and to show them what I am. (FI2)

Will went on to explain that because he was black, tall, and muscular many in society assumed he must be a trouble maker or that his abilities and aptitudes were limited to athletics.

Evident here is how racial and gender categories shaped their future goals. This finding extends the work of Tyrone Howard (2008). Howard examined how race and racism influence African American males' schooling experiences. The participants in his study were very aware of how race shaped how they experienced and perceived school. As Howard (2008) explained:

> Critical to each of these young men, were explicit attempts to not reinforce widely held beliefs and stereotypes about African American males. Most of the young men in this study attributed much of their academic success to their desire to challenge negative stereotypes about young Black males. (p. 969)

The males in Howard's study were determined to combat negative stereotypes about African American males through academic success. Likewise, males in this study believed they could use a science-related career—and associated status—to combat racism.

Each male participant talked about the pressure and responsibility they felt to change the pervasive, negative perceptions of African American males. As Curtis stated, "I have always felt a pressure to not be a statistic—or to beat the stereotypes" (FI2). Attainment of a science-related career was one way to change society's negative perceptions.

> I guess it [a science-related career] would make us the same as everyone else. Well, we [African American males] would be seen differently, like that we are not lazy or going to jail all the time. (Marcus, FI2)
>
> Yes, I mean, if I flourish from my career then I am definitely going to give back. You know set an example. (Joel, FI1)
>
> I feel like being a doctor or being a lawyer or a professor, will make you stand out and change some of those ideas because it is not expected of you. (Curtis, FI2)

As these examples demonstrate, males wanted high status leadership roles to fulfill their altruistic goals. Though I probed during interviews for more concrete examples of possible leadership activities, they found this very difficult. For example Joel explained that, "… if I am successful I could do something to change things in this community—you know—to have more—to make more—opportunities for us [African Americans]" (FI1). Clearly, Joel did not articulate exactly how he would change his community. Unlike the females who had fairly developed altruistic plans, the males found it difficult to make tangible connections between their future careers and humanitarian

commitments. They did not have an exact plan about how they might act upon their intentions.

The males' altruistic identity was decidedly more masculine than the females' altruistic identity (i.e. leader/role model vs. care-giver). Male participants did not necessarily see themselves involved in direct patient care or talk about themselves as nurturers. However, they held a different kind of critical perspective than the females. They aspired to be role models who could motivate and uplift the African American community as a whole. The males, at times, referenced their local communities. But more often, males discussed stereotypes as a society level issue. They did not think that these stereotypes were unique to just their local community.

In contrast, the females talked about taking action much more locally. Their discussions about future contributions to society targeted local issues such as the need for better personal care or the need for programs to assist underserved populations in their immediate communities. During our discussions, female participants did not make explicit connections between local health care disparities and larger historical issues of race and class. It is possible that they did understand these connections but thought these issues were too difficult to discuss with a white women. The contrasting local/global perspective is essential for understanding the gender differences that surfaced during the internship. I discuss this in more detail in the next chapter.

The altruistic identity all participants imagined for themselves was more complex than the simple desire to be a doctor or to learn the content of medicine. Instead, students envisioned their future selves as individuals who could use science to improve the lives

of others. I sensed that the participants' desire 'to help others' was not simply a *choice*; but it was a *necessity*. As Dante's words revealed, "…it is our job and our duty to help and inspire everyone". Over the course of the study, I sought to explore the sources or factors that influenced participants' altruistic values, goals, and images of their future selves. I discuss these factors in the next subsection.

Factors that Influenced Career Choice and Altruistic Goals

In the previous section, I discussed the centrality of altruism in African Americans' history. I wanted to understand more about the resources participants' drew on to make these commitments. What critical experiences or influences compelled them to follow an altruistic career trajectory? Did the Academy play a part? Were there similar themes that cut across the group? I probed students for information to better understand these questions. Then during analysis, I looked for references to human (e.g. family member), material (e.g. television programs), or institutional (e.g. school) resources/factors (Calabrese Barton & Ortiz, 2008). My goal was to tease out these influences and get a clearer understanding of the Academy's role in students' career choices. When asked about what influenced their initial career choice, students named: (1) the media/society, (2) family/community, and (3) their church as sources of influence.

Media and society. The media and society had an influence on career choice for many participants. Students watched shows such as *ER, Grey's Anatomy*, and the *TLC* channel—all which depict health care professionals working in various settings. Thus, work in health care as it was portrayed on television was exciting and dramatic. They

talked about how these health care professionals really seemed to make a positive difference in the lives of their patients. In addition, participants felt that society—in general—considered careers in medicine to be noble. Students felt that society "looked-up" (Will, FI1) to people in health care professions and they sought this kind of recognition. This finding is consistent with other literature which highlighted the role of the media in the career development of adolescents (Hoffner, Levine, Sullivan, Crowell, Pedrick, and Berndt, 2006; Signorielli, 1993). Hoffner and colleagues (2006) found television, in particular, had a significant influence on the future career aspirations of economically disadvantaged youth.

Family and community. Participants' family and community influenced their goals. However, data analysis revealed slight differences between the males and females. Many female participants talked about family members who worked in health care as nurse assistants. All but one female talked about shadowing aunts, mothers, and older sisters at work before they entered the Academy. The participants had career-related conversations with these individuals and they strongly influenced females' career-related decisions. It is possible that these experiences contributed to the "local" aspect of female participants' future identities that I discussed in a previous section because females' immediate, informal social network included career-related role models.

Males talked about the role of family and community differently. Family and community also had a large impact on males' altruistic goals. However, they did not have informal experiences like the girls (i.e. shadowing family members in health care facilities). Instead, family influence looked more like support and encouragement. For

example, males continually received messages about the importance of contributing to society in positive ways. Marcus explained, “My father talks to me about what I am going to with my life almost every day” (II1). Their families and communities expected them to make a difference in the future. Below, my discussion with Dante highlights this expectation.

Julie: What are your family’s hopes for your future?

Dante: To be better, to be successful.

Julie: What do you mean by successful? Talk about what successful means to you?

Dante: Making a difference (FI2)

My interview with Joel provides another example.

Julie: What motivated you to want to help others?

Joel: People in my family. My dad is always talking about giving back to the community. My grandma is always talking about never forgetting where you came from. (FI1)

These examples demonstrate how family and community encouraged the males to set and fulfill altruistic goals. However, this encouragement did not explicitly connect altruism to health science careers. Most male participants did not have anyone in their immediate families who worked in the health field. Dante was the only male participant who mentioned an aunt who was a nurse. However, Dante’s aunt lived a fair distance away and he had limited contact with her. He did not feel she had an impact on his career decision. Conversely, girls’ shadowing experiences did allow them to experience altruism

in health care more directly. Perhaps these experiences allowed the females to create more concrete images of their future selves. Overall, males and females had tremendous support from their family and often received encouragement to go to college.

The literature regarding career development for African Americans cites "family" as a source of influence, support, and motivation (Moore, 2006; Pearson & Bieschke, 2001). For example, Pearson & Bieschke (2001) examined the career development of African American women and found that parental values, expectations, and encouragement impacted their career attainment. Furthermore, Moore's (2006) work specifically examined the science career trajectories of African American males. Again, many of the participants in Moore's study cited the role of family members as an important influence on their career decisions. Many of the participants' parents had science careers or occupations that utilized scientific knowledge and skills such as a microbiologist, engineer technician, and electrician. My findings are consistent with this literature.

Church. Twelve of the fourteen students pointed to church as a major influence on their career choice and altruistic goals. Role models in the church who worked in health care provided mentorship for some of the females.

> I talk with some of the people who work and volunteer in the nursing homes. I tell them that I want to be a doctor. I wanted to know more about the nursing homes—so they talk to me about how they have to care for the patients. It was great. It made me want to keep going. (Brittany, FI2)

> Someone who goes to our church is a nurse. She is--I think--on her 20th year. She is working on getting her master right now. She is the one who has encouraged me to keep going. She has told me so much and I am like, "wow, you have accomplished so much". I would love to accomplish as much as she has. There is a lot of influence in the church because a lot of people have done stuff. (Serena, FI2)

For others, the church helped develop their altruistic goals.

> We have food drives and clothes to give to the community. (Jada, FI2)
>
> During Thanksgiving and Christmas we give away dinners to people who are in need. Even if you are ok and have what you need for Thanksgiving and Christmas you can still stop by because you never know when you may need the help. Also, we give away food to families for anyone who needs things. Sometimes we collect money and actually go buy the stuff that the people needs. So we are really about giving back to the community. (Roxanne, FI1)
>
> As far as with my church, I feel that our time here is temporary. So, it does not matter what you have; it is about what you did while you were here. It will mean nothing if I made a million dollars but never really did anything in my life for others. I really want to teach at the college level and somehow start a scholarship so that more AA students can go to college. My church definitely had a big, big deal to do with that [altruistic goals]. (Curtis, FI2)
>
> We have speakers that come to my church at least once or twice a month. She [church leader] always brings in someone that has made it--you know they made it. We always have people come to our church to speak to us and encourage us to just keep going. […] Careers that could help others were always encouraged. (Dante, FI2)

The church undoubtedly was a strong influence for the participants. In table 8, I provide a componential analysis (Spradley, 1980) to display the source of influence regarding career choice for each participant.

Table 8. ***Source of influence on career trajectory***

Participant	Media/society	Family/Community	Church	School
Brittany		X	X	
Ebony	X	X	X	
Serena		X	X	
Ashley	X	X		
Jada	X	X	X	
Roxanne	X	X	X	
Natalie		X		
Sasha		X	X	
Will	X	X	X	
Marcus	X	X	X	
Antonio	X	X	X	
Joel	X	X	X	
Dante	X	X	X	
Curtis	X	X	X	

It is striking that students did not mention school as an influence on their career decisions. Given students' positive experiences in school science, I expected school to play a major role. I even probed students about whether or not school helped them decide on a career trajectory. None of the students remembered learning about science careers, science-related careers, or *any* careers during elementary or middle school. Given this, students still recognized that science would play a major part in their career trajectories.

The fact that these students drew upon familial connections and histories is important. Holland (1998) explained that "one's history-in-person is the sediment from past experiences upon which one improvises, using the cultural resources available, in response to the subject positions afforded one in the present" (p. 18). In my study, students' history-in-person was comprised of economic struggles, exposure to healthcare injustices, and the hope for a more just society. These histories helped shaped students' meanings of a science-related career and their future selves.

Furthermore, family members who worked in health care served as immediate role models for female participants. This may partially explain why females, as compared to males, had more well-defined future selves. For example, Brittany talked of starting a program to help single mothers with health care. Conversely, male students had difficulty providing concrete examples of how they may use science to impact the African American community.

However, Holland and colleagues (1998) caution how past histories can make individuals "susceptible to the situational determinants of their production" (p. 46). Students', especially the girls', informal connections to health science were limited to low-paying, low-status positions within health care. Lewis/Mutegi (1999; 2009) argued that institutional racism has historically prevented many African Americans from holding powerful positions within science. When considering issues of underrepresentation, it is necessary to understand the resources (i.e. informal familial networks) that students draw upon when making career decisions; it forces us to pay attention to how social inequities (i.e. of African Americans as laborers) get reproduced. Students' familial connections

played a major role in supporting their career trajectories. I discuss this further in Chapters V and IV.

Academy as a Resource

Students sought out the Academy as a resource to support their career trajectory. Parents shared with me how their children researched the different high school options available to them. Many students attended informational meetings such as the school district's magnet fair and some researched school websites to find information about different high school options within the district. During student interviews, I explored their reasons for applying to the Academy. I grouped responses into the following two overarching themes: (1) innovative curriculum and (2) pathway to college and career.

Innovative curriculum. Students applied to the Academy because of the nature of the curriculum and learning experiences. Students liked the idea of a career focus because it gave them the courses they needed for college and future careers. As Sasha explained, "so in the Academy, they won't waste your time. I guess—like—you do not have to do unnecessary classes that you don't really want" (FI1). Hands-on learning experiences were important to the participants. They believed the Academy offered these kinds of experiences.

> I looked at the other schools and they did not really have hands-on that will teach you step-by-step about the medical field. So, I did my research. I even came on the tour here. One day we visited the medical class and they [the students] were really working. They had dummies and stuff that you could work with. So, that was what I really wanted. I wanted to go into it [the medical field] feeling like I know something. I did not want go into the medical field knowing that all I did

> was read a book. Because you can read a book all day but it will not help you know how to actually do the stuff. (Dante, FI1)
>
> No, um, to be honest no other school had what I was looking for, a way to learn what I really wanted to go to college for. Like, just to have that set pathway that I want to go to college for this [a career in health care]. (Sasha, FI1)

Students actively sought out this opportunity. This is another example of how students acted as agents by seeking out resources that would allow them to reach their goals.

Pathway to future. The Academy represented a pathway to their future careers. When asked why they decided to apply to the Academy, all fourteen participants' responses indicated that they believed the Academy trajectory aligned with their pursued career trajectories.

> Um, the fact that I want to become a Pediatrician. (Sasha, FI1)
>
> I always wanted to be a nurse. (Natalie, FI1)
>
> I was thinking that I wanted to be a doctor. (Marcus, FI1)
>
> I already knew that I wanted something in the health field. (Antonio, FI1)

Students felt they needed to have practical experiences in the health care field to reach their goals. Through membership in the Academy, they could "get a feel for what the medical field was all about" (Natalie, FI1).

Students also recognized that they needed to "get prepared for college" (Antonio, FI1) to reach their career goals. Participants trusted that the rigorous Academy curriculum would allow them to be successful in college. As Jada put it "I thought the Academy would give me a head start" (FI1). Students felt that the opportunity to acquire

career specific knowledge and skills and successfully move them toward their career goals.

Students and parents frequently used the word “opportunity” when talking about the Academy.

> It [the Academy] is a door to opportunity. (Dante, FI1)
>
> It [the Academy] offers you so much opportunity. (Ebony, FI1)
>
> My mom—she just talks about, “you know”, how when she was in high school they didn’t have the opportunity. (Ashley, FI1)
>
> It will give her opportunity. (Ramona, parent interview)
>
> The Academy gives them a choice. It is a wonderful opportunity—to be successful. (Tonya, parent interview)

I probed participants to understand what they meant by opportunity. For them, “opportunity” was much more than simply getting career experiences. The Academy represented a way to change their circumstances. For example, Joel explained that he felt that his employment opportunities were limited in his community and the Academy as an avenue to a better future.

> Joel: J: I always wanted to get out of [name of city]. I have wanted to get out so bad. I don’t want to say that nothing good comes out of here; but it is harder. Like with my cousins tell me, once you are in [name of city] you are stuck so I have always wanted to get out.
>
> Julie: What is the early college providing for you?
>
> Joel: A way out. I mean it is making it easier to get to college and therefore easier to get out. So, I just want to get out of [name of city].

Parents explained that many of the community's manufacturing jobs—available to them when they graduated from high school—were now gone. Students and parents believed the Academy offered needed career options.

> It costs a lot to go [to college]. The program helps me. (Brittany, FI1)
>
> We do not want our kids working at the mall. They have to go to college. The Academy does that. (Tonya, parent interview)

Both parents and students recognized college as a necessity for economic stability and mobility. As Will shared, "It [college] does get rid of a lot of obstacles, like to keep us from poverty." The "us" that he referred to in this statement is the larger African American community. For these participants and their families, the Academy and college signified a better future.

Summary of Chapter IV

In this chapter, I discussed students' personal science histories and how students defined their science-related futures. Participants' early science experiences—both in and out of school—spurred and supported their interest in science. An interest in the content of science, hopes of personal empowerment through science, and altruistic aspirations shaped students' meanings of a future science-related career. Students' imagined future identities that would allow them to pursue their altruistic goals. They drew upon many informal resources when making career decisions and viewed the Academy as a formal resource that would facilitate their science career trajectories. I discuss implications from the findings presented here in the last chapter.

CHAPTER V

THE HEALTH SCIENCE CAREER ACADEMY

The findings presented in this chapter address research sub-questions (c), (d), and (e). Below I list the primary research question and supporting sub-questions that guided this study.

Primary Research Question:

1. What is the potential of a High School Health Science Career Academy to support African American students' critical science agency and science-related career trajectories?

Sub-questions:

a. What were Academy students' personal science histories?

b. How did Academy students describe their science related futures?

c. How did the High School Health Science Career Academy define its potential in regard to Academy students' futures?

d. What were the meanings of science and science person produced in everyday practices in the Academy's culminating medical course and clinical internship? What meanings of science and science person supported Academy students' critical science agency?

- What meanings of science and science person truncated Academy students' critical science agency?

e. How did Academy students make sense of their experiences in the High School Health Science Career Academy?

I begin with a description of how the Academy promoted itself to students and parents. Next, I explain the meanings of science and science person produced within the culminating medical course and clinical experience.

The Health Science Career Academy

In this section, I address how the Academy defined its potential in regard to students' futures. For analysis, I attempted to understand this "potential" by examining the Academy's dominant discourse. Olitsky (2006) described dominant discourse as "entailing both schemas and resources, as they are composed of resources (the symbols that make up language) but also schema, in the form of the shared ideas, categories, positioning, perspectives, and typical ways of portraying types of people that are invoked through the use of particular language" (p. 748). Dominant discourses invoke particular meanings and subject positions such as "crazy" science teacher (Carlone, Haun-Frank, & Kimmel, 2009) or "potential" science learner (Olitsky, 2006). They operate through texts, images, and social practices (Gee, 2000). Thus, the Academy's dominant discourse implied certain meanings (i.e. institutional potential) surrounding the purpose of the Academy, the opportunities it could provide to students and families, science, science-related careers, and identities. The Academy's institutional potential was conveyed through documents such as recruitment materials, advertisements, and messages communicated by administrators, counselors, and teachers.

Peddling the "Institutional Potential" of the Academy

To get an idea of how the Academy marketed itself, I analyzed promotional materials and field notes from two sources—the district magnet fair and a school family recruitment night. The Academy presented itself as a *network* that offered multiple career trajectories in science-related fields. It conveyed messages about the possibilities available to students through their membership in the Academy. I refer to these "possibilities" as *institutional potential* which I describe in the following paragraphs.

The selling pitch given during recruitment nights and within advertisements implied the Academy would prepare students for a variety of roles in many areas of health care. For example, recruitment material stated that:

> [The Academy] of Health Sciences offers an opportunity for motivated rising ninth and tenth graders to prepare for a future career in the field of health science to include nursing, biotechnology, respiratory/physical therapy, pharmacy, or medicine to name a few. Students will have the opportunity to participate in internships allowing them practical experience in their field of interest. (promotional material A)

Clearly, the official discourse of the Academy conveyed the message that it provided many career trajectories in health science. This message was also conveyed to students and parents by school representatives during recruitment events. The district held an annual magnet fair that provided information regarding the various magnet options available to prospective students and parents. I attended this event and captured the following exchange between a prospective parent and the Academy coordinator.

Academy coordinator: Do you have a child who is interested in applying?

Prospective parent: My son may be interested in the medical field.

Academy coordinator: A career in medicine would fit under the health sciences umbrella. We say that these courses will lead to becoming a physician, radiologists, forensic scientist or similar fields within the health sciences umbrella. I have students who want to be veterinarians. I have students who want to be doctors. I have students who want to get into the school of nursing and even biotechnology. (Field notes, district magnet fair)

I also attended a family night at Edgeview High School. Again, the Academy conveyed the same message—it prepared students for multiple career trajectories. In the following excerpt, an Academy teacher detailed to prospective students and parents the variety of careers that past Academy students pursed.

> Most Academy students want to be doctors and, of course, nursing. In the past, I had a student who was interested in biomedical engineering and another who wanted to be a vet [erinarian]. (Field notes, high school family night)

Clearly, the Academy promised to support a variety of career trajectories in health sciences. To understand this potential in Nespor's (1993) terms, through membership in the Academy, students would be "hooked" to multiple career pathways and multiple roles. The Academy did not just prepare students to become nurses—a role typically associated with the term "health science". Instead, it claimed to prepare students to become medical researchers, physicians, and even health care administrators. The Academy communicated its potential through multiple avenues—promotional materials, recruitment events, and school representatives.

The Academy also promised a “rigorous and innovative curriculum” (promotional material C). Students would be introduced to the health field through hands-on activities and interactive internships where “students would receive real-world experiences” (advertisement insert/local newspaper, 3/2006). Students will learn diagnostic skills and how to use tools such as stethoscopes and blood pressure monitors (promotional material, B). Additionally, the Academy pledged to prepare students who are “successful in college” (advertisement insert/local newspaper, 3/2006). The Academy administrator mentioned college preparation during an interview, “what [the Academy] affords students is that they can get ahead in terms of their collegiate experience” (administrator interview A). In sum, the Academy assured the opportunity for students to build a strong academic foundation—necessary for a successful college experience and future career.

The institutional potential of the Academy conveyed a sense of power. First, the Academy portrayed prestigious careers. Largely, the Academy advanced career trajectories that aligned with professional positions (e.g. doctor or pharmacist) as opposed to entry-level kinds of positions (e.g. medical technician or nurse assistant). The Academy depicted health care careers as powerful by suggesting that they are a significant part of a “changing global economy” (advertisement insert/local newspaper, 3/2006). That is, a career in health science is a stable career choice given the uncertainty of the economy.

Membership in the Academy also conveyed as sense of power. Promotional materials contained messages such as “distinguish yourself from the competition” (advertisement insert/local newspaper, 3/2006), “graduate with the competitive edge” (promotional

material B), and “compete on an international level” (promotional material B). The words used in these slogans—*distinguish*, *competitive*, and *international* suggested that the Academy network was powerful and membership came with status. Further, students would “get ahead” (advertisement insert/local newspaper, 3/2006) or “get a head start” (promotional material C) on their futures because they earned college credit while still in high school.

Also important is the global nature of this discourse. As the school superintendent wrote in an editorial:

> Today we train for careers that did not exist even a decade ago. Our students are not just competing with those across the state; they are competing with those across the globe. To allow our students to thrive in an advanced global workforce, [the district] offers a variety of magnet and high school option programs. (advertisement insert/local newspaper, 3/2006)

Accordingly, participation in the Academy held the promise to connect students to multiple, powerful networks within science. Through membership students would gain the status, skills, and knowledge necessary to compete and succeed in their prospective career fields.

Alignment between “Institutional Potential” and Students’ Goals

Participants’ educational goals aligned nicely with the promoted institutional meaning of the Academy. Table 9 summarizes this connection.

Table 9. ***Alignment between students' goals and institutional potential of Academy***

Reasons for applying to the Academy	Institutional potential of Academy
• Students sought a variety of roles/identities within the health care field • Students sought an innovative curriculum. • Students sought experiences that prepared them for college and their future careers.	• Students could pursue a variety of health care careers • Students will get practical, hands-on experience in the health field as well as a strong foundation in science and math. • Students will acquire the knowledge and skills necessary for college and entry into their career.

Students came to the Academy with hopes of pursuing future careers as physicians, pharmacists, physical therapists, nurses, and medical researchers. They wanted an innovative curriculum that offered actual career experiences. Finally, students wanted to acquire the skills and experiences necessary for college and career success (Refer to Chapter IV). The institutional potential presented to students and parents supported each of the students' pre-Academy goals. However, these more meso-level meanings (i.e. institutional potential) did not necessarily reflect the more micro or local meanings of science and science person produced in the classroom. Next, I describe these meanings.

The Local Production of Science and Science Person: Meanings that Truncated Critical Science Agency

Within the culminating medical course, my observations revealed many interesting insights into how the Academy's institutional potential was realized in practice. To remind the reader, I concentrated my observations on this course for several reasons. First, the Academy touted this culminating experience as an innovative and distinguishing feature. Next, this course provided students with opportunities to engage in hands-on career experiences both in the classroom and in various health care facilities. Because of the specific career context and exposure to the medical field through the internship, this course was ideal for examining the institutional potential of the Academy and critical science agency. That is, this aspect of the Academy curriculum may have the potential to connect students to powerful disciplinary networks within medicine (Nespor, 1993) and support various career trajectories. Finally, data from the pilot study hinted at how this culminating experience created possible conflicts for some students—especially male students—and warranted further investigation.

My objective while analyzing and interpreting data was to understand what it meant to "do science" and "be scientific" in this setting. In short, I wanted to get at the meanings of science and science person. One way to get at meanings is through a close examination of the promoted practices—regularly occurring activities that use science/health care training in some way (Carlone, Haun-Frank, & Webb, in preparation). In addition, I categorized these meanings according to their potential to either support or truncate critical science agency. The supporting evidence is derived from my analysis and

interpretation of the activities, tools, and talk within the classroom and internship contexts.

While the Academy was meant to be an innovative context, the meanings of science and science person constructed within these contexts did not further develop the critical stances which students possessed as they entered the Academy. First, I present two meanings of science and science person that truncated agency—science as caregiver training and science/science person as low-status. By providing an in-depth description of the classroom and internship experiences and opportunities, I illuminate how these meanings were produced in everyday activity. This is followed with a discussion about the meanings of science and science person that had the potential to support critical science agency. I begin with science as caregiver training.

Science as Caregiver Training

> I was thinking that they [teachers in the Academy] would just lay out all kinds of occupations and I could just pick what I want. (Antonio, FI1)
>
> [I thought] that there would be so many different categories and you can do whatever. It [the Academy] would give you a variety--you know--options. (Ebony, FG1)

I begin with these statements because they reveal students' hopes upon entering the Academy. They also suggest that students bought into the institutional potential of the Academy—to prepare students for a variety of health care careers. However, in reality, science and health care was very narrowly defined. In essence, science was practiced as care-giver training.

Vignette 1. ***Knowledge required of a CNA***

"I am truly proud of your grades and your progress on the skills. However, we need a little more practice adding up intake and output. We are going to have a quick review. Once you memorize this it will become part of your daily practice." As students retrieve their classroom notes, Mrs. Mahoney begins a review to emphasis content students will need for the certified nurse assistant test. "What is considered intake and what is considered output? Give me some intakes."

"Water", a student offers.

"Jell-O", another states.

"Any liquid", a few students respond.

The class continues to discuss examples of intake and output. Mrs. Mahoney provides them with two problems that require the students to calculate intake and output. Students work out the problems with partners. After providing time to solve their practice problems, Mrs. Mahoney reads off the correct answers. She warns the students, "I cannot sign you off on intake and output unless you really know it and are able to calculate it. As a CNA (certified nurse assistant), you will need to know how to do this--anywhere you go." (Field notes, 04/02/09)

The first thing that surprised me about this class was its content. One look at the course content and associated skills and it is evident that this class prepared students to become caregivers—not medical researchers or physicians. For example, some of the

topics covered in class included: (1) safety practices in health care facilities, (2) infection control, (3) communication in health professions, and (4) ethical issues in health care. Appendix E displays a more complete summary of each topic covered in the course most of which or all of which related to preparing students to become adept caregivers.

Classroom activity followed a fairly predictable pattern. Mrs. Mahoney presented students with a "key" question and students found answers by reading their textbook, having classroom discussions, and practicing skills. Table 10 provides examples from a unit on *Safety Practices* that illustrate the kinds of questions and activities I observed in the classroom.

Table 10. ***Example of content, questions, and classroom activity from Safety Practices unit***

Curriculum Content	Key question	Corresponding Classroom Activity
Safety practices in health care facilities (body mechanics, fire safety)	What are some of the most common accidents in a nursing home facility?	• Teacher leads classroom discussion based on assigned readings • Students work on questions from the back of the text book
	How can you prevent injury to patients and yourself?	• Teacher leads classroom discussion based on assigned readings • Teacher reviews key vocabulary • Teacher demonstrates "good" body mechanics • Students practice "good" body mechanics

	• Teacher tests students on skill
How can a properly made bed prevent injury and harm to a patient?	• Teacher demonstrates how to properly make a bed • Students practice how to make a bed • Teacher tests students on skill
What kinds of technologies are used for patient transfer?	• Teacher demonstrates how to use transfer patients using belts and lifts • Students practice patient transfer • Teacher tests students on skill

As this example demonstrates, students learned content that was limited to the knowledge and skills necessary to provide patient care. Entry-level health care workers are typically responsible for transferring patients and making beds; physicians and medical professionals do not generally engage in these practices. Thus, the content limited students' opportunities to explore powerful knowledge associated with prestigious health care roles. I did not witness student engagement in any laboratory investigations that delved further into the topics covered in class.

For example, I expected perhaps an investigation on bacteria during the unit on infection control. Or, I thought students may explore issues of antibiotic resistant bacteria. I expected these sorts of activities because the Academy promised to provide students with the knowledge and skills needed to pursue powerful careers in health care. Students aspired to a career trajectory that will require a large amount of science

coursework. The activities that I expected develop skills students need for their future college coursework (Johnson, 2008). Further, the kinds of "thinking" and "grappling" students would engage in are representative of issues that doctors or other health care professions would explore.

A considerable amount of classroom activity was used to introduce, practice, and master skills related to personal patient care. For example, students routinely practiced bed making, transferring patients with wheel chairs and lift belts, techniques for cleaning patients, and changing adult briefs. Next, I present an example from my field notes that depicts skills practice in the classroom. In the following excerpt, Mrs. Mahoney introduced a new skill to the class. She demonstrated how to clean an incontinent patient using a medical mannequin in the classroom. This experience allowed students to work through a typical task they would be responsible for during the upcoming clinical experience.

Mrs. Mahoney: So this patient has wet the bed. You do not fuss at them. You just change them.

Mrs. Mahoney: First I need to remove the soiled pad and replace it with a clean one. The teacher demonstrates how to roll the patient and put a clean pad underneath them.

Sasha: Are you going to clean her first?

Mrs. Mahoney: No, I have to put on a clean pad before I clean her. The dirty pad will just soil her again. The teacher proceeds by putting a clean pad under the mannequin.

Mrs. Mahoney: You only expose the area that you need. Use a towel or the bed sheet to provide cover. Remember patient dignity. The teacher proceeds to demonstrate how to properly clean female patient. (Field notes, April 2)

Table 11 lists all the skills students learned during the classroom portion of the medical course. I categorized them based upon the nature of the practice (i.e. whether the practice was limited to providing personal patient care or if the practice could extend beyond this entry level position).

Table 11. ***Connection between classroom skills and possible health care roles***

Classroom skills	Limited to care-giving	Potential to reach beyond personal patient care
Applying patient restraints	X	
Bathing	X	
Caring for wounds	X	X
Changing adult briefs	X	
Changing bed linens	X	
CPR	X	X
Diagnostics	X	X
Dressing patients	X	
Emptying colostomy and urine collection bags	X	
Feeding patients	X	
Hazardous waste disposal	X	X
Mathematical conversions/Pharmacy skills	X	X
Measuring vitals: (Blood pressure, Pulse, Temperature, Respiration rate)	X	X
Medical notation/charting	X	X

Nail care	X	
Oral care	X	
Patient confidentiality/privacy	X	X
Proper hand-washing techniques/Sterile technique	X	X
Transferring patients/body mechanics techniques	X	
Weighing patients	X	

As this table demonstrates, only nine of the twenty classroom skills were associated with skills used in health care positions beyond CNA work. What is more, the teacher did not reference the relevance of these practices to other possible careers during class.

Applying skills to the "real-world". Students put their classroom skills into practice at various health care contexts (refer to Chapter III for a description of each health care context). The next example exemplifies a typical exchange between teacher and students in the clinical setting. In this excerpt, Mrs. Mahoney used questioning to help the student understand what happens when patient briefs are not changed regularly.

Mrs. Mahoney: [addressing Sasha] Make sure to check the bedding because they wet through the bed liner and protector for two days.

Sasha: Ok [she answers hesitantly as if she is not sure why the teacher is asking her to complete this task]

Mrs. Mahoney: So what does that tell you [the fact that the patient has wet through the bed liner and protector for two days]?

Sasha: They [employees] are not changing her at night? [Sasha's intonation indicated a question as if she was not sure her answer is correct]

Mrs. Mahoney: What can that lead to [allowing the patient to be wet]?

The student is silent.

Mrs. Mahoney: Remember our unit on skin care?

Sasha: bed sores?

Mrs. Mahoney: Exactly- leaving a patient wet can lead to bed sores and this is also a dignity issue.

Exchanges like this one were typical and numerous. Consistent with the classroom, students engaged in practices geared toward care giving. Students only grappled with questions and problems associated with personal patent care. I did not find any instances in my field notes where student/teacher exchanges went beyond discussions of care giving.

As the previous data example demonstrated, students did confront many of health care's harsh realities. However, to support students' critical agency, it seems reasonable that students have the opportunities to wrestle with these sorts of issues (i.e. skin care and patient neglect) and possibly how these issues relate to other health care professionals—not just nurse assistants. For example, in an effort to make a meaningful impact as a future health care professional (and at the same time developing student agency), students could have explored the kinds of treatments that are typically provided for bed sores. Other questions may have included: (1) What sorts of administrative procedures could be

put in place to prevent bed sores? and (2) Are there any innovations in the health care field to address this issue?

These kinds of questions prompt students' investigations into the health care system with a critical eye. Investigating injustices or inequities as well as possible solutions further supports students' critical stances. Remember, the males did not provide tangible ideas about how they would actually carry out their altruistic goals. This sort of analysis would have allowed them to construct concrete ways to act on their intentions. Moreover, these kinds of questions connect altruistic values with science and go beyond learning to be a care giver. They connect students to knowledge and skills associated with powerful positions within medicine. Without addressing these sorts of questions, it is unlikely that students can develop agency in ways that allow them to envision science as anything more than care giver training.

"I believe in you": Teaching to the CNA test. I had several informal conversations with Mrs. Mahoney which provided valuable insights about the medical course and internship. Below is an excerpt from one of those conversations. Here, Mrs. Mahoney shared her thoughts on the course and about the kinds of experiences she deemed beneficial for students.

> I want to provide the skills and experiences to where they can become CNAs. I want to make sure they get a hands-on experience in health care. I know that many of these students want to be doctors. But doing this work will give them a better picture-you know-if they start at the bottom and work their way up. This will give them the sensitivity toward those who do this hard work. It just gives them exposure and a different perspective. (Informal interview, 4/7/09)

Mrs. Mahoney's thoughts were very telling and no doubt helped to shape the practice of science within the classroom and clinical experiences. Given Mrs. Mahoney's commitment to preparing future nurse assistants, it should be no surprise that this course was geared toward CNA work. In addition to the content, skills, and classroom activity, teacher talk also influenced the meaning of science as care giver training.

Mrs. Mahoney expected students to learn the necessary knowledge and skills for the CNA test at the end of the class. During classroom discussions and teacher/student interactions, Mrs. Mahoney highlighted crucial information that students needed to know for success on the test. The following fieldnote excerpts demonstrate how the teacher stressed the importance of understanding classroom content for the CNA test.

> Mrs. Mahoney: We are going to go over the important parts of the body mechanics chapter. Some of this was "hit on" during your presentations. **We are getting ready for that CNA test**." (Field notes, March 9)
>
> Mrs. Mahoney: From your reading what does the term closed bed mean? **You will need to know this for the [CNA] test**. (Field notes, March 24)
>
> Mrs. Mahoney: "We need a little more practice adding up intake and output. We are going to have a quick review. **This is important for the written portion of the [CNA] test.** (Field notes, April 2)

I observed and documented several references like these over the course of this study. Mrs. Mahoney made clear that the purpose of class was to become a CNA.

As was the case in the classroom, Mrs. Mahoney often stressed the importance of mastering skills for the CNA test during clinical. In the following example, Jada and Roxanne cared for a patient who was placed in isolation because of a urinary tract

infection. They bathed the patient, changed the bedding, dressed the patient, took vital signs, collected urine, and measured output. But before students entered the room, the teacher tested their knowledge about how to work with a patient in isolation.

Roxanne: Do we wear gloves for this?

Teacher: Remember your infection control unit.

Roxanne: I guess, then.

Roxanne and Jada grab a pair of gloves.

Teacher: Just one pair?

Jada: oh, we need two?

Teacher: Yes, double glove because this patient is in isolation. We know she has an infection.

Students get a second pair of gloves.

Roxanne: We need a gown too right?

Teacher: Yes, and a mask. Do you remember the order that you are supposed to put these [gown, mask, gloves] on? We practiced this in class. **Remember this may be a skill that is pulled for you on the CNA test.**

At the end of this dialogue, Mrs. Mahoney reminded the girls that the skills related to infection control may be "pulled" during the clinical portion of the CNA test. During clinical, Mrs. Mahoney continually gave students these kinds of reminders. She stressed the importance of competence so they would pass their CNA certification test. Implicit throughout is the message that, "You are training to become a CNA".

Students' questions during class indicated their compliance in their positioning. I analyzed the kinds of questions students asked during a span of twelve instructional hours (twelve hours equaled four class sessions). During this time (which is a representative sample) students asked very few questions. Of these questions, many were related to the CNA test. In table 12, I provide a frequency count and examples of each type of student question.

Table 12. ***Kinds of student questions asked of Mrs. Mahoney during class***

Kind of Question	Frequency
CNA test-related (How many hours of clinical do we need to sit for the test?; Will we have to change an occupied bed for the test?; Do I have to provide privacy if I get tested on this skill?; So, on the test, do we use different cloths for washing and drying?)	12
Procedural (Do we hand in our notes on this?; Are our uniforms tops in?; When do I have to turn in my permission slip?)	6
Content-related (Could you explain the difference between a closed and open bed?; How do I convert this to cc's?)	4

As is evident from the table, students had an awareness of the test and showed concern over being prepared for it. Clearly, they heard and took up the message that "You are here to become a CNA". I did not observe students challenge this meaning of science while in the classroom. Even though students' career goals did not include becoming nurse assistants, they were serious and deliberate when practicing their skills within the classroom.

As the data presented above demonstrate, classroom and clinical activity centered upon providing students with the knowledge and skills needed to become a practicing nurse assistant. The practice of science within the classroom and clinical settings was defined as a set of knowledge and skills used to care for the elderly. Next, I discuss the second meaning of science and science person that truncated agency—science and science person as low-status.

Science and Science Person as Low-status

> Mrs. Mahoney: Your patient has a fever, feels warm, sweaty—just looks different. What is your role?
>
> Dante: Observe and report.
>
> Mrs. Mahoney: Yes that is your part….part of your duties. (Field notes, 3/24/09)

I begin with this exchange between the teacher and one of the students because it underscores the way students were positioned within their clinical experience. As the teacher pointed, their role was to simply observe and report. The Academy's institutional potential promised to connect students to powerful positions within health science; instead, they were funneled into low-status positions.

The cultural production of low-status science and science person is apparent through examination of student positioning. The clinical and classroom contexts positioned students as low-status laborers. Holland, Skinner, Lachicotte, and Cain (1998) presented a theory of positional identity which helped me to understand how local practice produced this meaning.

> Positional identities have to do with the day-to-day and on-the-ground relations of power, deference and entitlement, social affiliation and distance-with the social-interactional, social-relational structures of the lived world. […] Positional identity, as we use the term, is a person's apprehension of her social position in a lived world: that is, depending on the others present, of her greater or lesser access to spaces, activities, genres, and, through those genres, authoritative voices, or any voice at all. (pp. 127-128)

Holland and colleagues (1998) explained that relations of power create and maintain individual's social position within particular contexts whereby some individuals occupy positions of power and status, relative to others. Further, they suggested that the presence of others and access to spaces, activities, and discourses determines one's social position. Hence, the activities (and associated people/practices/tools) put participants—and science—in low—status positions. Below, I support this argument by highlighting the nature of students' positioning during the clinical and classroom contexts.

Positioning in clinical. I begin with a vignette that captured our first day at the nursing home. This vignette characterizes the nature of students' engagement and typical responsibilities within the various clinical settings.

Vignette 2. *"Real-world" experiences: Becoming a laborer*

Before departing for our clinical experience, Mrs. Mahoney checks each student to ensure they are dressed properly. Students are wearing red smocks, white pants, and white shoes. Seeming satisfied with their attire she announces, "Ok, CNAs, I think you are ready."

We file onto the bus and I sit among the students. I hear students commenting to each other about how nervous they are to start their experience in the nursing home. Mrs.

Mahoney reassures them by telling them that she would not be allowing them to participate in their clinical experience if they had not mastered all their skills. "I am very proud of all of you."

As we arrive at the nursing home, Mrs. Mahoney ushers us into one of the patient recreation rooms. She grasps her clipboard which has a list of the day's assignments and tasks. The students sit nervously on the various couches and chairs. Each student is ready with their pocket-sized notebook and pen to jot down their assignments. Mrs. Mahoney reads down her list and calls out their assignments. "Sasha and Covina, you two will bathe Ms. Henderson. She is a tub bath and you will have to use the lift". She continues, "Ok, Dante and Natalie you will bathe Mr. Plessy and he is a bed bath." Each student is teamed with another classmate so that each team of two will care for two patients.

After reading off the assignments, Mrs. Mahoney takes us to the nurse station. Here she shows the students where to find information regarding each patient's personal care. She explains to the group:

> *"This is the book that the CNAs use to chart the patients' baths. You will record in here when you are done with your baths. If you look, some patients require a bed bath, some like to be transferred to the whirlpool, and a few can sit in the shower stall in their rooms. You have to check this book to see what your patient for the day requires. You have to check it each time because you never know if the nurse or doctor has changed a patient's orders."*

Many students make comments that reveal their concerns about bathing patients who cannot get in and out of the tubs and showers on their own. Mrs. Mahoney clarifies the students' responsibilities concerning non-ambulatory patients. "Because some patients are unable to walk, you will need to use a lift to get your patients from their bed to the whirlpool bath. Before the students disperse to find their patients, Mrs. Mahoney reminds them to find her if any of their patients need to be moved with a lift. (Field notes, 4/23/09)

To say the least, I was a bit taken aback from this first day in the nursing home. I expected that students would be shadowing various health care professionals because the Academy promoted that it offered opportunities in various health-related careers. Also, I anticipated that students would be able to choose the specialty area (i.e. physical therapy, pharmacy) they would explore. As illustrated in this vignette, this was not the case. Students actually took on the CNAs' daily duties at these health care facilities. When students arrived at the nursing home and rehabilitation center, they got their patient assignments and fulfilled their tasks which included: bathing, dressing, and feeding patients to name a few. The CNAs (employed by the facilities) worked with different patients during this time. Though they occasionally dropped-in the patients' rooms to offer encouragement to the students, for the most part, students fulfilled their duties independently.

At the nursing home, rehabilitation center, and adult day care center, students overwhelmingly engaged with practices related to CNA work. Students spent most of their time bathing patients, changing adult briefs, dressing patients, and changing bed

linens. Less frequently students took vital signs, weighed patients, and fed patients. These practices funneled students into low-status roles.

Tool use in clinical. The tools students used during clinical also produced low-status meanings of science and science person. Nasir and Hand (2006) discussed the utility of tools as a unit of analysis in sociocultural work. They explained that a focus on cultural practices and associated tool use is essential to understanding how "hierarchies of power… [ ]… become reproduced in the local activities of the classroom" (p. 465). Thus, tool use as a unit of analysis highlights the ways in which meanings of low-status science got produced within the Academy. The tools that students accessed influenced how they came to understand, value, and indentify with science, a particular science career trajectory, or identity role. Thus, tool-use embedded within classroom and clinical practices, imbued particular meanings of science and science person. For example, the use of soap and towels may imply a different meaning of science than the use of physical therapy equipment. In this study students used tools associated with care giving—towels, soap, combs, toothbrushes, nail clippers, patient lifts, and bed linens. To illustrate this point, I analyzed my field notes looking for the variety of tools students used. Table 13 represents the tools students used during clinical. This data represent four episodes from my participant observations at the nursing home.

Table 13. ***Tool use during clinical***

Tool	Observed tool use (4/23/09)	Observed tool use (4/24/09)	Observed tool use (4/28/09)	Observed tool use (4/30/09)
Adult briefs	X	X	X	X
Bed linens	X	X	X	X
Blood pressure cuffs			X	X
Feeding utensils	X	X	X	X
Hair brush	X	X	X	X
Nail clippers/files	X	X	X	X
Patient bath chart	X	X	X	X
Patient lifts (gate belt and Hoyer lift)	X	X	X	X
Scale (patient weight)	X			X
Soap/shampoo	X	X	X	X
Stethoscope		X	X	
Thermometer		X		
Tooth brush	X	X	X	X
Towels	X	X	X	X
Wheelchairs	X	X	X	X

This analysis clarifies how students used, for the most part, tools associated with low-status roles in health care. Over four clinical sessions, students only used blood pressure cuffs and stethoscopes one time. What is more, I only observed students use these instruments on two other occasions in clinical. Even at the rehabilitation center that had much more sophisticated medical equipment—such as intravenous fluid pumps,

pulse/oxygen monitoring machines, and various equipment used for physical therapy—students were not even introduced to these technologies. As a whole, these practices and tools defined students' clinical role as low-status health care worker.

Playing with identity roles. My first impressions of the classroom were encouraging. The overall "look" and "feel" of the classroom were much different than a typical high school science classroom. Below is an excerpt from my first day as a participant observer.

Vignette 2. ***First day as a participant observer***

The classroom is filled with medical instruments and materials. It looks very different from a typical classroom. A few tables and chairs are arranged in the center of the room with many computer stations flanking the sides of the room. Hospital beds, medical mannequins, wheel chairs, lifts, and cabinets with bed linens are set-up in the back of the room. A curtain hangs from the ceiling and it can be closed to conceal hospital beds. In the front of the room, there are models of the human body and stainless steel trays filled with various medical instruments including stethoscopes, blood pressure cuffs, thermometers, bed pans, and nail care instruments. Book shelves at various areas around the room contain anatomy textbooks, drug reference books as well as several books that provide information about various medical careers. The walls of the classroom are adorned with vision charts, posters highlighting different body system (e.g. eye, ear). Wow, this room is filled with medical "stuff". It appears that students are able to "try out" or "play with" many different careers. (Field notes, 2/23/09)

As my field notes suggested, I was hopeful students would be introduced to a variety of identity roles in health care. However, this is not how it played out in the classroom. Students only "tried out" caregiver identity roles. I examined classroom activities to characterize how students engaged with health care practices and discovered that students were positioned as CNAs through teacher talk and role playing activities.

For example, during skills practice, the teacher presented students with possible scenarios they might encounter as future nurse assistants. In the following example, the teacher provided a scenario to address how to apply patient restraints. This example highlights the nature of the identity roles made available to students within the classroom.

> Mrs. Mahoney: Your patient has tried to get up three times and has fallen. Thankfully she has not been hurt from any of her falls. After you talk to her, she still wants to get up. She wants to go home and make dinner for her husband. You talk with the doctor about this. The doctor says that you can put a chest restraint on so that is your order.
>
> Student: We would put it on?
>
> Mrs. Mahoney: yes
>
> Mrs. Mahoney: How often do we have to check her [the patient]?
>
> Student: Every fifteen minutes
>
> Mrs. Mahoney: Yes, check to make sure the restraint is still on and the patient is not in danger. (Field notes, 3/12/09)

In this exchange, Mrs. Mahoney made clear to students that their responsibility—as future nurse assistants—was to fulfill the doctors' orders and to monitor patients. Her talk categorized students as nurse assistants and did not allow them to explore other roles.

Students always “played” the entry-level role; they never “played” more powerful positions.

Students practiced their CNA skills through “role play” in the classroom. Mrs. Mahoney encouraged students to work through real health care scenarios. The next example depicts one of these role playing episodes and highlights how classroom activity reinforced students’ low-status positioning. Below, two students used a gate belt to transfer a patient (who was actually a fellow classmate).

Jada: Hello Ms. Jenny. The doctor would like for you to walk some today. So, I am going to walk you a little bit today. Ok?

Jenny: ok.

Jada raises the bed.

Teacher: Tell her what you are going to do next so she is not surprised.

Jada: Next, I am going to move you to the edge of the bed.

Jenny: ok.

Jada: Could you please bend your knees for me? I am going to put my arms underneath your legs and shoulders and slide you over to the edge of the bed.

Jada proceeds to sit the patient upright in the bed and put on the belt. (Field notes, 3/09/09)

This “role playing” happened daily in the classroom. This example demonstrates how role playing limited students’ possibility to play with other identities. I did not witness any situations, simulations, or role playing activities where students got “to be” doctors, physical therapists, or medical researchers. Instead, students practiced how to

bathe, dress, and feed patients. Clearly, the classroom and clinical experience limited identity roles.

Additionally, students had almost no contact with other health care workers while in clinical. For the most part, they only interacted with CNAs—individuals who held the lowest rungs on the health care ladder. As Marcus shared, "I mean—we saw other people. There were MDs and radiologists and all sorts of other people. But the main people we were with were CNAs" (FI2). The nursing home and rehabilitation center employed several other health care professionals. The nursing home employed a physical therapists, social worker, and dietician. While, the rehabilitation center employed occupational therapists, physical therapists, respiratory therapists, recreational therapists, x-ray technicians, dieticians, and a large staff of health care administrators. However, students had little to no contact with any of these people. This limited exposure hampered students' exploration of other roles. Even if students could not practice physical therapy in the classroom; they could have shadowed a physical therapist during clinical. Regardless, a shadowing experience may allow students to decide whether a physical therapist role aligns (or not) with their imagined identities.

It stands to reason, if the intent is to prepare students for powerful positions in health care, they should have opportunities to work with these individuals. If students are exposed to the daily work of a doctor or physical therapist, they can make more informed career decisions. This directly relates to students' identity development as future health care professionals and the kinds of experiences that facilitate students' development. Unfortunately, with the exception of the hospital experience (which is discussed in a

subsequent sections), students did not have access to these sorts of individuals or experiences.

The gendered nature of the care-giver identity. The care-giver identity role, available to students, was unquestionably feminine. Historically, females dominate in nurturer/caregiver career roles (Harding, 1986) and this was reflected in students' clinical experience. Students engaged in roles dominated by females. With the exception of one male, all CNAs were female. The director at the nursing home was male as well as some of the health care professionals at the rehabilitation center. However, the students did not have any meaningful contact with these individuals. The nursing home director would greet the students and praise their hard work but did not discuss his job or responsibilities. At the rehabilitation center, I did not witness student interaction with any of the male employees (except the male CNA). Thus, students experienced a feminized side of health care.

The findings here are reminiscent of what Olitsky (2006) found regarding how limited subject positions can interfere with students' possibilities for their science futures. In her study of an urban magnet school, she found that the meaning of science person promoted in the school was associated with a dichotomous view of students who were either college-bound or not. These limited subject positions constrained some students' ability to identify themselves as science learners. Likewise, in my study, the limited identity roles (i.e. subject positions) may make it impossible for students to identify with and further develop their imagined identities as health care professionals.

The "Network" was actually a Funnel

Students engaged in practices that connected them to low-paying, low-status, and feminine positions. They did not have access to a broad range of health care roles. In essence, the meaning of science person (or health care worker) was not broadly construed. The Academy's *institutional potential* promised a multifaceted network that would support multiple career trajectories. In reality, the Academy funneled students into feminine care-giver roles. In table 14, I list all the practices students engaged in during the classroom and clinical experiences. I then did a componential analysis (Spradley, 1980) to examine how these practices might support a CNA/feminine identity or a more broadly construed health care identity.

Table 14. ***Relationship between classroom and clinical practices and identity roles***

Practices	CNA role	Multiple roles within health care
Applying Patient Restraints	X	
Bathing (bed and shower)	X	
Caring for Wounds	X	X
Changing adult briefs	X	
Changing bed linens	X	
CPR	X	X
Diagnostics	X	X
Dressing Patients	X	
Emptying colostomy and urine collection bags	X	

Feeding	X	
Hazardous waste disposal	X	X
Measure vitals: (Blood pressure, Pulse, Temperature, Respiration rate)	X	X
Medical Notation/charting	X	X
Nail care	X	
Oral care	X	
Patient confidentiality/privacy	X	X
Proper hand-washing/sterile technique	X	X
Recreational activities	X	
Transfer Patients (using belts, wheelchairs, stretchers, Hoyer lifts)	X	
Weigh patients	X	

This chart provides evidence that students did not have access to multiple networks and or identity roles; they were essentially funneled into CNA roles. However, eight of the twenty-one practices did have the potential to allow students to engage in practices associated with other roles. Students came to the Academy to pursue professional careers in health care with the hope of achieving social mobility and economic stability. However, it is unlikely that positioning students as low-status laborers can connect them to powerful disciplinary networks in health care.

Student Outcomes: Making Sense of Their Experiences

> *Our practices provide resources for building that picture, and that picture in turn determines how we understand our engagement in practice. (Wenger, 1998, p. 195).*

This section describes students' meanings of their Academy experiences. These meanings revealed tensions between the images of who they wanted to be and do in health care and the meaning of health care worker promoted in the medical science course. Male and female participants made sense of their experiences in different ways. In the end, some students abandoned their goals of working in health care but not their altruistic goals.

"It was a good experience.": Girls' (Reluctant) Acceptance of the Feminine Caregiver Identity

Female participants, in some ways, affiliated with the feminine caregiver identity; it aligned with their imagined future selves. In the end, they understood their experiences were a way to "try out" what it was like to work in the health care field. The female participants recognized that the kind of work they did during clinical was not representative of what they hoped to do in the future. Overall, females reasoned their clinical experiences were valuable and gave them insights into their future careers. For example, Roxanne was very uncertain about having to clean patients and change adult briefs. The first day in the nursing home she barely tolerated the odor.

> But, going through the clinical, I had no choice but to touch patients and clean them. It almost killed me the first couple of days. So like working in the dentist office, it will be nothing now. I have smelled the worst smells possible so working in a dentist office will be nothing. (Roxanne, FG2)

While Roxanne often made negative comments during internship—"this work is not for me" (fieldnotes, 4/7/09); she felt it prepared her for dentistry. She reasoned that after this sort of difficult work—bathing and cleanings patients—work in a dentist office will be a breeze. Many girls commented on the importance and value of "knowing what this work is like" (Brittany, FI) because "it gives you a different outlook (Natalie, FG2).

> I feel that it is better because you can read a book all day but you will never know the real deal until you get out there and do it. When we would practice in the classroom that was ok but you still do not know the real thing until you get out there with real patients. (Serena, FI1)

Serena's words reflect the merit she found from the social interactions with patients during clinical.

Many of the females were alarmed by the quality of care residents received. Natalie reflected after her clinical experience, "I did not like the kind of care and the attitudes of some of the workers" (FG2). She and the other females believed they had the proper work ethic, caring nature, and moral commitments necessary for health care. Students witnessed many injustices such as poor quality care and were dissatisfied with employees' attitudes toward the patients.

> I look at it like this. You know the people who work there--they did not take the time to be patient, caring or gentle with the different residents. And, I mean—it made me want to help more. Some of the people [who worked at the facilities] would say things about the residents-like they are mean or grouchy. But, when I worked with the patients they were not like that to me. You know—I treated them the right way. (Roxanne, FG2)
>
> I know I am really good at it—more than some. (Brittany, FG1)

> It was like--we were the ones who really cared. But, it is going to take more than us to really make that change. But I know now that I definitely will help—change it. The way they treated them—I mean, I know that they have to put up with a lot—but still. It is just not right. (Jada, FG2)

These injustices that students witnessed during clinical did reinforce their desire to work in health care. All female participants believed their future contributions would improve health care. In these ways, the female participants did view their clinical experiences critically. During clinical, students identified health care injustices and were determined to contribute to the field in positive ways in the future.

In the example above, Jada expressed that the CNAs appeared to have poor work ethics and attitudes. However, students and the teachers did not discuss the injustices CNAs likely faced with poor working conditions and salaries, which could have partially explained the contributing factors for their perceived poor work ethic. In a small way, the clinical experience had the potential to further develop their critical science agency. However, the injustices students witnessed were not discussed in class or during clinical. These opportunities were not supported by the curriculum or the teacher. Over all, the clinical experience helped, in small ways, further develop their altruistic identity. Nonetheless, the females did not clamor to become CNAs.

In fact, at times the girls contested their roles—especially within clinical. Each female, at some time, expressed displeasure with her duties. In the following example from my field notes, the two girls expressed dissatisfaction with having to care for a patient who was in isolation.

Roxanne: Why we have to do this today?

Jada: They [the CNA's who are employed at the nursing home] should be doing this.

Roxanne: I did not sign up to get sick.

The girls reluctantly put on their gown, mask, and gloves and proceed into the room to care for the patient. (Field notes, 4/23/09)

Other examples:

This is not worth it for ten dollars an hour. (Field notes, 4/28/09)

I am not working with Maddie today. I better not get her. (Field notes, 4/24/09)

In addition to these comments, I also witnessed dissatisfaction through non-verbal communication such as eye rolling, "dirty looks", and heavy sighing. These were usually directed at the teacher and occurred either when she gave assignments for the day or asked students to re-do a task.

As demonstrated here, the girls were, at times, reluctant and resistant during clinical. But in the end, the female participants still wanted to pursue a career in health care. Table 15 displays their intended careers after their clinical experiences.

Table 15. ***Comparison of career intentions pre-Academy and after clinical***

Participant	Intended career before the Academy	Intended career at the end of the clinical experience
Brittany	Pediatrician	Pediatrician
Sasha	Research Scientist	Nurse/medical research scientist
Ebony	Physician or Nurse	Health specialist in army (still plans to become a Registered Nurse)
Serena	Physician	Physician
Roxanne	Dentist	Dental Assistant (still wants to pursue dental degree)
Jada	Optometrist or Ophthalmologist	Optometrist or Ophthalmologist
Ashley	Physical Therapist	Physical therapist
Natalie	Registered Nurse	Registered Nurse

Thus, the feminine aspect of the caregiver identity did appeal to the female students. However, they did resist the low-status roles they were asked to take-up. But, more importantly, the females recognized that their experiences were not representative of what they intended to do in the future.

> I know that is really not what I want to do. I just can't do it. But, I have so much respect for those who work with old-the elderly. But, it's not me-at all. It will still help me in what I want to do. (Roxanne, FG2)

> I do not want to work with the elderly. But I am interested in pediatrics. I think it will be a lot different. (Sasha, FG2)

In the end, the females were able to see beyond their clinical experience and follow a health care trajectory. Ebony, however, decided to follow a different path than intended

by the program (i.e. 2- 4 year higher education institution). After her experience she wanted to pursue a health care position in the army. She strongly identified with health care but because of economic constraints believed that the army was the best place for her to realize her goals. In addition, Roxanne decided to attend a local community college and pursue her degree as a dental assistant instead of a dentist. She assured me she still planned to get her professional degree in dentistry. However, because of her and her grandmother's financial situation, she was not able to attend the four-year university where she was accepted.

Next, I discuss the males' reactions to their experiences. As you will read, the outcomes for male participants were vastly different from the females' outcomes.

"It's just not me.": Males' Resistance

> *Imagination can yield a sense of affinity, and thus an identity of participation, but it can also result in a reaction of dissociation and a consequent identity of non-participation. Our practices provide resources for building that picture, and that picture in turn determines how we understand our engagement in practice. (Wenger, 1998, p. 195).*

The males experienced conflict during the clinical experience. They did not identify with the feminine, care-giver role. After completing the clinical rotation, five of the six males decided not to pursue a career in medicine. It was not that they did not have the academic ability or motivation; instead, it was an issue of identity.

> In my mind, I was going to school; working hard; getting a degree so I don't have to do this kind of a job. So, coming in and seeing this, I was like, "no I don't want to do this". (Curtis, FI2)

> I couldn't do it every day. I feel like those jobs you really have to love it to be able to do. It was not what I was looking for. That is when I started thinking that maybe this is not for me. (Will, FI2)
>
> Well, I worked in a nursing home trying to do the CNA thing and when I saw that and it kind of threw me off a little bit. (Marcus, FI2)
>
> The bottom line is—it is just not for me (Dante, FI2)

Apparent in these representative examples are the identity conflicts males experienced during clinical. Their preconceived notions about healthcare did not align with what they experienced in clinical. The males' trajectory sharply diverged from the Academy's trajectory. Remember, the males came to the Academy because they wanted to pursue high status positions in health care; instead, they bathed and dressed patients. All male participants mentioned how they respected the CNAs who did this sort of work but this work was just not for them. It is interesting how the males did not recognize (or at least reveal to me) that the health care roles they participated in during clinical were not representative of other possible roles within the field.

Conversely, the females understood the CNA role was an entry-level position, different from the positions they hoped to hold in the future. Perhaps the difference between the males and females can be partially explained by the girls' informal experiences in health care. This resource (i.e. informal networks) may have allowed the girls to construct a better or more realistic understanding of health science careers. Male participants did not have these kinds of experiences.

In fact, after their clinical experience, male participants realized their pre-Academy images of health care did not represent reality.

> The medicine on ER is glamorized—I guess. It is not what medicine is all about. When I really began to think about my career, I realized that I was "in love" with the television drama of medicine and not the actual practice of it. (Marcus, FI2)
>
> It is not like you think it will be. (Joel, FI1)

Curtis did not want to give up on his goal. Accordingly, he sought opportunities outside of the Academy and decided to volunteer in the local hospital's emergency room.

> So for me, my favorite show was *ER.* I had the opportunity to volunteer in an ER. I was so excited and for my first shift, I poured water for three hours. I was like, "Where are the police and the rushing in?" There was none of that. (Curtis, FI2)

Again, Curtis' volunteer experience was not what he expected. The ER experience did not align with his image of what it meant to work in health care. As these examples demonstrate, students experienced a "disconnect" between their preconceived notions of health care and what they actually experienced. The Academy provided a very narrow view of health care. The only role to take-up was that of a feminine, care-giver; it is no wonder they experienced identity conflicts.

The Academy did not provide males with the experiences and resources needed to generate an identity in science that blended who they were as African American males and their future goals. For example, Will decided on a career in medicine because he wanted to help others. He believed this career could provide him a certain status that would help to change the negative perceptions of African American males. However, he was interested in the technological side of medicine. Specifically, he was interested in developing technologies such as artificial limbs or hearts. However the Academy's career trajectory did not intersect with Will's imagined trajectories in ways that allowed him to

further develop his identity in health science. The promoted meanings of science person within the Academy conflicted with who Will wanted to be and the ways he wanted to use science. As a result, he changed his career goals. Instead of a career in medicine, he decided to pursue a career in the Army as a satellite communication specialist. He saw this trajectory as a way to use his interest and expertise in technology and apply it in ways that could contribute to a more just society.

Will, Joel, Marcus, and Curtis all decided to change their career trajectories. Table 16 provides a list of intended careers after the clinical experience.

Table 16. ***Comparison of males' intended careers pre-Academy and after clinical***

Participant	Intended career/college major before the medical courses and clinical experience	Intended career/college major after medical courses and clinical experience
Will	Engineer (Biomedical)	Army-Satellite communication specialist
Marcus	Physician	Majoring in music/Wants to be a record producer
Joel	Physician or Astronomy	Majoring in planetary geology
Antonio	Physician or Hospital Administrator	Pharmacy/possibly drug development
Dante	Physician or Psychologist	Majoring in theatre/ also interested in psychology
Curtis	Pediatrician or Obstetrician	Majoring in political science with a minor in African American studies

At the completion of data collection, Joel planned to pursue a career in Astronomy, not medicine—an interest he had prior to his experience in the Academy. Dante shared

that he was still very committed to finding a job where he could help others. At one point during the study, he considered majoring in Psychology the next fall. However, at the end of this study he leaned toward pursuing a theatre degree. He participated in theatre in his local community and also mentored middle school students in a theatre club. Mentoring was his way to express altruism.

The outcome for Antonio was somewhat different. Antonio also experienced identity conflicts but remained committed to finding a health science career that fit with his goals. Throughout clinical, Antonio struggled to make a decision about his career. He and his family searched for resources to help with this decision. Antonio's grandmother connected him with a neighbor who was a pharmacist. He got to shadow this individual in the workplace over the summer and he experienced the everyday nature of a pharmacist's work. Antonio also researched the possible trajectories available in Pharmacy (i.e. drug development versus retail). These resources allowed him to acquire a robust understanding about Pharmacy. Interestingly, Antonio was the only student in the study with parents who had college degrees and both parents held high-level jobs in banking. Perhaps his parents' social capital facilitated Antonio's access to resources that advanced his imagined identity.

The next section describes additional meanings of science produced locally as students engaged with daily practices in the culminating medical course and clinical settings. These meanings had the *potential* to support critical science agency.

The Local Production of Science and Science Person: The Potential to Support Critical Science Agency

In this last section, I describe the following *potential* meanings of science: (1) science as empowering, (2) science as relevant, and (3) science as character building. Because these instances were not as frequent or robust as the meanings that truncated agency, I refer to them as *potential* meanings. Some experiences within the Academy held promise for the support of critical science agency. I consider these *potential* meanings to be small *cracks of possibility*. A various times, albeit inconsistent, I saw opportunities for transformation. However, the teacher did not capitalize on these opportunities; they were only *cracks of possibility*. I begin with science as empowering.

Science as Empowering

High status practices and tools. Students engaged in a few practices that had the possibility to be empowering. For example, a small part of the curriculum involved learning diagnostic skills. I captured the following episode in my field notes when students discussed diagnostic skills in the classroom.

Teacher: How do you know that someone has an infection as a health care professional?

Student: Different symptoms

Teacher: How would you know that I might have an infection?

Teacher waits then rephrases the question.

Teacher: What signs and symptoms could I have or present with?

Student: Coughing, sneezing, runny nose

Teacher: Think about your diagnostics.

Student: High temp, high pulse, low or high bp [blood pressure]

Teacher: Imagine if I came into your office, and I am up to the bathroom every few minutes, what might you think about in terms of an infection?

Student: Bladder infection

This example had the possibility for supporting other (i.e. other than caregiver) trajectories in health care. First, the teacher addressed them as health care professionals. This was the only instance I observed where students were positioned as anything other than CNAs. Not incidentally, during interviews, every student mentioned diagnostics as one of their favorite practices.

Brittany: It [learning diagnostic skills] really made me happy. Taking the blood pressure, we really got to do it.

Serena: I loved it when we did pressures--blood pressure. Oh, and we took temperatures. We used thermometer, blood pressure cuff and a stethoscope. It was great.

Marcus: Taking blood pressures was cool. We got to use a stethoscope. You know- I could do that.

Curtis: We got to use a stethoscope—you know—wear it around our neck like a doctor.

These quotes illustrate students' excitement about using stethoscopes and taking vital signs. It is possible students recognized "diagnostics" and associated tools as a practice connected to high-status positions in health care. This is an example of an experience

within the Academy that had potential for connecting students to powerful networks within health care. Even Mrs. Mahoney hinted at this possibility.

> The students have to learn the basic diagnostic skills. All health care personnel have to learn the basics--the vital signs-temperature, pulse, respiration, blood pressure, and weights. Those are your diagnostic skills. They are the foundation skills for whatever field you are going into. (Teacher interview, 6/16/2009)

Diagnostics had the potential for students to "try out" some of the skills and tools associated with other roles. Unfortunately, I never witnessed times in clinical when students used any of their diagnostic skills. Again, the use of tools such as a stethoscopes and blood pressure cuffs were rarely used in clinical.

Additionally, the students' hospital experience showed some potential for providing students with an empowering experience. However, the students spent only two days in the hospital. The first day, students toured different areas of the hospital including: the emergency room, cancer center, wound center, obstetrics/gynecology, cardiac care and rehabilitation, outpatient surgery, radiology/nuclear medicine, and physical therapy. At each department, a representative provided a tour of the facility. They talked with the students about the kind of work they did, the nature of patients' illness/situations, and shared information about the different kinds of roles in each specialty area. On the second day, students chose a department to shadow. All students reported the hospital was their favorite clinical experience.

> I liked the hospital-even though I did not get to do much. (Jada, FG2)
>
> That was my favorite too. We got to see a real wound and watch a doctor examine it. (Natalie, FG2)

While the hospital experience was only a small part of their clinical experience, it was the first and only time I saw students get excited and ask questions that went beyond clarification of bathing or bed making procedures. For example, during or tour of the physical therapy department, students commented about the vast amount of technology/equipment and commented that physical therapists' work appeared to be exciting. Students asked the physical therapists many questions. Below is a sample of students' questions during our tour of the physical therapy department.

> Why do people get physical therapy? (Field notes, 5/18/09)
>
> What about sports injuries? (Field notes, 5/18/09)
>
> How long did you have to go to school? (Field notes, 5/18/09)

Similarly, while visiting the cardiac care and rehabilitation department, I documented the following questions in my field notes.

> What kind of patients do you see here? (Field notes, 5/18/09)
>
> What do you have to major in—in college—to work here? (Field notes, 5/18/09)
>
> How long do you have to go to school to be a surgeon? (Field notes, 5/18/09)

After only a couple of hours within the hospital context, students asked substantive questions about possible careers in health care. This was the first time I witnessed students asking questions related to other possible health care trajectories.

While leaving the cardiac care and rehabilitation department, I documented the following short conversation between Dante and Jada.

> Dante: This place is cool. I could really work here.
> Jada: Yeah, I bet CNA's don't work here. (Field notes, 5/18/09)

After a twenty minute tour, Dante suggested that he liked the atmosphere of the cardiac care and rehabilitation department. This is the first time a student mentioned they would like to work in one of the clinical settings (including the nursing home, adult day care, and rehabilitation center). Also, striking here is the comment Jada made about CNAs not working in this department. It suggests that she considered this health care context to be of a higher status—not a place where CNAs would work. Also, It reflects how CNA work became the "meter stick" by which other career trajectories were judged.

The hospital experience held the most potential for hooking students to powerful networks within health care because it exposed students to multiple career trajectories within the health care field. The hospital context gave students access to professionals who worked within many of the career trajectories students wanted to pursue.

Acquiring competence. The teacher expected each student to perform their skills with a hundred percent accuracy. She allowed students to retest on a skill until they passed and she provided considerable time during class for students to practice. She made herself available before and after school, and even some Saturdays. Mrs. Mahoney instilled the importance for competence in health care.

Students considered themselves competent in their responsibilities. While at first nervous to go into clinical, they eventually became more comfortable. For example, only

after a few days in clinical students declared that they really "knew their stuff" (Serena, FI1).

Mrs. Mahoney aimed to produce capable health care workers, but she also wanted to change the culture of the school.

> Students here [Edgeview High School] have been acclimated to the easy road. Many teachers do not expect much and do not hold them accountable. They just get used to it. It is not always that hard to get the A. You know-as long as they don't cause trouble. We do not push them to their limits. I want to get them to take charge of what they are learning--maybe go out and learn a little more on their own. We have to do this if we want them to be successful in their life.

Students recognized and appreciated Mrs. Mahoney's efforts.

> No, my teacher actually care that I understand and get my work done, that I am really getting the proper training to go out into the real world. (Dante, FI2)
>
> Yes, Mrs. Mahoney, she makes sure that we know what were are doing and she tests us on it constantly. (Curtis, FI2)
>
> It was the first time that I actually had a teacher whose lesson plans were not just from between the covers of a book. (Antonio, FI2)

Mrs. Mahoney's persistence in assuring students' competence in the content and skills provided students with support to not only to become capable health care providers but also good students. Her desire to change the culture of the school is echoed in the literature. Buxton, Carlone, and Carlone (2005) found that teachers at an urban science and math school also recognized the need to change students' thinking and behaviors regarding what it meant to be a "good students" and produce "good student work". Mrs. Mahoney explicitly communicated her high expectations to students and reminded

students of the accuracy needed to work in health care. Mrs. Mahoney's high expectations and assistance on competence empowered students, even if it was as competent CNAs.

Membership in the Academy. Students gained status because of their membership in the Academy. The participants felt that other students in the school were a bit envious of their experiences and opportunities.

> I guess there is—you know-- a kind of status with the Academy. There is definitely a different reaction when you tell people that you went to the Academy. I feel like sometimes the other students resented us. Because, we were obnoxious when we got our acceptance letters—to colleges and universities. We were like, "we are out'a here". (Curtis, FI2)

Many participants explained how other students and teachers assumed they must be very smart to be in the Academy.

> I mean, they [other students] do kind of--you know--say like, "You must be very smart". Or something like that. (Jada, FG2)
>
> They [other students] say wow, you are smart. I do not consider myself smart. I am just willing to learn. (Ebony, FG1)
>
> They [teachers] look at you like "Oh you are in advanced classes and you don't just go in and make a C". (Will, FG1)

While participants admitted they enjoyed the label of "smart" student, they assured me that the Academy is not just for "smart" students. Many participants did not consider themselves "smart" and explained how the Academy is for students willing to work hard.

In some ways, the meaning of successful Academy student counters prevailing assumptions about who does science. Students who choose to pursue science or who are

successful in school science are typically labeled as “geeky” and “super-smart”. However, participants’ characterizations of a typical Academy student did not fit this stereotype. Below, I provide examples of how they described Academy students.

> I think it’s for-- it’s for the people who are trying to--you know--just get ahead. I think in life and college. (Jada, FG2)
>
> First, I will say that they have to loyal and trustworthy--a caring person. (Roxanne, FG2)
>
> Someone who is willing to try and put forth the effort. (Sasha, FG2)
> Understands what they want to do--in their career—and knows where they are going. (Marcus, FG1)

In their eyes, a successful Academy student is someone who is not necessarily smart but someone who is willing to work hard and put forth effort in pursuit of their future goals. As this section highlighted, students found some experiences in the Academy empowering but were not nurtured in ways that supported students’ critical science agency or career trajectories. The next section discusses the ways that students made connections between what they learned in the Academy and their life outside of school.

Science as Relevant

Students found some relevance in the science they learned. Namely, they made connections between their coursework and skills to their everyday life outside of school.

> Dante: Even if I was not going to be a doctor I feel—you know--those skills you can use. You learn like first aid and CPR. And even if you are not going to be a doctor you need to know those skills.(FI1)

Curtis: When you have kids and they get sick at night you cannot always just rush them to the emergency room. So it helps to have a little foundation in medical science. Then if your kids say, “this hurts”, then you can say well maybe you have blah-blah-blah. It just helps you diagnose stuff better. Like learning about what the body needs. If you have leg cramps, it may mean that you need potassium. So if my kid came to me in the night and had cramps I would give him a banana. (FI1)

Ebony: We are learning about infection control and I mean that is good anywhere. (FI1)

Serena: Yeah—um--being clean and washing your hands properly-- that’s good. I mean, I can use that now--whether I’m in school or at home. (FG)

Students saw some utility in what they learned because it related to their world outside of class. This type of relevance falls under Aikenhead’s *need-to-know* category which emphasizes everyday uses of science (Aikenhead, 2006).

Over all, six of the students specifically mentioned the difference between science in the medical course and more traditional science courses because they did not have to memorize useless information. Instead, they learned and applied their knowledge and skills to real contexts. Unfortunately, students only applied their knowledge and skills as caregivers.

I probed students about the relevancy of other science courses and they could not make any connections between other school science subjects (e.g. chemistry or biology) and their world outside of school. Sasha did recall a brief discussion about pharmaceuticals in her chemistry class.

Students did find the health science course relevant in other ways. Students valued some skills they learned in the Academy such as how to fill out job applications, how to

answer interview questions, and how to dress for an interview. Mrs. Mahoney brought in examples of applications from several local health care facilities (for CNA positions). She walked them through the application process and provided example interview questions which they discussed as a class.

> Not only that but just carrying myself as a young adult. You do not want to go out to a job interview in some baggy jeans, a messed up T-shirt and stuff like that. You know when you are in the Academy they teach you this is how you talk and this is the proper way of dressing for an interview. So I am ready for life. (Dante, FG2)

Student valued the opportunity to learn how to prepare for a job interview and it was not an experience they had in other courses.

Science as Character Development

Mrs. Mahoney focused on the social side of health care. She talked about "bedside manner" and modeled for the students how to talk with patients. During clinical, Mrs. Mahoney encouraged students to initiate conversations with patients.

> Sasha: Mrs. Mahoney, I am done with Ms. Smith. What else should I do?
>
> Mrs. Mahoney: Why don't you just talk with her?
>
> Sasha made a face of disapproval.
>
> Mrs. Mahoney: This is part of the job.
>
> Sasha: What do I say?
>
> Mrs. Mahoney: She is watching television. Ask her what she likes to watch--to start the conversation. (Field notes, 4/28/09)

Students had many opportunities during the clinical experience to practice their relational skills. For example, during our time at the adult day care center, students spent the majority of their time talking with residents and engaging in recreational activities such as bingo and dancing. All students enjoyed these activities.

Many students mentioned how working so closely with people improved their confidence, patience, and sense of responsibility.

> I am more patient. I really learned a lot from working with difficult patients. I really learned to control myself. I have more compassion. Before, I might just get mad but know I understand. (Sasha, FG2)
>
> I feel more responsible. (Roxanne, FG2)
>
> I like that we got to know our patients on a different level-personally. (Dante, FG2)
>
> Oh, it was very helpful. I learned people skills for one thing. I can go up and start a conversation now with just about anyone. It has been very helpful. I mean the medical things are very helpful to know too. If I break my leg or someone else does, I can help them out. (Marcus, FG1)

Students also shared how they felt more empathy for patients—especially the elderly. Initially apprehensive about working with elderly patients, students came to realize the importance of treating them with dignity and providing them with quality care. However, after these experiences students realized the importance of treating them with dignity and providing them with quality care. Each of the possible meanings I discussed here had potential for supporting students' critical science agency and career trajectory: students engaged in some practices that better represented their desired health care roles; they made many connections between the medical courses and their lives—science was

relevant; they liked the status the Academy brought. These small cracks of possibility did point to the potential of the Academy.

Summary of Chapter V

In this chapter, I described how the Academy defined and communicated its potential to students and parents. The Academy's potential—conveyed through promotional materials, recruitment events, and school personnel—promised to prepare students for a variety of powerful careers within the health science field. Through an innovative curriculum, students would receive exposure and experience in their chosen career field. The institutional potential of the Academy seemed to align nicely with students' future career goals. However, in practice, the Academy did not deliver on its potential.

Next, I discussed two meanings of science—science as caregiver training and science and science person as low-status. Students learned content and skills associated with care giving. Moreover, the clinical experience positioned students as low-status, nurse assistants and failed to expose or connect students to more powerful career trajectories within the health care field. This overwhelmingly feminine entry-level role caused identity conflicts for students, particularly for male participants.

Students came to the Academy with altruistic goals with hopes of changing their future and the lives of others. They had a very critical outlook regarding the way they wanted to use science in their futures as health care professionals. However, the promoted kinds of participation, skills, and content did not support students' critical stances. The promoted meanings of science and science person did not explicitly connect

students to powerful disciplinary networks in health care. Thus, these meanings of science and science person did not further develop students' critical science agency.

Finally, I described three *potential* meanings of science and science person--science as empowering, science as relevant, and science as character building. A few skills and experiences were empowering because they had the potential to connect students to more powerful roles, connected to their life outside of school, and developed their relational and life skills. However, these *potential* meanings represent missed opportunities because they were not nurtured by the teacher or supported by the curriculum. I discuss the implications from these findings in the final chapter.

CHAPTER VI

DISCUSSION AND IMPLICATION

The Underrepresentation Problem

For over two decades the underrepresentation of African Americans in science and science-related careers received attention from educators, policy makers, and researchers. During this time, equity scholars identified many variables that hindered African Americans' career attainment such as—student interest and attitudes (Post, Stewart & Smith, 1991), access to higher-level science courses and qualified teachers (Hrabowski, 2003; Russel & Atwater, 2005), and low science achievement (Lewis, 2003). Following a liberal paradigm (Rosser, 2005) this approach to science equity research exposed deficits in the system (i.e. lack of qualified science teachers) or in the students (i.e. negative attitudes about science) and focused on ways to minimize the effects of these variables. Thus narrowing the gap meant, in part, to make a quality science education more accessible and to make science more engaging and fun through hands-on curricula. This approach resulted in small pockets of improvement in closing the underrepresentation gap.

A quality science education is a precursor for career attainment (2008) but these static variables do not account for other factors that contribute to the underrepresentation gap. For example, students must identify with science and science learning communities and find science relevant to their lives and future goals (Aikenhead, 2006; Brown, 2004).

Previous approaches to the underrepresentation problem left unexamined identity-related barriers that hinder African Americans' affiliation with science and subsequent career attainment.

In response to these limitations, equity scholars turned their focus to understand how issues of race, class, and gender impacted African American students' experiences in school science. They sought to understand how these larger social structures limited African Americans' possibilities for achievement and career attainment. These scholars utilized a cultural difference approach for understanding and contextualizing the underrepresentation problem. A cultural difference approach suggests that learning school science requires some students to cross cultural borders, forcing them to abandon their cultural ways of knowing, behaving, and talking (Aikenhead & Jegede, 1999). A cultural difference lens made clear how some students experienced cultural conflict as they moved into a culture of school science that required them to use "scientific" language instead of their own cultural discourse (Aikenhead & Ogawa, 2007; Brown, 2004).

Scholars developed interventions to mitigate cultural conflict through culturally relevant curriculum and teaching practices that capitalized on students' linguistic repertoires and cultural ways of knowing or being (Brown, 2004; Parsons, 2008a). This line of research expanded the focus of the underrepresentation problem from exposing deficits to including ways to capitalize on students' resources.

However, this latter approach, steeped in cultural difference theory, attended mostly to local power relations within the science classroom. Thus, students' strengths and

resources were recognized and leveraged in ways that allowed them to more fully participate within a community of science learners. Attention to local power helped to understand how hierarchies exist in the classroom and categorize some students as "smart" science students or "future" scientists and others as "low" science achievers (Carlone, Enfield, Haun-Frank, Johnson, Kimmel, 2009). However, cultural difference explanations did not explicitly attend to larger power structures.

After Gutstein (2006), I argued in Chapter II that pushing the equity framework requires that we acknowledge science as a way to critique and remedy structural inequities that contribute to African Americans' marginalization in society (and science). This requires a lens that examines how local classroom science practices enable students' connections to networks of power (i.e. medicine, physics, college) (Carlone, Enfield, Haun-Frank, Johnson, & Kimmel, 2009; Gutstein, 2006).

The idea of a "network" implies that as college physics students (as an example) interact with physics texts, physics problems, and physics equipment they simultaneously connect with the physics discipline (Nespor, 1994). The local physics practices and tools (in a classroom) are recognizable as part of a future career goal, identity, or space (a physicists' lab). The meaning of "good physics student" (produced in the classroom) is connected to a larger network of power—the discipline of physics.

From this perspective equitable science education is a vehicle through which to accomplish social change by allowing students to access networks of power (Carlone et. al., 2009; Gutstein, 2006). More recently, equity scholars turned their attention to an examination of students' agency and identity development with a more explicit focus on

both local power and larger networks of power. For example, Calabrese Barton & Tan (2008) posited that a focus on equity must focus on supporting students' *critical science agency* (defined in Chapter II) in ways that allow them to combat political, social, or economic forms of oppression.

For practice, the critical science agency lens allows us to understand the underrepresentation problem by drawing our attention to how the Academy, for example, connected its promoted practices to powerful networks within health care. Also, it makes explicit how local classroom practices are connected to students' future goals. Supporting students' critical science agency allows them to make connections between science and their future goals in ways that enable them to use science in agentic ways—to secure a high-paying career, to have a voice in key environmental issues, or to make informed health decisions.

However, educators and researchers know little about the kinds of contexts and experiences that support critical science agency. I argued in Chapter II that if school science cultivated this kind of agency then African American students will find science and a science career more relevant, accessible, and attainable. But, to date, we do not know about the relationship between critical science agency and African American students' career attainment. As such, I set out to examine the potential of a Health Science Career Academy to support critical science agency as it relates to science-related career attainment for African American students.

Career academies are popping-up all over the nation (Gott, 2007; Gran & Krudwig, 2007; Maxwell & Rubin, 2000) and represent the changing landscape of urban science

education. Career academies are typically implemented as part of urban reform initiatives in an attempt to increase achievement through smaller learning communities and to provide relevant curriculum and experiences, career mentoring, and access to post-secondary opportunities (Castellano, Stringfield, & Stone, 2003; MacIver, 2007; McPartland, Balfanz, Jordan, & Legters, 1998). Moreover, many of these academies have a science or science-related career focus (i.e. biotechnology, engineering, or health science). Currently, career academies define accessible science and science-related trajectories for urban students, and we know very little about their potential for attracting and retaining urban youth.

My study was designed to investigate the potential of a Health Science Career Academy to support African Americans' science and science-related career trajectories. Are career academies possible contexts for cultivating critical science agency and, if so, does this sort of agency advance students' along their career trajectories? The findings from this study answer these questions for the context I studied. Did the Academy have potential? Overall, I was very disappointed. The Academy, as realized, failed to support students' science-related career trajectories in two major ways. I discuss the reasons for the Academy's failure next.

Institutional Potential Unrealized

At the start of this study, I was hopeful about the Academy's potential. The career context provided the possibility for career exposure and seemed to push the boundaries of traditional high school science. The Academy's institutional potential reflected many of

the recommendations made by scholars concerned with equity and career attainment—the curriculum was connected to real-world experiences, students took many high-level science and math courses, and the school district paid for college tuition during their senior year. These features seemed like the necessary resources needed to support African American students' career trajectories. I was encouraged that students had the possibility to realize equity (i.e. via social mobility and economic stability) through the Academy. The Academy did live up to its promise in some ways; it provided access to high level science and math courses and access to post-secondary education. However, many aspects of the Academy actually hindered the possibility for students to advance their science-related career trajectories. In this section, I describe two ways the Academy failed to deliver its institutional potential.

Limited Identity Roles

The Academy's distinguishing features were the culminating medical course and internship. I was excited about these features because students learned specific knowledge and skills related to health science and interned in a variety of health care facilities. The Academy promised to expose students to a variety of health care roles in these settings. However, in reality, the Academy promoted a narrow health care identity that limited students' possibilities for exploration.

Students only had access to a feminine, care-giver identity role. They learned content and skills related to care-giving and role played as CNAs over and over again in class. In clinical, students did more of the same. Students bathed, fed, and dressed patients. The

activities, tools, and talk within the classroom and clinical limited students' ability to "try out" other possible roles that more closely aligned with their pursued identities.

Why was the exploration of identity roles critical to supporting critical science agency and students' career trajectories? Students came to the Academy with a critical stance regarding who they wanted to be, how they wanted to use science, and how they wanted to impact the African American community. However, students did not have access to the resources needed to craft these imagined identities in health care. For example, Will decided on a career in medicine because he wanted to help others. However, Will was interested in the technological side of medicine. He envisioned developing technologies such as artificial limbs or hearts. Will did not find a connection between medicine and technology within the Academy. After his clinical experience, he shared that "If I can find a kind of bridge between the two, I wouldn't mind working in the science or the medical field". The Academy did not provide Will with the space or experiences needed to further develop his imagined future self.

As I discussed in Chapter V, male participants had similar experiences during clinical. In all cases, the feminine caregiver role did not align with their future selves and caused them to experience identity conflicts. As a result, most males opted-out of a science-related career trajectory. Could males have stayed the course if they were exposed to more masculine identity roles? Perhaps yes, but we can only infer. Apparent though, is how the sanctioned feminine care giver role did not advance the males' career trajectories.

The females had much different experiences and outcomes. The feminine caregiver role aligned, in some ways, with their imagined future selves but also with their identities as young women. None of the female participants decided to opt-out altogether from their science-related career trajectories, but they did not have access to the resources needed to develop all aspects of their pursued identities. For example, Brittany wished to establish a health care program for single mothers and their children. Similarly, Roxanne envisioned starting a free or low-cost dental clinic within the community. These roles unquestionably require skills that go beyond care giving—such as general leadership skills and business skills. Students did not have the space to explore leadership roles. The internship did not connect students to these kinds of powerful roles needed to develop their leadership goals. However, particular experiences, such as the hospital, hinted at the possibility to better support both the males' and females' imagined identities in health care.

The hospital experience held promise for realizing the Academy's potential because it exposed students to a variety of possible identity roles. Students were excited, asked substantive questions about possible careers, and commented on the desire to work in this environment after just a few hours in the hospital. A feminine entry-level role did not limit students' identity work; instead, they got to "play with" the notion of being a doctor or physical therapists. These identity roles more closely aligned with students' imagined selves. Out of all the clinical experiences, the hospital had the most potential for further developing students' health science trajectories because it provided space and opportunity for exploration and broadened accessible career trajectories. Unfortunately, students only spent two days or six hours in this facility. In the end, the Academy's did not realize its

potential—to expose students to a variety of health care roles—and hindered their science-related career attainment.

Outdated Vocational Model

The medical coursework (and internship) drew from an outdated vocational model. Scholars have long argued that vocational curriculum and training reproduce and sustain class and racial inequities by funneling ethnic minority students into low-paying jobs—a career trajectory connected to laborer positions (Apple, 2004; Kantor, & Lowe, 2000; Oakes, 1985; Willis, 1977). The Academy, in part, reproduced this vocational career trajectory. The meanings of science and science person as low-status cast a shadow of bleakness on the Academy's potential. The Academy intended to connect students to powerful networks in health care; however, this intention was derailed by an oppressive vocational model.

Students did not learn content associated with professional health science careers. Instead they learned to labor as entry-level caregivers. For example, they learned how to use proper hand washing techniques for infection control. But, they did not delve deeper into how bacteria reproduces or issues of antibiotic resistant bacteria. They learned how to take blood pressures and to recognize if a blood pressure was too high or too low. But, they did not learn about underlying conditions that contribute to high or low blood pressure. Students engaged with medical coursework that promoted *functional literacy*.

> A literacy is functional when it serves the reproductive purposes (i.e. maintaining the status quo) of the dominant interests in society—in the United States, these are the needs of capital. Thus, providing functional

> literacy for some individuals (e.g. low-paid service workers) could mean a curriculum focusing on low-level basic skills […]. (Gutstein, 2006, p. 5)

Students did not engage with meaningful and relevant health care problems connected to their lived experiences and imagined futures. They engaged with content associated with low-paid service workers.

Further, the outdated vocational model did not tap into students' altruistic goals. They came to the Academy with critical stances; they viewed health care and society with a critical eye. For example, Roxanne wanted to improve access to dental care for economically underserved populations. The vocational model did not support the experiences needed to further develop Roxanne's or others' critical altruistic intentions. Overall, it failed to foster *critical literacy*. Gutstein (2006) explained that:

> *critical literacy* means to approach knowledge critically and skeptically, see relationships between ideas, look for underlying explanations for phenomena, and question whose interests are served and who benefits. Being critically literate also means to examine one's own and others' lives in relationship to sociopolitical and cultural-historical contexts. (emphasis in original, p. 5)

The vocational model did not push Roxanne, for example, to inquire about the connection between health care access and larger political or economic structures.

The health care internships provided a possible platform to foster critical literacy. In fact, students did uncover injustices (i.e. poor quality health care) through these experiences. However, classroom discussions did not explicitly address or deconstruct these injustices. Modification to the outdated vocational

curriculum by centering these injustices in students' inquires and classroom discussion will target critical literacy and facilitate students' deeper understanding issues such as patient neglect or poor working conditions for entry-level health care workers. This way, students will have the tools to act upon their altruistic goals and ultimately advance their career trajectories. So why did Mrs. Mahoney not do more with the curriculum to foster critical literacy?

Mrs. Mahoney wanted to make modifications to the curriculum. She envisioned that the students would plan and carry-out a community health care project (Teacher interview, 6/16/2009). For example, students would provide information to the community about available health-related resources and even educate them about particular health care concerns prevalent within the community. Students would also provide blood pressure screening and even invite medical professionals in to provide consultative services. However, she doubted her ability to include this project into the future curriculum because of the high-stakes testing culture in her school. The fact that Edgeview High School was a "low-performing school" added to this stifling culture.

Mrs. Mahoney faithfully followed her state and district mandated curriculum. She felt an immense pressure to ensure that students mastered the curriculum and performed well on the state mandated test at the end of the semester. She had to cover the medical course curriculum and provide students with the required number of clinical hours to master their skills—deviating from this charge would jeopardize the end-of –the-course testing. She was essentially enslaved to a system that rewarded teachers for "getting the score". In fact, in this district, teachers received monetary incentives for high test scores. I

believe that Mrs. Mahoney saw the hegemony associated with the curriculum (evidenced by her desire to modify the curriculum) and truly wanted to change some of these practices. Overall, the high-stakes testing culture determined the classroom content and clinical experiences (Carlone, Haun-Frank, & Kimmell, in press; Chinn, 2008).

In this section, I discussed the Academy's potential for supporting African Americans' science related career trajectories. The Academy did not fully support all students' science-related career trajectories because it provided limited identity roles and drew from an outdated vocational model. Next, I outline how insights from this study contribute to our current understanding of the underrepresentation problem.

African Americans' Science-related Career Trajectories: Contributing to our Understanding of the Underrepresentation Problem

By looking at African American students' science-related career trajectories, I got an in-depth look at why they decided to pursue a science career, the identities they wanted for themselves, and the resources they drew on to do so. There are very few studies that have specifically examined the underrepresentation problem from an agency/identity perspective (for exceptions see Carlone & Johnson, 2007; Lewis & Collins, 2001; Packard and Nguyen, 2003; Rahm, 2007). These previous findings made evident that career attainment is much more complex than just providing access to high-level science courses or better teacher training. This study adds to these previous findings by contextualizing how identity-related factors influence African American students' career attainment.

Here, I outline various insights from this study and how they contribute to our current understanding of the underrepresentation problem. These insights are organized into three sections where I discuss: (1) how we can better capitalize on school as a resource for attracting and retaining African American youth interested in science; (2) shifting our research and curriculum development lenses from attracting African Americans to science (a "science interest" lens) to understanding and working toward African Americans' persistence in science; and (3) altruism as a critical, but under-utilized component of an equitable science education for African American youth. My discussion here focuses on providing recommendations for future research, curriculum and program development, and career academies aimed at achieving a socially just science education for African American youth.

Capitalizing on School as a Resource

School (or even informal experiences) must do a better job to support students' science-related career attainment. In my study, school science piqued students' initial interest in science, but after elementary school, it was a non-resource. Students did not receive any support from school to explore the possibilities for science in their futures. I probed students for the resources they drew upon to make career-related decisions, and *none of the students* named school as a resource. This is quite shocking, especially since these students pursued the early career program aimed at supporting their career decisions! How might schooling be used as more of a resource for African American's science-related futures? I make the following recommendations based on findings from

this study: (1) Science education must provide space for students to "play with identities", (2) We must re-conceptualize school science as a multifaceted network rather than a "funnel", and (3) Schooling must facilitate social networks.

Space to "play with" possible identities. Programs or interventions aimed at supporting career attainment must offer students access to multiple identity roles and the space to explore those roles. The possibility for students to "play with" their imagined roles is one of the major reasons students' came to the Academy and was also one of the major ways the Academy failed to support their trajectories. Students needed experiences that allowed them to know whether a particular career role fit with who they wanted to be. For this study, the hospital context seemed to enable students' engagement in this sort of identity.

Packard and Nguyen (2003) suggested that students' science-related career development required *negotiation*. My study builds on that work to understand what that negotiation requires. As I stated, the Academy provided no wiggle-room for students to "play with" their possible future selves. This "playing" or "negotiation" is not just about acquiring content knowledge necessary for a particular career; it is also about "trying on" possible roles. For example: What is it like to be a physical therapist? What do they do each day? What are their working conditions? How many hours do they work? In what kinds of places do they work? What is the potential for their work to help others? Internship experiences *do* have the potential to allow students to answer these kinds of questions or negotiate their future selves. However, students cannot be limited to just one role. Identity work requires playfulness and imagination. In order for these imaginings to

become more concrete trajectories, students need to explore if and how they fit into possible roles.

We can also apply the idea of creating opportunities for students to "play with" identities to other science or science-related fields and informal contexts. For example, Tomasek, Matthews, and Allen (in review) reported on an informal science learning context where students engaged in field ecology research with a variety of professionals employed within the field. These experiences allowed students to "try on" identity roles as future field ecologists. Creating these identity spaces requires that we think about school science differently. School cannot continue to offer students just one career trajectory or just one identity role to "try out", otherwise we are endanger of losing interested and talented youth. I discuss possibilities for re-conceptualizing school science in ways that will advance students' science and science-related career trajectories.

School science as a multifaceted network. To increase African Americans' representation in science or science-related careers, school science needs to be re-conceptualized from a funnel (or based on "pipeline ideology" as Aikenhead (2006) argued) to a multifaceted network that connects students to multiple trajectories. Historically, school science funneled students into lab or bench science disciplines and alienated many African American students in ways that deterred their career attainment (see Chapter II for this discussion). The Academy had potential for disrupting this narrowly defined "pipeline" science (Aikenhead, 2006) by connecting students to other science-related career networks such as physical therapy, pharmacist, medical researcher,

or surgeon. But in reality, the Academy just funneled students into a different narrowly defined trajectory—that of entry-level caregiver.

The content of school science could be connected to trajectories in food science, alternative energy, or public health to name a few. This requires that the school science curriculum make explicit connections between science knowledge and skills and the many possible careers/identity roles available in science or applied science. When I probed to see if students could make connections between their traditional school science subjects (e.g. chemistry and physics) and possible careers (including health care), they made no connections. School must facilitate these connections for students so that the content and skills they learn in the classroom are recognizable and relevant to their future goals (Nespor, 1993).

For example, understanding topics such as bacteria reproduction and resistance (in the science classroom) is necessary to understand why a patient must take an entire course of antibiotics to cure an infection (as a future doctor). Part of allowing students to explore possible roles requires they understand the knowledge associated with that role but it also requires they understand more informal aspects of careers—that might not be learned from classroom lab activities. Classroom lab activities expose students to the kind of thinking a doctor does each day but it does not expose them to other aspects of the job, such as working conditions. Students can access informal career information through social networks. A multi-faceted network focused on science or science-related career development should also build social networks. I talk about the role of social networks next.

Social networks. Social networks are important supports for students' career development. Much of the career development literature suggests that informal/formal social networks are significant influences on career choice in general (King & Madsen, 2007; Moore, 2006; Pearson & Bieschke; 2001). Students in my study drew upon informal social networks to make career related decisions. Early in their career development, the girls received exposure to health care from family and church members. These relationships helped the girls to make informed decisions about pursuing a health science career.

The males did not draw on these informal networks to make pre-Academy career decisions, but they drew on them when they experienced conflict during the clinical experience. For example, Curtis had a neighbor who was a lawyer and this informal connection influenced his decision to pursue law. Likewise, Marcus had several family members who served in the armed forces and this relationship influenced his decision to go into the army. Perhaps if the male participants had built similar relationships with significant others in health care, they would have persisted. These kinds of social networks have the potential to allow students to construct their imagined identities in ways that realistically represent science and science-related careers.

Persistence vs. Interest

The literature about the underrepresentation problem has concentrated on how to get students interested in science and has generally neglected issues of persistence. The "interest" approach does not account for those students who are *already* interested in

science and a science career. A unique group of students participated in this study; they were interested in science, had the academic ability, and had a desire to pursue a science related career. These are the kinds of students we want; but, we lost them along the way. The problem was not about interest; it was about persistence.

Results from this study suggest that students need career support and exploration earlier than high school (or at least earlier than grades eleven and twelve). Many of the students in this study considered a science-related career during late elementary and middle school. Thus, programs meant to explore career possibilities need to happen earlier. Early exposure will provide students the opportunity to understand their options and to construct more realistic images of possible science and science-related careers. The students in this study, especially the males, did not realize that their imagined identities did not match reality until grades eleven and twelve.

In the past, the "interest" approach prompted the creation of curriculum (i.e. hands-on or project-based science) meant to engage students and arouse their curiosity. Hands-on curricular experiences effectively interested the students in this study, but they did not further support students' career development. Students' persistence required them to move along a career trajectory in ways that aligned with their future goals and identities. The males opted-out because the Academy's trajectory did not support their imagined trajectories. The males' divergent path highlights the *tenuous* nature of their imagined identities. Curtis' case illustrates this insight.

Curtis lived in another part of the district, had to travel a fair distance, and ride several busses to attend the Academy. He volunteered at a hospital on his own time. He

was near the top of his class and was accepted, with a scholarship, to one of the most competitive universities in the state. His "pre-med" identity and fate as a future doctor seemed so secure, his family, friends, and teachers referred to him as "Doctor Curtis". But, on the turn of a dime, he decided to study law. This sudden departure was influenced by the narrow Academy experience. Curtis reflected on his clinical experience: "It was not what I was looking for. That's when I started thinking that maybe this is not for me." (FI2). However, his departure also had to do with his pre-Academy image of health care. He held romanticized notions of health care and experienced an identity conflict during the clinical experience. Curtis and the other males did not receive enough career-related support along the way. To fully address the underrepresentation problem, a focus on student persistence is necessary. In this section, I argued why a focus on persistence versus interest is needed to close the underrepresentation gap. Next, I discuss how altruism can be used as a way to support African Americans' science and science-related career trajectories.

Altruism as an Entry Point

The findings from this study suggest that altruism is an entry point for African American students in science and plays a major role in their commitments to pursue a science or science-related career. Students in this study decided to pursue a career in health science because of its altruistic potential. In part, they saw it as an avenue to end personal economic and social oppression but also to impact the lives of others. This is helpful for thinking about underrepresentation in *all* areas of science. The literature talks

about images of science (as masculine, elitist, and devoid of emotion) and scientists (as nerdy, white males) and how these images prevent some marginalized groups from pursuing science (Aikenhead, 2006; Carlone, 2004; Rahm, 2007; Osborne & Collins, 2001; Scantlebury, Tal, & Rahm, 2007). However, the fact that *these* students chose to pursue science for its altruistic potential is significant.

The cultural model of medical professional as an altruist is very accessible. At some point, regardless of socioeconomic status, an individual living in the United States is likely to visit a doctor's office or health care clinic. These kinds of informal experiences allow students to understand the altruistic nature of a doctor's work. They are important resources for identity construction in science (Holland, Skinner, Lachicotte, and Cain, 1998).

Additionally, the media makes the altruistic aspect of health care accessible. Popular television programs such as *Greys Anatomy* and *ER* flood us with images of people working in medicine, saving lives, and making the world a better place. Students in this study cited the media as a significant resource. However, television health care roles do not necessarily depict reality. Curtis commented that *ER* was his favorite television program. He reflected that, "I guess you get all caught up in the drama. But then you go into your clinical, kind of thinking that it will be the way it is on TV. Then you realize that it is really just an ordinary job like other people have." (FI2). For the males, these sensationalized images contributed to the identity conflicts they experienced because their pre-Academy images did not match what they confronted in their clinical internships.

A career in medicine may be a logical choice for students with altruistic goals. However, this may not be the only model available that combines both science and altruism. The cultural model of doctor and nurse as altruist, for example, is much more accessible than say the cultural model of chemist as altruist. While an exploration of students' cultural models of altruistic scientists was not within the scope of this study, informal conversations with students pointed to a limited awareness of career options in science that supported altruistic goals. For example, Antonio and Sasha had a deep interest in chemistry. I asked Antonio why he did not pursue a chemistry career and he told me that he chose medicine because of its altruistic potential. Likewise, Sasha wanted a career that allowed her to help others. They did not see the altruistic potential in a chemistry career.

Students must understand the nature of science and science-related careers to persist. A chemist is not just a geeky male who mixes chemicals for science sake. They may, for example, work on water sanitization processes to provide safe drinking water to underdeveloped countries. Students may not have a clear understanding about how a physicist's work contributes to social justice projects, such as developing manufacturing technologies for developing countries. It is unlikely that large numbers of individuals in society have experiences with chemists and physicists in ways that allow them to get a robust understanding about the altruistic aspects of their work. Thus, other cultural models of *scientist who engage in altruistic work* are not widely accessible.

In fact, Eisenhart (2009) made similar conclusions regarding her after-school program for girls. FREE (Female Recruits Explore Engineering) aimed to generate girls' interest in engineering and IT fields. She concluded:

> FREE focused on overcoming the nerdy-male image of engineering/IT and triggering interest in these fields. We found it easy to dispense with the nerdy-male image. Rather than having a negative or "not-for-me" image, the girls knew almost nothing about engineering or IT. The fields weren't unappealing, they were unknown. (Eisenhart, 2009, p. 8)

Like the girls in Eisenhart's study, these students did not have a robust understanding of the possible career trajectories in science. Perhaps their original commitment to pursue a health related career was due to their lack of exposure to other possible trajectories. Thus, if we provide students with other possible career trajectories that combine altruism with science, students can make more informed career decisions.

In this section, I discussed how students' interest in altruistic aspects of science and science- related careers can be used to support their career development. I suggested that students' limited access to cultural models of other altruistic science identities and trajectories contributes to the underrepresentation of African American students in science. As such, educators must be explicit about the altruistic aspects of science and science careers. If students have access to these models, they will be able to imagine future selves that allow them to use science as a tool for transformation.

Concluding Remarks

Given the disappointing results of this study, I am still hopeful about the potential of career academies to offer African American students a more just science education. This study involved only one career academy program with a small number of participants but it is reflective of a broader urban reform movement. Large urban districts across the nation have implemented similar reform initiatives and, as this study points out, have important implications for science education. The Academy hindered many students' science-related career attainment but it also undermined students' struggle for a better life. We see how educational policy, such as career academies as a model of urban school reform, impacts the kind of school science urban students can access. As it stands, we have much more to learn about these kinds of contexts—their limitations and possibilities. I urge educators, researchers, and policy makers to continue to examine and improve these kinds of programs because they have the possibility to push the boundaries of school science.

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Appendix A. Observation Protocol Date:

Time observation began: Time observation ended:

Classroom Practices [Guided by Spradley's (1980) framework for "participant observation", explained in Chapter III]

What are students doing?

- Process skills/tasks?
- What science content are they studying?
- What are students' responsibilities?
- What kinds of products or artifacts are produced through activity?

What tools and technologies are students using?

- Nature of the tools?
- Purposes for tool use?

What are students and teachers saying?

- How are teacher expectations communicated?
- How (or do) career discussions happen? In what contexts?
- What kinds of questions are asked (teacher/student)? (targets the local "meanings" in the classroom promoted by teacher, taken up by student)

Appendix B. Student interview protocol and focus group protocol

Individual Student Interview Protocol

Introduction Script: The purpose of our conversation is to discuss your past experiences with science, your experiences in the academy, and the role that you see science and the health science career academy having in your life. There is no "right" or "wrong" answer to any of these questions. If you do not understand a question let me know. I will audio-recording our conversation so that I do not miss any of the information you are sharing with me.

Background with science and school science

1. Tell me about your past experiences with science in school.
    - What did you like?
    - What did you dislike?
    - Elementary school science was _____. (2 adjectives)
        - Probe for examples
    - Middle school science was _____ and _____.
        - Probe for examples
    - High school science (pre-HSCA) was _____ and _____.
        - Probe for examples

2. Describe what kinds of science activities you have participated in outside of school?

Current views of science and relationship to Science

3. When I say the word "science," what comes up for you? What do you think of?
   Probe: Science is (describe with as many adjectives as possible).

4. Now, I would like you to describe yourself with as many adjectives as possible.

(Provide example, Julie is _____).

5. Ok, you've described science this way and yourself this way. What connections can you make between yourself and science?
    - What personal characteristics make you a good fit for science?

Future career goals

6. What are your career goals?

7. What role do you see science having in your future goals?

8. What do you envision the role that the HSCA has in your future goals?

9. Describe how you see the academy supporting (or not) your goals?

10. Is a science-related career important for you? Why or why not?

Experiences within the health science career academy

11. Why did you decide to apply to the academy program?
    - What led you here? (Probe: Why did you decide to enroll in the academy instead of just taking science classes in school?)
    - What were you hoping to get from the program?
    - What will it enable you to do?

12. Tell me about your experiences in the academy?
    - Describe the science that you do.

    - What is the purpose for doing (or learning) science in the academy?

- How do you think that you can or will be able use the science that you are learning within the academy?

13. Are you interested in what you are learning in the academy?
    - Why/why not?

14. Think of something important that you have learned about science in the academy.

    - Describe it to me.
    - Why do you think it is important?

15. Describe your internship.
    - What kind of science activities do you participate in?
    - How are they related to your future goals?
    - Is what you are learning in your internship important to you? Why or why not?

Community/Family

16. Explain what you think the academy means to your family.
    - Do any of your family members have science-related careers?
    - Has anyone in your family attended college?
    - Did they earn a degree?

17. When you tell people in the community (church, work, after-school sports, etc.) that you're in the Academy, what are their reactions? (Probing for the perceptions of the Academy in the community).

18. What other options for a career do you see that are available for you?

19. What do you think are your families' hopes are for your future?

Focus Group Questions (these questions were constructed after initial analysis of student interviews, informal conversations, and participant observation)

20. Describe a successful academy student.
    - Probe: How do they use science?
    - What do they do with the science they're learning?
21. Talk to me about what you hope to accomplish with a science-related career.
22. In your individual interviews, each of you shared the importance of helping others. Tell me more about that.
    - How will a science related career help you achieve those goals?
23. Tell me more about what you liked from your clinical experience.
24. Tell me more about what you disliked from your clinical experience.
25. Describe how you felt about participating in the clinical settings?
26. Describe how your clinical experience aligned with what you want to do in the future.
27. Do you still plan to pursue a health science career?
    - Why/why not?

Appendix C. Administrator/Teacher Interview Protocol

State the administrator/teacher name and date

Introduction Script: The purpose of our conversation is to find out your perceptions of the academy and the role that you see science and the health science career academy having in the students' lives. There is no "right" or "wrong" answer to any of these questions. If you do not understand a question let me know. I will be audio-recording our conversation so that I do not miss any of the information that you are sharing with me.

1. Tell me about the purpose of the Health Science Career academy.

2. What do you see as any differences between the science/experiences among the students in the academy compared to students taking the traditional curriculum?

3. What do you hope students gain as a result of membership in the academy?

4. What do you perceive as the role that science/the academy has (will have) in the lives of these students?

5. Is there anything else that you would like to share about your visions for the academy or for the students?

Appendix D. Parent interview protocol

State the parent name and date

Introduction Script: The purpose of our conversation is to find out your perceptions of the academy and the role that you see science and the health science career academy having in your child's life. There is no "right" or "wrong" answer to any of these questions. If you do not understand a question let me know. I will be audio-recording our conversation so that I do not miss any of the information that you are sharing with me.

1. Why did your child enroll in the academy?
2. What did you hear about the Academy before your child enrolled? (What was/is the word on the streets?)
3. How did you hear about the Academy?
4. What are you opinions of the program?
5. What are your hopes for your child's future?
6. What role do you see the academy playing in your child's future?
7. Is there anything else you want to share with me about the HSCA and/or your child's experiences in HSCA?

Appendix E. Overview of medical course curriculum

Unit Content	Competencies and Objectives
Health Care Systems	• Analyze health care facilities, including government and non-profit agencies. • Explore insurance and trends
Client Communications	• Apply medical terms and abbreviations. • Apply customer service skills.
Employability Skills	• Demonstrate professional qualities of a health care worker. • Prepare for the world of work.
Legal and Ethical Responsibilities	• Analyze legal responsibilities and issues related to death and dying. • Evaluate ethical behavior in health care settings.
Safety Practices	• Apply body mechanics and client safety. • Observe fire safety regulations.
Infection Control	• Analyze principles of infection control. • Maintain sterile technique and isolation.
Emergency Care Skills	• Acquire certification in cardiopulmonary resuscitations • Provide basic first aid.
Diagnostic Skills	• Measure and record vital signs. • Apply medical assisting and laboratory skills.
Nutrition and Diet Therapy	• Analyze patient/client nutritional measures. • Evaluate therapeutic diets.
Dental and Pharmacy Skills	• Identify teeth and dental instruments. • Work with medications and mathematical conversions.
Nursing Skills	• Position, turn, and transfer patients. • Make a bed. • Administer personal care and apply

	restraints.
Therapy and Sports Medicine	• Demonstrate assistive and therapeutic techniques. • Analyze the therapeutic role of messages.
Information Services	• File records and use telephone and scheduling techniques.

Appendix F. Sample taxonomic analysis diagram

<table>
<tr><td colspan="9">Ways to describe science-related career (students)</td></tr>
<tr><td colspan="3">General characteristics of science-related career</td><td colspan="4">Action oriented/Science-related career allows me to do X.</td><td colspan="2">Related to personal experience</td></tr>
<tr><td rowspan="2">Help others</td><td rowspan="2">Stable</td><td rowspan="2">High-paying</td><td rowspan="2">Provide quality care</td><td rowspan="2">Leadership</td><td colspan="2">Change life conditions</td><td rowspan="2">Community injustices</td><td rowspan="2">Personal/family health issues</td></tr>
<tr><td>Personal</td><td>Others</td></tr>
</table>

Appendix G. Sample Componential Analysis Chart

Tools used in clinical	Dimensions of Contrast	
	Connected/limited to CNA work (Tools CNAs used)	Connected to other roles (Tools other health care workers used)
Adult briefs	x	
Bed linens	x	
Blood pressure cuffs	x	x
Feeding utensils	x	
Hair brush	x	
Nail clippers/files	x	
Patient bath chart	x	
Patient lifts (gate belt and Hoyer lift)	x	
Scale (patient weight)	x	
Soap/shampoo	x	
Stethoscope	x	x
Thermometer	x	
Tooth brush	x	
Towels	x	
Wheelchairs	x	x

Appendix H. Sample of storyline