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Black, Confident, and Capable: The Science Student Beliefs of Four Black Male Science Students in a Rural Middle School Science Classroom

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BLACK, CONFIDENT, AND CAPABLE: THE SCIENCE STUDENT BELIEFS OF FOUR BLACK MALE SCIENCE STUDENTS IN A RURAL MIDDLE SCHOOL SCIENCE CLASSROOM

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ABSTRACT

Lacking in educational research are the positive narratives of Black male students and their science classroom learning experiences, as told through the voices of Black male science students. This study highlighted the normative scientific practices found in *A Framework for K-12 Science Education* that four Black male science students experienced during a cells unit in their rural middle school science classrooms. Their shared science-student beliefs centered around the themes of confidence and capabilities, behaviors matter, the perceptions and expectations held by self and others and the utility of the normative scientific practice. These study findings provided a counter-narrative to the predominantly negative schooling experiences of Black male students. Moreover, the findings revealed the instructional significance of exploring the contention and harmony between student beliefs, teacher instructional intentions, and the performance expectations of normative scientific practices.

Keywords: Black male science students, rural science education, middle school science, science-student beliefs, attitudes, social psychology

DEDICATION

I dedicate this to my Lord and Savior, Jesus Christ. From the beginning to the end, your purpose shall be fulfilled.

I dedicate this to my mother and father, Gloria and Adenrele Odutola. They worked to support me in every way throughout my academic career. I could not have reached this goal without their continual love and support.

I dedicate this to my brother who provided me with the much needed laughs to keep my spirit up when I needed it.

I dedicate this to my family, extended family, and my dedicated friends... who are really my family. You all know that your prayers, listening ears, and support have carried me through every stage of my life.

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TABLE OF CONTENTS

Page

TITLE PAGE i

ABSTRACT ii

DEDICATION iii

ACKNOWLEDGMENTS iv

LIST OF TABLES vii

LIST OF FIGURES ix

CHAPTER

I. INTRODUCTION 1

Statement of the problem 13
Purpose of the study 15
Subjectivity statement 16
Definitions 19

II. LITERATURE REVIEW 22

Theoretical framework 60

III. METHODOLOGY 65

Case study 65
Ethnography 68
Settings and participants 71
The cells unit of study 87
Data collection 87
Data analysis 96
Measures of trustworthiness 107

Table of Contents (Continued)

Page

IV. RESEARCH FINDINGS 118

Black male student beliefs about self 119
Cross-case summary 137
Normative scientific practices experienced by
Black male students 140
Section summary 156
Black male student beliefs and normative scientific
practices 158
Section summary 190
Chapter summary 199

V. DISCUSSION AND CONCLUSION 206

Discussion 206
Significance of the study 219
Limitations and future research 222
Conclusion 224

APPENDICES 226

A: Sample of field notes and observations 227
B: Studenting interview questions 229
C: Normative scientific practices observation tool 230
D: Card sort interview 231
E: Semi-structured interview questions 233
F: Descriptive coding for research question one
(studenting interview) 235
G: Descriptive coding for research question one
(field notes and observations I) 238
H: InVivo coding for studenting interview 240
I: Descriptive codes with InVivo code designations 244
J: Semi-structured interview: InVivo and pattern coding 246
K: Field notes and observations III attitude categories 260
L: Field notes and observations III pattern coding with practices 276

REFERENCES 289

LIST OF TABLES

Table Page

3.1 Ethnographic multiple case study research design 70

3.2 List of possible study participants 79

3.3 Research questions and data sources 95

3.4 Sample coding for research question one 96

3.5 Descriptive code frequencies for research question one 97

3.6 Field notes and observation III pattern coding with associated practices 103

3.7 Intercoder agreement comparison for five InVivo codes..........................112

3.8 Intercoder reliability percentage agreement 114

4.1 Individual student beliefs 137

4.2 Extended framework practices with abbreviations and descriptions...142

4.3 The scientific practices experienced by Jay, LT, Kyle, and Mikel...144

4.4 Top three scientific practices experienced by Jay, Kyle, LT, and Mikel 147

4.5 NSP observation tool results, first period..149

4.6 NSP observation tool results, second period 149

4.7 Observed normative scientific practices, first period...............................152

List of Tables (Continued)

Table Page

4.8 Observed normative scientific practices, second period 152

4.9 Mrs. Sunshine's card sort interview results 154

4.10 Mrs. Sunshine's top three scientific practices 155

4.11 Study findings for Jay, LT, Kyle and Mikel 199

LIST OF FIGURES

Figure Page

3.1 Example coding process for initial science-student beliefs (Jay) 99

3.2 Example of the coding process for the semi-structured interviews (LT) 102

3.3 The process of data analysis for research question one 105

3.4 The process of data analysis for research question two 106

3.5 The process of data analysis for research question three 107

CHAPTER ONE

INTRODUCTION

Research on Black male students and their schooling experiences has commonly been situated in deficit perspectives. One example of a displayed deficit perspective is in the practice of comparing the Black male student to his white male counterpart, who as positioned in the literature, serves as the standard when discussing issues concerning the educational achievements of students in the United States (Martin, 2012). This positioning masks the complexity of the Black male and his lived experiences inside and outside school environments because it narrowly focuses on Black male student achievement through one lens. The single lens compares the achievement of Black male students to the achievements of an(other). Black male students are not the only group of students who live complex schooling lives, however, they are the group of students who statistically reside at the lower end of academic measures of achievement (Harper & Davis, 2012; Roderick, 2003; Whiting, 2009). Black male public school students also experience school disciplinary punishments at a higher rate than their peers (Ferguson, 2001). Arguably, these occurrences, among others, are the result of multiple societal, historical, cultural, and institutional factors (Fordham & Ogbu, 1986; Howard, Flennaugh, & Terry, 2012).

Emdin (2012a), a science education researcher, admonishes education researchers and educators to stop pretending that every student is the same, thus moving forward to acknowledge, affirm, and utilize these differences for the educational good of the student. In a science, technology, engineering, and mathematics (STEM) related study, Strayhorn

(2015) acknowledges that there is a need to hear more about the stories of 'other' Black males to push back against the overwhelmingly negative narratives associated with Black males in general and Black male students in particular. Stories that speak to the percentage of Black male students who navigate institutional structures to achieve personal success (Harper & Davis, 2012; Strayhorn, 2015). Brand, Glasson, and Green (2006) also call on the need for those involved in conducting research concerning Black male students, and other marginalized student groups, to allow for the students to tell their own stories, for their voices to be heard more often in the literature. I assert that more of these stories are necessary to create a more realistic and dynamic narrative of Black male students. This study's aim is to highlight the voices of four seventh-grade Black male students in a rural science classroom setting. The findings of this study are important in widening our knowledge base and better understanding the science teaching and learning experiences of Black male students during their years of early education.

Black Males and Schooling Institutions

Historically, the Black male and schooling conjures up deficit narratives that describe the Black male as not being interested in school, "a problem", unable to learn, and hyper-aggressive, among others (Anderson, 1988; Noguera, 2003). Little attention is given to the institutional structures in which the Black male student finds himself living in and how these structures are sometimes in conflict with his race and gender, influencing his behavior and performances in school. In an elementary school setting, Ferguson (2001), gives multiple accounts of Black male students and their behaviors. She states that of one student in particular, Horace's behavior at school was "... classified as lazy, belligerent, incorrigible..." (p. 15), but in other contexts he was "...respectful, diligent, and responsible..." (p. 15). Her account of Horace's behavior was based on her own observations in school and interviews with his family members. Horace responded in opposition and rebellion to how he was treated in school by some school adult personnel. Whereas, other school personnel garnered obedience and focus from Horace.

Similarly, in a study designed to better understand how Black male middle school students handled microaggressions at school, Henfield (2011) notes that three of the five Black male participants shared experiences of being accused of deviance. However, the author mentions that this middle school is not only predominantly White but that it has traditionally been White. Therefore, the increase in Black students during the current study school year could have created a new classroom dynamic in which the teachers may have lacked the cultural knowledge to handle the actions and behaviors of their Black male students. Whether this was or was not the case in the Henfield (2011) study, it does speak to cultural differences being a potential factor in how Black male students behave and are perceived to behave in schools with school rules based on dominant cultural and social norms. These studies highlight some of the institutional and cultural factors that play a role in the schooling experiences of Black male students.

Love (2014) provides an example of how the enacting of "Hip Hop swag" (p. 294) by a Black male student can be misinterpreted by a teacher as being a sign of "...arrogance or a dismissal of authority." (p. 294). This perspective held by a classroom teacher, along with other personal bias can negatively influence the immediate academic and classroom performance and future educational trajectory of Black male students. The learning environment cultivated in such a classroom can then produce a certain kind of student who sees himself and his abilities through a socially and culturally constructed lens. These projected lens' may prove to harm the academic path of some Black male students while other Black male students move through and attain their own versions of academic success.

In more recent years, researchers have begun to explore what I refer to as the 'other' stories of Black male students (Harper & Davis, 2012; Strayhorn, 2015). As previously mentioned, stories that speak to the percentage of Black male students who navigate these institutional structures to achieve personal success. Ferguson (2001) referred to these Black male students as "Schoolboys" (p.9). After spending time with twenty fifth- and sixth-grade Black male students, she described schoolboys as the boys who were rarely in trouble and had figured out how to navigate their way through school. However, she cautioned, as a researcher, that it was a mistake to think that these boys were "fundamentally different" (p. 10) from the boys who frequently got into trouble. Ferguson suggested that in telling the stories of an 'other' Black male student, we are telling a story that could be the story of *any* Black male student. She highlighted that Black male students classified as the schoolboys could have easily been the Black male students who were not the "school success" stories. Therefore, further supporting the need for inquiry into the lived schooling experiences of Black male students and specific to this study, four Black male science students.

Black Males and Science Education

Much of the education literature concerning the success of Black males in a science-related area discusses the Black male and his decision to pursue a STEM career field during his postsecondary education, such as the Strayhorn (2015) article previously referenced. According to Strayhorn's (2015) study concerning the college and STEM career choices of undergraduate Black male students, self-efficacy was a factor in the college and STEM career decisions of his participants. He stated that "Black male students who feel confident in their academic abilities and believe in themselves academically also tend to major in STEM fields, earn good grades, and persist in college" (pp. 59-60). This study also pointed to the nurturing of early school-age STEM interests of Black male students through informal or formal science-related activities, opportunities, and coursework and the notion of "belonging in STEM fields" (p. 60) as factors that influence the STEM career decisions of Black male undergraduate students. However, stories of Black male students told by Black male students during their early science classroom schooling experiences are lacking. The implications of the findings for these types of studies are not only useful to college and university personnel but also to K-12 administrators and educators involved in the schooling experiences of Black male students. Specifically, the concept that intentional, positive, and early school interactions with Black male students have the potential to cultivate school success and career success for more Black male students.

Early Science Education

Zacharia and Barton (2004) highlighted that the science interests of students influence the future choices that students make regarding science and importantly, these choices for science have been reported to decline during the middle grades and high school years of a student's life. Education literature purports that sustainable student interests in science specifically, are established prior to the high school years. Farland-Smith (2009) stated in her study with middle school girls and their science identity that middle school girls are "... constructing their own identities" (p. 415) during this age range. She noted that students in this age range begin to form attitudes for or against science. When the middle school girls in Farland-Smith's (2009) study interacted one-on-one with scientists, the author stated that the girls began "... to search their own identities in the process of identifying if they could picture themselves in a particular science career." (p. 421). The views toward science for the middle school girls in the study stayed the same or were enhanced as a result of having science role model experiences. Similarly, the science interests of sixth and seventh grade students who opted to participate in an afterschool science program were also reported to have a "...sustained interest in science..." (Basu and Barton, 2007, p. 466). The paucity of education literature concerning young Black males and science education supports the need for the current study. Additionally, the studies concerning young Black males are largely situated in urban school contexts. Therefore, in order to extend the knowledge that exists pertaining to Black male science students, this study explores the science learning experiences of four Black male students in a rural middle school context.

A Definition of Rural

According to the National Center for Education Statistics (NCES) website 27.7% of public elementary and secondary schools and 53% of public school districts are classified as rural, compared to 27% and 5.7% for urban (city) public schools and public school districts. According to the NCES, rural refers to an area's geographical proximity to an urban area or urban cluster (Office of Management and Budget, 2000). Farmer et al. (2006) used US Census locale information and population density per square mile as rural school identification markers. Whereas, Avery (2013) mentioned isolation as a factor in classifying a school as rural or not. In Grimberg and Gummer (2013) the authors explored culturally relevant pedagogy and practices and teacher professional development programs for teachers who lived in or near an American Indian reservation in the state of Montana. Grimberg and Gummer (2013) did not label these communities as rural, however, if isolation and their description of the students who attended school on these reservations as "non-mainstream" (p. 13) are considered, this community could be classified as a rural community. The degree of rurality for Reese Middle School (RMS), the middle school context in which the study participants attended school, could be described as a rural school based on its proximity to an urban area or cluster as outlined by the NCES (Office of Management and Budget, 2000). However, more importantly for this study, this rural context was also described as rural because RMS functioned as a family and existed as a community of care (Knutson & Del Carlo, 2018). Rural communities of care will be discussed further in the next chapter.

Lack of uniformity of this definition has resulted in literature that may or may not have been about rural science education (Oliver, 2007). Therefore one may ask, what knowledge do we have concerning modern day Black male students in rural school settings? Do the examples of tools and resources such as working on a farm, small classrooms, and/or family-oriented school environments still hold true today for rural students in rural school contexts? Additionally, how or do these resources influence the learning environment for students today and in what ways? In posing such questions, I make a problematic assumption that is seen in rural education literature. The assumption is that what happens in one rural school setting can be generalized to all rural school settings.

Avery (2013) mentions how rural education research is oftentimes generalized and applied to any rural setting. Such generalizations mask the complexity of the lived experiences of Black male science students in diverse rural contexts. This study sought to attend to the "how or why" concerns raised by Mutegi (2013) and unmask any issues that are present for four Black male students in a rural middle grades science education classroom in the southeast region of the United States. The goal of this study was to better understand the science learning experiences of Black male students in a rural middle school setting through the voices of Black male students.

Rural Science Education

Ignoring the intellectual capital of knowledge pertaining to a population of students, their education experiences, and how they view the utility of science, impedes their access to science, science literacy skills, and their future science career pursuits (Parsons, 2008). The stories of the science students within rural school contexts also deserve to be heard. Their stories may highlight particular nuances of rural school teaching and learning. For example, what the authors Carlone, Kimmel, and Tschida (2010) label as empathetic science, was enacted within the context of a rural science, technology, and math (STM) elementary school. A STM school was intentionally developed in this area because education stakeholders recognized that they needed to focus more attention on these three discipline areas. Empathetic science in this newly developed context is depicted in the following excerpt.

> For example, two separate [local newspaper] articles showed and explained students role-playing as baby sea turtles to find their way to the ocean to understand the confusion caused by human lights (5/19/04; 11/5/04). One student said, ‘‘I found a grocery bag floating and pulled it out. These bags kill leather back sea turtles" (11/5/04). Much of the science portrayed was about ‘‘taking care.’’ (p. 471).

This depiction of empathetic science being enacted in this way, and influenced by what the authors refer to as "multiple networks of practice" (p. 447), extends the knowledge we have concerning the science education experiences of students in rural school contexts. Additionally, Brandt et al. (2010) state about their study site that "...in this rural area cultural struggles and resolutions are so different in tone and dynamics from the struggles in urban schools." (p. 478). Therefore, without education research and targeted research questions for this demographic in rural areas, our knowledge base concerning students and their learning in the United States is incomplete.

Research literature concerning Black male students and science education within a rural school context remains nominal. Where it concerns Black male youth and science education, urban school contexts comprise the majority of the literature (Avery, 2013; Kane, 2012a). According to Carlone, Kimmel, and Tschida (2010) this emphasis on urban school contexts has failed to address the issues and concerns that exist in science education within rural school contexts. Black male students are sometimes included in urban science education literature under the descriptor, minority (Mutegi, 2013). The literature surmises that Black male students have complex urban school science identities influenced by varied social, cultural, political, economic, and historical structures (Howard, Flennaugh, & Terry, 2012).

Although, more recent studies have worked to unpack the complexity of science education learning for Black male students to emphasize those students who have a positive affinity toward science and the ways by which that affinity has been cultivated (Harper & Davis, 2012) there are still gaps in the literature. Literature pertaining to how young Black male student beliefs about their science-student-selves influence how they interact and perform within rural science classroom settings is missing from the greater body of knowledge. Additionally, attention to how the normative scientific practices they experience play a role in the beliefs that Black male students have about their science abilities is lacking.

Normative Scientific Practices

I used the normative definitions coined by Cobb, Gresalfi, and Hodge (2009) and Carlone (2012) as a framework for this study to explore the normative scientific practices present within a rural middle grades science classroom context and their influence on the beliefs that four Black male students held concerning their science-student-selves within this context. Normative practices are reflected in what Cobb, Gresalfi, and Hodge (2009) defined as normative identity in mathematics. Normative identity in mathematics reflects how students identify with mathematics through the lens of group norms and structures present in a classroom context, separate from personal identity. Cobb, Gresalfi, and Hodge (2009) situated normative identity as "a collective or communal notion rather than an individualistic notion" (p. 4).

Normative scientific practices, as defined by Carlone (2012) are "scientific practices in which students are held accountable to be considered competent" (p. 13). The normative practices within a science classroom frame what science is, who can be considered a science expert, and how a "science person" should perform within that classroom. These practices shape what is expected of Black male students' performance of their science-selves and when made visible can highlight any barriers that hinder a Black male student's self-identification as a science person and entry into the culture of science. The study of these practices and the way in which they frame and influence students' science learning environments has come into greater focus for authors exploring students' science identity and identity works.

Science Identity

A study by Kane (2012a) showed the complex science identity construction of a third-grade urban elementary school Black male student named Kenny. Kenny connected to science through the in-school and out-of-school experiences he had during the time of the study. He shared that he enjoyed science, saw himself as a scientist and saw himself as someone who embodied the traits of a science person. The study reported that Kenny connected to science through imagining himself as a superhero "... inventing chemical potions..." (p. 38) and as a scientist. Kenny also shared that caring for others and being a responsible person were part of what it means to be a scientist. These ideas that contributed to how Kenny related to science and viewed himself in his science classroom revealed that speaking to a Black male student directly can unveil new knowledge pertaining to how he connects to, learns, and thrives in a school science context.

Kane (2016) also reported that for the two Black boys in her study, Lawrence and Deangelo, one believed he was not competent as a science student and scientist because compared to his classmates, he did not conform to the classroom norm of raising your hand quickly to answer a science question from the teacher. The other young boy believed he was competent as a science student because of his strong content knowledge and ability to communicate this knowledge with his classmates, in turn interacting with his classmates in mutually beneficial ways. In both cases, their teacher recognized what made each boy feel competent in science and she adjusted the structures in class to cultivate a greater sense of belonging in science for both boys. The teacher intentionally "...position[ed] Lawrence as a scientist who asked questions and offer[ed] spaces in which Deangelo could interact with his classmates" (Kane, 2016, p. 114). According to Carlone and Johnson (2007), recognition as competent in science, as provided by their teacher, is an influential factor in the development of sustaining science identities and interests for individuals of color. There were social, cultural, and institutional factors involved in the science classroom narratives for these two boys. I argue, with Mutegi (2013), that knowing how these practices influence student beliefs about their science-student-selves should also be considered when exploring the formation of their science identities.

Statement of the Problem

Young Black males are part of the discussion within education research concerning their science education, but not specifically their science education within rural school settings. A specific catalog search in ERIC (May 2019) using the search terms, Black or African American or African-American students and rural and science education yielded 36 results. Filtering for the years 2001-2019 yielded 15 results. The articles in some way pertained to science education, although two results concerned Black students in general and their science classroom education, none spoke to the science classroom beliefs of Black male students. Two of the results were studies outside the US. Only one article included the voices of Black students. Lastly, six articles situated teachers as the primary unit of focus.

A second search conducted using the Education Research Complete (ERC) catalog and the same search criteria listed in the previous paragraph yielded 13 articles. The results covered the same time span, 2001-2019. Five of the thirteen articles were the same as the ERIC search above. One article pertained to non-US schooling and five other articles concerned teachers as the research topic. The remaining two articles involved college student inquiry science experiences, one article focused on African American college students. None of these articles spoke specifically to young Black male students and their science schooling experiences in rural middle or secondary school settings.

When Black males or African American males and rural education in the US and science education were combined as part of the search criteria to highlight Black or African American males, no results were found in ERIC or ERC. Additionally, Black males or African American males and rural education as search criteria yielded no results in ERC. Search criteria removing rural education and only including Black or African American male students and science education yielded 12 results in ERC. The literature provided limited knowledge pertaining to Black male students in rural school science classroom contexts. Completely lacking is how the scientific normative practices within a rural classroom may influence the beliefs that Black male students have concerning their science-student-selves. The assertion of this study was that it is not known 'how' these practices influence their beliefs about their science-student-selves.

Practices and Beliefs

Engaging in research with four Black male students concerning their beliefs about their science-student-selves within a rural school in the southeast and a science classroom community within the school, required an understanding of the practices that took place within their science classroom context. These practices define what science education means in this context and how science is performed in this space. According to Varelas (2012), normative scientific practices lay the foundation for the context within which Black males are accepted, denied entry into, resist, and/or traverse the science border and position themselves as science experts within their science classroom. Their science identities are being formed and/or transformed in these institutional settings. Therefore, it is plausible to believe that normative scientific practices influence Black male students and their beliefs about their enacted science-student-selves.

Science practices are sometimes defined as the types of practices performed by professionals within and outside the science field. Dewey (1910) made mention of the significance of science practices as tools used by students to aid in their beliefs regarding knowledge and how we come to know what we know. He suggested that science literacy should be the goal for science instruction in the classroom. Thus implicating that students would leave school with the ability to reason and think scientifically about varying aspects of their lives as a result of engaging in science practices.

Since this time, researchers have argued, using varied terms, how authentic science learning, learning via scientific practices, is the most ideal way to teach students science (Chinn & Malhotra, 2002; Rahm et al., 2003; National Research Council, 1996). Science practice(s) include observation, scientific argumentation, scientific explanations, the use of tools or resources to answer a question, among others. Authors such as Buxton (2006) also made note of the authenticity of science practice relating to the student's perspective of science within the context of issues that are meaningful to them. The academic intent of employing these practices in a classroom is to cultivate a more scientific way of thinking and knowing within students. This notion thus informs the current study in suggesting that engaging in scientific practices can cultivate a more scientific way of thinking and learning for Black male students.

Purpose of the Study

As Love (2014) suggested, a deficit-laden narrative can shape the way in which a middle grades Black male student sees himself. This predominant societal view can also shape the mental picture and preconceived ideas of the teacher who regularly interacts with Black male students. Thus, the style of teaching and learning reflects these ideas whether knowingly or unknowingly. The void in education research concerning Black male students in rural middle school science contexts leaves questions unanswered about the science teaching and learning experiences of Black male students in rural school settings. Specifically, questions related to the contextualization of the learning environment to explore how normative scientific practices influence the beliefs that Black male students hold pertaining to their science-student-selves.

To attend to this gap in the literature, the following research questions were explored in this study: 1) What beliefs do Black male middle grades students have about their science-student-selves at the start of a unit of study in a rural school setting? 2) What normative scientific practices do Black male students in a rural middle school classroom experience during a unit of study? and 3) How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a unit of study in a rural middle grades science classroom?

Subjectivity Statement

The development of this study, the sections written above and the study chapters that follow were written as a result of the researcher's multiple identities. Research scholars such as Merriam (1998) and Stone (2005) assert the unavoidable presence of researcher subjectivity in any study. This assertion comes from the position that one's multiple identities (i.e. race, culture, ethnicity, background, experience) inform the way that one sees and perceives his or her surroundings. These experiences continually (re)shape the lens used by a researcher in his or her scholarly work. Such life experiences and culture also play into the research questions asked by a scholar (Glesne, 2011). My own culture and life experiences have shaped the way that I view the world. These biases exist, whether self-identified or not. Therefore, I will use this section to explain the lenses through which I conduct this study.

As a US born Black female raised in a bi-cultural two-parent household my entire life, I enter this study with a sensitivity to differences. Once understood, I see differences as a benefit to all involved parties. I have come to privilege differences inclusive of thought, culture, beliefs, (dis)ability and education choices. I privilege such differences, not in a way that suggests that being different from another in beliefs, culture, etc. is somehow better than having the same culture or beliefs but to recognize that differences exist. Differences not only exist, but they also influence our perceptions of life and our lived experiences and all are valuable. Emdin (2012b) has iterated the need for researchers, school administrators and teachers to recognize and value the different ways that Black male students perceive their worlds and learn within a classroom. This notion speaks to my *personal* and *caring* lenses (Glesne, 2011).

My *personal* lens has specifically been shaped by my schooling experiences of the past and present. As a Black student in culturally and ethnically diverse elementary and secondary school settings in urban or suburban areas, I cannot recall a school experience void of adequate resources, qualified and caring teachers, and access to any means of enhancing learning for students via technology or outside-of-school experiences. I describe my schooling experiences as generally pleasant which contributes to my belief that schooling can and should be enjoyable for all students in some way. However, working as a secondary science classroom teacher and speaking directly to students has revealed that not all students have enjoyable schooling experiences. This has created a personal curiosity in me to explore the schooling experiences of students in hopes of making a positive difference in the lives of students particularly with regard to their schooling and learning environments. My *personal* lens is directly linked to my *caring* lens.

As previously stated, working as a secondary science teacher privileged me to observe students daily and work to help them realize something new and positive about school and about science. I cared that each student was seen and heard. I observed that some of the Black male students whom I interacted with as a teacher and as a teacher education student were highly intelligent but their school performance and grades did not reflect this observation. When asked to answer varied questions in class, they would, but when asked about not completing a classroom or homework task, very little was said. For one Black male student in particular, his response at first seemed apathetic, however, after probing further he opened up more about his choice to not complete classroom assignments even though he knew the content. This encounter, along with others and the way in which Black male youth are depicted and perceived in society has led me to care deeply about Black male students. Specifically, Black male students and their overall schooling experiences. I care that the Black male students I have interacted with in school settings reach their full potential. Pertaining to science education, I desire that more Black male students would see their innate intellectual skills and recognize that they can learn new skills to pursue a science career and more importantly, to pursue anything in life with the content and process skills that can be learned and refined in a science classroom.

Definitions

Affective domain: The attitude domain referencing student feelings and emotions pertaining to the scientific practices that they experience in a classroom setting (Haddock & Maio, 2019).

Attitude: "[A]n overall evaluation of an object that is based on cognitive, affective, and behavioral information." (Haddock & Maio, 2019, p. 5).

Behavioral domain: The attitude domain referencing student actions pertaining to the scientific practices that they experience in a classroom setting (Haddock & Maio, 2019). These actions can be expressed as intrapersonal (self) or interpersonal (with others).

Beliefs: Thoughts, feelings, or perceptions pertaining to self, others, social environment, and/or one's academic abilities (Rascoe & Atwater, 2005).

Black male: In this study, Black male refers to a male of African, Caribbean, or African American heritage.

Cognitive domain: The attitude domain referencing student thinking and decision-making thought processes pertaining to the scientific practices that they experience in a classroom setting (Haddock & Maio, 2019).

Evaluative attitudes: "The evaluative aspects of beliefs and thoughts, feelings and emotions, and intentions and overt behavior." (Eagly & Chaiken, 2007, p. 583).

Identity works: In this study, identity work is based on the description by Carlone, Scott, and Lowder (2014), "students' identity work may involve different performances and take on different meanings depending on the norms, practices, values, and demands of the setting and the enabling and constraining aspects of history and larger social structures." (p. 838).

Normative science identity: Cobb, Gresalfi, and Hodge (2009) situate normative identity in mathematics as "a collective or communal notion rather than an individualistic notion" (p. 4). In this study, I use the idea of normative identity in mathematics in a science context to represent how students identify with science through the lens of group norms and structures.

Normative scientific practices: In this study, the normative practices within a science classroom refer to what science is, who can be considered a science expert, and how a "science person" should perform within that classroom (Varelas, 2012).

Rural: In this study, the definition for rural is taken from the National Center for Education Statistics (NCES) school locale definitions (Office of Management and Budget, 2000). NCES has three categories for rural areas. Rural (fringe), census-defined rural area that is less than or equal to 5 miles from an urbanized area or less than or equal to 2.5 miles from an urban cluster. Rural (distant), census-defined rural area more than 5 miles and less than 25 miles from an urbanized area or between 2.5 miles and 10 miles from an urban cluster. Lastly, rural (remote), is a census-defined area more than 25 miles from an urbanized area or more than 10 miles from an urban cluster. (Office of Management and Budget, 2000)

Science identity: The Carlone and Johnson (2007) definition for science identity is used in this study. Science identity is described as the interrelationship between competence, performance, and recognition as a science person by self and others. Carlone and Johnson also emphasize that race, ethnicity, and gender interact with competence, performance, and recognition.

CHAPTER TWO

LITERATURE REVIEW

The lens by which Black male students view themselves in school or in a science classroom is not independent of the ways in which Black males are viewed in society. Brilliant Black male students exist within every school setting, and yet the common narrative within educational research and American society concerning Black males would tell a different story. The contemporary narrative as expressed by Anthony Brown (2011) and others, is that Black males are depicted as "troubled" or a "problem" in the literature. These narratives are told using different frameworks based on myriad of descriptors and yet they are still the same stories. Stories that according to Brown (2011) described or explained Black male behavior as absent and wandering, impotent and powerless, soulful and adaptive, and endangered and in crisis.

Noguera (2003) depicted Black males from a different perspective. Noguera described a taxi car ride with three Black men, who each stated that he was successful in career and family. During this car ride the men discussed what factors could have contributed to them being successful and other Black men not having the same luck. Noguera suggested the only explanation for their success compared to other Black men was luck, being in the right place at the right time. Ultimately, Noguera concluded that this random encounter in a taxi car ride in San Francisco, CA, USA of three successful Black men spoke to the notion that "[a]lthough it is true that many Black males are confronted with a vast array of risks, obstacles, and social pressures, the majority manages to navigate these with some degree of success." Many researchers and a large portion of the body of literature concerning Black males paints a different picture. An image that suggests the contrary, that the majority of Black males do not manage to persevere in spite of obstacles or factors in the form of varied institutional or structural constraints. It is true that some Black males struggle in school and outside of school, as pointed out by Noguera (2003) above, it is also true that some Black males are successful in school and outside of school.

What this study aims to do is to explore the science classroom practices within a rural middle school classroom to unveil how aspects of classroom structures may trouble the Black male student and/or how these elements may enhance the experiences of Black male students. In order to develop a more thorough context for the Black male student's science classroom experience, background on the history of Black people in the US and Black student schooling experiences, in general, is needed. As vividly presented by Martin (2012), without details about the lived experiences of a Black male student, one behavioral outburst or consistent low performance in his academics will not be fully understood.

Multiple topics will be discussed below to provide background information pertaining to Black males and their schooling experiences while learning within rural middle school science contexts. The first two sections, Black students and perceptions and Black male schooling experiences serve to present background on Black (male) students and the perceptions that exist regarding who they are in US schools. Given that the study is centered on how Black male students learn science within rural school contexts, the following sections give an account of rural schools, rural schooling, Black students in rural contexts, and rural science education. Within rural schools, middle school science education is of importance to the current study. A section discussing Black students and middle grades science is included in this chapter. To then situate Black students and science education and the normative scientific practices that they experience in these science contexts, sections on Black students and general science education and normative scientific practices follow. Next, text defining normative scientific practices, examples of normative scientific practices, how these practices have evolved over the last several decades and student beliefs toward these enacted normative practices are included in this chapter. Lastly, the data from the study will be interpreted through the subjective lens of the researcher as mentioned in chapter one and through the lens of science identity and sociocultural theory. The sections mentioned in this paragraph offer context for the current study exploring Black male student beliefs pertaining to the normative scientific practices that they experience in a rural middle school science classroom and how the data will be interpreted.

Black Students and Perceptions

Black students educated in the US have been portrayed in the research literature as a group of students who academically struggle to keep up with their peers of different races. Reasons for such a gap in achievement have been attributed to the racial inequality history of the US and racism (Terry, Flennaugh, Blackman, & Howard, 2014), negative stereotypes (Steele, 1997), inadequate instructional resources, lack of quality teachers providing quality instruction (NRC, 2012), cultural differences in learning (NRC, 2012), and the idea of biological inferiority (Crummell, 1898; Fordham & Ogbu, 1986), among others. To some extent, researchers would argue that each of the aforementioned reasons either on its own or in combination with others has influenced the educational experiences of Black students in the US (Ford, Grantham, & Whiting, 2008; Howard, 2013).

In the 1800s, Black people in general were described as inferior beings (Crummell, 1898). The full depth of this notion and its affects has yet to be determined (Mutegi, 2013). However, the effect of this notion on the human mind when internalized by Black students, specifically Black male students, is something that has been and can be realized (Howard, Flennaugh, and Terry, 2012). A clear depiction of this is seen in modern contemporary media sources. The documentary, *Hoodwinked* by Janks Morton illustrated how the negative stereotypes about Black people have been accepted by some Black people as the truth about their own race. When those interviewed were asked what they thought the dropout rate for Black males is, the median response was 50%; however, at the time of the documentary, the rate was 12.1% for Black males. This suggests that of those interviewed, the majority believe that Black males generally drop out of school.

Concerning positive stereotypes, it came easy for those interviewed in *Hoodwinked* to name a positive stereotype about Asians (“they are smart”) and Hispanics (“they are hard workers”) that build wealth. It was difficult for the same participants to answer the same question related to Black people. The responses to this question with regard to positive stereotypes about Black people (by Black people) included: "We can run, jump, dance, and sing," "I can't really think of one," "We go to church on Sunday," and "Well endowed" (iYago Entertainment Group, 2012). The responses suggest that these Black people viewed their own race as being "less than" or being known for few positive (socially-acceptable) traits. These responses speak to a socio-historical thread that has perpetuated the notion of Black people as inferior beings, existing in the US as far back as the early 1800s.

More recently, an inferiority mentality was observed among the 166 gifted Black students (5th grade through 12th grade) included in a study by Ford, Grantham, and Whiting (2008) pertaining to the students' perceptions of what it means to "act White" and to "act Black." Acting Black was described to be the opposite of how students defined acting White. Students deemed the following traits to be representative of acting Black: "...lacking in intelligence, placing a low priority on academics, speaking poorly, behaving poorly, and dressing in ill-fitting clothes." (Ford, Grantham, and Whiting, 2008, p. 234). Only one of the students who participated in the study noted a positive attribute to acting Black. The views of the Black students in the Ford, Grantham, and Whiting (2008) study clearly showed that some Black students possessed an inferiority mentality about being Black, even if they were formally classified as gifted students. Additional research concerning Black students and education also illustrated this negative belief of being perceived as less-than by self, peers, and adults (Howard, Flennaugh, & Terry, 2012; Rascoe & Atwater, 2005; Roderick, 2003; Whiting, 2009).

On the reverse side of this inferiority idea, specific to Black males, are documentaries such as *American Promise* (National Black Programming Consortium, 2013) and *Bastards of the Party* (Fuqua Films, 2005) and videos such as *For Colored Boys: Redemption Video Series* by Stacey Muhammad (Wildseed Films, 2013) that displayed Black males and Black male students who desired a "way out" and pushed themselves and/or their Black male children to do well in school to later get out of their communities. Performing well in school was viewed as a means to changing the outcome of one's present and future. They described their communities as dangerous or in some way hindering their Black males from reaching their full potential in not only academics but also in life. The sentiment expressed in these films was that school is important to some Black male students and to the parents of Black male students. The thought of being inferior in any way was not a belief for the Black males depicted in these films. Such a perception of inferiority based on race is part of the foundational framework of the history of the US.

Black Male Schooling Experiences

The experiences of being Black and male in school settings is rarely nuanced from being a Black student in school settings. Schools in the US, generally, call for students to assimilate when within their walls. Black students, along with other non-White groups, are expected to assimilate to the norms of the school, which oftentimes negates their own cultural, community and social norms (Mickelson & Greene, 2006). Cultural dissonance is still present in the experiences of the Black male students telling their stories in the previously mentioned documentaries. In *Bastards of the Party*, Black youth rejected the social norms of school and society because it was in stark contrast to their lived experiences, to the violence they saw from day to day; essentially, it was a lie. These students at times sought ways to still be considered "cool" in their communities, by participating in acceptable "Black" sports and using the language of their communities

(Roderick, 2003). Reproducing such behaviors in the classroom has been documented as a barrier that keeps some Black male students from experiencing academic acceptance and/or success during their schooling experiences (Harper & Davis, 2012; Roderick, 2003).

Roderick (2003) reported that in a gender comparison study of Black male and female students, Black male students transitioning from 8th grade to 9th grade experienced greater declines in academic performance compared to their female counterparts. Although this statistic adds to the negative narrative of the Black male student regarding academic achievement, Roderick extended the above statistic to explore the reasons behind why this was the case for 15 of the Black male students who participated in the longitudinal study. With the analysis of case study data of the lived experiences of the Black male students, the findings revealed a myriad of influences contributed to the decline of their academic performance. Some of these influences included self, teachers, high school performance expectations, motivation, school environment, community, and parental involvement. Bettina Love (2014) stated that some Black male students in public schools experienced hardship because of the way that Black males in general are criminalized in society. What these two studies illustrated is that contextualizing the experiences of Black males and Black male students is critical in understanding how their school experiences are impacted by varied internal and external factors.

Ferguson (2001) specifically looked at the punishment of Black male students at a public school (Rosa Parks School, grades 4 to 6) and observed that Black male students were disproportionately punished for their behaviors over other students. What she found interesting was that the social norms established at the school automatically placed students who were Black and male on the margins. The behavior of these students was outside of what the teachers and school administrators deemed to be "normal" school behavior- Anglo-European-American behavior. Therefore, because of the way in which Black male youth would speak, behave, and express themselves, teachers viewed these behaviors in negative ways and would send Black male students who got in trouble to a punishment room.

In reference to affinity toward schooling in general during the middle school years, Smith, Estudillo, and Kang (2011) used a 13-item assessment, *Identification with Academics*, to better understand how urban Black and White eighth-grade students in the Midwest identified with academics. The study participants included 464 students, 256 were Black students and 208 were White students. Within that group of students there were 236 male students and 228 female students. Confirmatory factor analysis categorized the assessment by two factors, "abstract identification with school" and "perceptions of testing" (p.80). The Black students had an overall mean score that was greater than the overall mean score for the White students in the study regarding the abstract factor. The reverse was the case for perceptions of testing.

Patterns from data analysis were observed by Smith, Estudillo, and Kang (2011) that were not statistically significant but were of interest to the authors. The pattern most pertinent to the current study concerning Black male students will be discussed. Black males specifically, were second from the top in how they identified with the abstract notions of schooling. Suggesting that their overall beliefs about the validity of school and it being something worth engaging in were positive and greater than their White counterparts. Which is contrary to the majority of the research literature discussing the schooling interests of Black male students. This study displayed a positive narrative concerning Black male students and their beliefs about school.

Schooling experiences that positively influence the lives of Black male students in particular and Black students in general include an atmosphere of care (Moore, 2006). In the vein of care, according to the following statement by Knutson and Del Carlo (2018) rural school settings feature characteristics that would provide care and support for Black male students. "Within such an intimate environment, personal relationships are constructed and build trust between students, parents, teachers, administrators and members of the community and it is these relationships that are distinguishing of the rural education experience." (Knutson & Del Carlo, 2018, p. 21). Thus, Black male students who reside within schools in rural communities may potentially experience more positive school and/or science learning experiences.

Rural Schooling

The 1954 *Brown v. Board of Education* decision, in theory, was going to serve to equalize education for all public school students in the US. However, the actions that followed, including closing Black schools, firing Black teachers and administrators, and busing Black students to White schools maintained the standard that 'other' schools, mainly White schools, and their educators and staff were superior to Black schools (Horsford, 2010). Worth mentioning here is the success that pre-*Brown* schools for Black students had in educating their students. The combined efforts of students, teachers, families, and communities contributed to the academic achievement of Black students during that time. Current post-*Brown* research also speaks to the benefit of interdependent relationships between school, family, and community for the academic advancement of Black students (Horsford, 2010). What this suggests is that the advantageous resources and relationships that existed pre-*Brown* still exist post-*Brown*. However, in general, they no longer function as a mutually supportive network for Black students in all-Black public school institutions. From the position that *Brown* did more harm than good for Black students, Horsford (2010) concluded that "... community support, cultural affirmation, community, caring, and interdependency among African American constituencies" no longer worked together in the same way to enhance the schooling experiences of Black students (p. 59). Although these elements may not work together in the same way for Black students in general, rural education research literature posits that some combination of these support structures still exists and works to enhance the schooling experiences of rural students in general.

The authors of *The Rural School and Community Trust* published their annual report for 2015-2016 in June 2017. The authors make a relevant statement pertaining to my study, that rural schools and their students are facing changing dynamics which continue to play a role in how rural students in the US are educated. There are rural students who are disadvantaged from the lack of resources in their school districts, yet, rural students as a whole continue to have successful achievement records comparable to their suburban and urban counterparts. This notion suggests that rural school contexts are complex and warrant additional research attention.   Statistically speaking, in the United States, "...18.7 percent of all students attend rural public schools... just under 15 percent of all students, are enrolled in rural school districts." (Rural School & Community Trust, 2017, p. 1). Additionally, the rural schools annual report disclosed that about half of rural students were classified as coming from low-income households and 25 percent of rural school students were from marginalized student groups. Performance-wise, on the 2013 National Assessment of Educational Progress (NAEP) assessment, fourth-grade rural students averaged a score of 243 in math, compared to 244, 240 and 236 for suburban, town, and urban fourth-graders. This set of fourth-graders also scored similarly in reading. Significant to this study, rural fourth-graders and eighth-graders averaged higher scores in science when compared to their peers in the 2009 (fourth-graders) and 2011 (eighth-graders) assessment comparison data. Thus suggesting that characteristics of rural school contexts may work together to cultivate academic success for students.

Black students in rural contexts

Bailey (2014) provided a review of the cognitive and learning conditions for rural preschool children. The study focused on the conditions for rural students within this specific context, however, the author selectively highlighted African American rural students and families. The African American rural students were positioned at a learning disadvantage at the start of their schooling experiences. The author positioned them in contrast to their White student counterparts. Bailey reported that school readiness for rural preschool students was based on the primary children being able to use primary sounds. Primary sounds can be taught either at home or in an early preschooler program.

This review reported that rural African American preschoolers did not participate in primary school programs and thus were not prepared for first grade, based on the measure of being able to use primary sounds. In this area of preparedness, non-rural African American preschoolers fared better than their rural counterparts, 20% were proficient compared to 5% of the rural African American primary children being proficient at primary sounds. This skill was linked to further language skill development in children. Being at a disadvantage at this stage coupled with inconsistent attendance at multiple preschool programs, for those rural African American primary students who attended, was correlated with not being ready for kindergarten or first grade (Bailey, 2014).

Juxtaposed to this situation are factors that seem to provide an advantage for rural school preschoolers. As also mentioned by Avery and Kassam (2011), the home lives of rural students can positively connect with the school lives of students to help them succeed (Bailey, 2014). Additionally, the multiplex relationships (Knutson & Del Carlo, 2018) associated with rural communities can also aid in preparing preschoolers for primary school entry (Bailey, 2014). Bailey also advocated for a need to develop, implement, and support teachers in professional development centered on employing early preschool curricula based on national standards that can help to better prepare all rural preschoolers and African American rural preschoolers, in particular. The next study explored the school lives of Black students in rural elementary school classrooms.

The student-teacher relationships in twenty rural elementary school classrooms also made mention of the academic achievement of African American students in general, and male students in particular, among other student demographics. This study however, focused on the perspectives of teachers and their relationships with their students. Therefore, although this study provided some context for how teachers perceive their relationships with their Black male students, the lack of student voice only provided one side of the story. Gallagher, Kainz, Vernon-Feagans, and White (2013) stated that student gender, ethnicity, behavior, and literacy ability predicted student-teacher conflict. Boys were shown to be at a disadvantage regarding the quality of their student-teacher relationships compared to the female students in the study. Male students who were also noted as having "dysregulated" behaviors also had poor relationships with their teachers (p. 526). Additionally, the authors reported that teachers experienced more conflict with their African American students during the fall and spring school semesters. The authors of this study posited that this perceived conflict with African American students needed further exploration given that research literature had shown that quality teacher-student relationships for African American students positively influenced the academic success of Black students (Moore, 2006).

The authors of the study mentioned in the section above brought attention to the ethnicity matching of teachers and students within the classrooms that participated in the study. However, the African American teachers and non-Black teachers reported perceived conflict at the same rate pertaining to their relationships with their African American students. Therefore, ethnicity matching of teachers and students in this rural context was not a factor in how the teacher-student relationships in this study developed over the course of the school year.

Similar to the Knutson and Del Carlo (2018) study, Irvin, Farmer, Leung, Thompson, and Hutchins (2010) asserted that some aspects of rural African American students' outside of school lives played a role in their achievement in school. Their study included 280 African American seventh- and eighth- grade participants from two middle schools in the rural Deep South. This study found that students who attended church activities had better end-of-year school grades, the measure for student achievement in this study. This influence was attributed to the support and historical benefits that being a part of church activities in African American communities provides to both youth and adults.

Contrary to what the authors expected to discover, general outside of school community activities were not influential in improving student achievement. The authors suggested that this may be due to the limited community activities available to rural students in highly impoverished rural areas. Thus, providing school activities and school-related opportunities would be more influential in improving student achievement for rural African American students. However, the data in this study showed that not all school activities were equally correlated with student achievement. Analysis showed that "... only participation in school vocational activity predicted achievement after accounting for other variables." (p. 15).

Irvin et al. (2010) reported another finding related to the current study, the African American boys participated in more sports-related activities in school and the community and did not participate in school vocational activities at a higher rate than the African American girls in their study. This finding implied that the student achievement for African American male students in this study may not be as high as that of the African American girls in the study. The difference between the academic performance of African American male and African American female students in this study showed a need for research studies that explore the student achievement of rural African American male students.

Specific to the math performance of African American rural students, Jones, Irvin, and Kibe (2012) examined how the influences of peer academic perceptions and math self-concept played a role in the math performance of students. The authors stated that for the 189 rural African American tenth-grade students in the study, there was a statistical relationship found between having high academic perceptions of their peers and having a high math self-concept. Academic self-concept was defined in the study as "... the extent to which one perceives their academic abilities given past experience within a specific academic domain..." (Jones, Irvin, & Kibe, 2012, p. 320). Therefore, for these students, if they perceived their peers as displaying good math student behaviors, they perceived their own abilities in a similar way. This connection between peer relationships and math self-concept speaks to the social nature of learning for rural students.

The authors also discovered that for the student participants in the study, those who possessed a positive math self-concept also performed well on math assessments. Therefore, for these African American students, including those residing in rural areas, they experienced higher math performance when their math self-concept was greater. The study also revealed that female African American students had greater perceptions of their peers than the male students in the study. There was no explanation given as to why this may be the case, which suggests that this would be an area worth further study. Research literature explanations were provided that would support the opposite, that female African American rural students would have lower academic self-concept compared to their male counterparts due to reports of lower self-esteem in rural female students compared to male students (Puskar et al., 2010; Yang & Fetsch, 2007). This study contributed to the research literature pertaining to factors that can positively influence the academic achievement of rural Black students in general and rural Black male students, in particular. As illustrated in this section, rural students in general, and Black students in particular, live varied lives within different rural school contexts.

Rural science education

Although we are in a post-Brown era in the US, many students are educated in increasingly segregated schools (Orfield & Lee, 2005), by race and/or class. These categories of segregation are sometimes linked to the quality and type of science education that students receive (Gilbert & Yerrick, 2001). As stated in chapter one of this study, rural science education is marginalized within science education literature (Oliver, 2007). Oliver attributes this paucity to the inconsistent use of the term 'rural', while Schafft and Jackson (2010) present a more modern perspective regarding the lack of research conducted in rural education contexts. According to Schafft and Jackson (2010), rural education institutions are viewed by some as being "ill equipped to run their own school and prepare students to be economically competitive and productive in a modernizing world" (p. 1). Suggesting what some authors have mentioned as a perspective that still positions rural science education as being less than, prioritizing scripted lessons, focusing on rote memorization, and including a science education experience suited for students who have been labeled or tracked into non-higher education paths (Yerrick & Johnson, 2011). However, Avery and Hains (2017) strongly iterate that just as the NAEP scores mentioned above show, rural communities and the teachers and students that reside within them possess great knowledge useful in the advancement of local and global communities.

A special issue of *Cultural Studies of Science Education* published in 2017 featured articles focused on rural science education. The conception of this special issue illustrated a need for science education research that explored rural education as mainstream rather than marginalized. Eppley (2017) presented a perspective often associated with rural spaces that perpetuates a marginalized narrative for rural populations juxtaposed the complexities of rural places in the US. "[R]ural disadvantage is attributed to individuals' personal failings rather than understood as inextricably tied to complex social, cultural, geographic, and economic systems." (Eppley, 2017, p. 46). Therefore, in an effort to represent the complex and diverse aspects of rural communities, science education research featuring the funds of knowledge (Moll, Amanti, Neff, and Gonzalez, 1992) that exist within rural communities will be highlighted. The study will concentrate on the ways in which Black male students who live and learn within these communities may experience science learning that positively influences their affinity toward science in their science classrooms. General studies of students and rural science education will be included in this section due to the lack of research literature that specifically speaks to Black male students and their rural science education experiences.

Avery and Kassam (2011) worked with 20 fifth- and sixth- graders in rural New York state. The authors discovered that these students learned science and engineering skills and practices from the activities and responsibilities in their everyday lives. The rural students from this rural New York study dwell within the category of rural students who have the opportunity to learn practical science and engineering skills while working on a farm, using farm equipment, working on cars, woodworking, or other chores at home. The authors stated that the students were able to make connections between what they observed and did outside school to in-school science content once direct teaching strategies were used to help students make those connections.

Avery and Kassam (2011) used Local Ecological Knowledge (LEK) as part of their framework to highlight the funds of knowledge that rural students possessed. The authors described this knowledge as experientially based knowledge that rural students possess that is science and engineering based and linked to students' local surroundings. A related finding of this study was that two of the student participants were able to make connections from the science and engineering concepts in their home life to their science classroom lesson standards. However, the authors stated that the students did not make these connections without explicit guidance from their teacher. This finding suggests that something impedes the process that allows most students to make content-specific connections from home life to school science. Therefore, what can be gleaned from this study is that, if identified and utilized by educational personnel, the funds of knowledge that rural students possess can be used to enhance the science learning experiences of rural students in general. Moreover, rural students may find greater utility in learning science content and science and engineering process skills that transcends attaining a future job within the domains of science and engineering (Avery, 2013). This idea could essentially encourage more students toward the multi-decade long goal of "science for all".

Rural student science education literature has also explored the home beliefs of rural students, which are often religion-based, and how these beliefs may also impede the science learning process of rural students. Borgerding (2017) showed how teachers can teach a commonly controversial topic in southern rural schools, evolution, while maintaining and respecting the home beliefs of students. The teacher in this study chose to position himself in as much of a neutral zone as possible and state the facts of both sides, evolution and the local students' beliefs about nature and their religious thoughts related to evolution. The students in this study experienced a positive unit of study on evolution. They may not have embraced evolution as their own new personal belief but they acquired the scientific knowledge pertaining to evolution as described by scientists. The students were also able to maintain and view their religious-based funds of knowledge as local expert knowledge. Therefore, neither side was dismissed and students were able to learn that multiple perspectives and knowledge exist pertaining to their lived experiences in their worlds.

Knutson and Del Carlo (2018) drew attention to what they referred to as "multiplex relationships" (p. 21) in rural settings. The authors described multiplex relationships as relationships in rural communities that extend outside of the classroom into the communities. An example of a multiplex relationship could be that a rural school teacher lives in the same subdivision or home community as his or her student(s) and grew up with the parents of his or her students. The teacher and students may also attend the same religious institution outside of school. This type of relationship can potentially influence the lived experiences of students inside their schools and classrooms. The authors found that the multiplex relationships that the Iowa state teacher participants and students experienced in their rural contexts did not correlate with increased science standardized test scores. However, these more intimate relationships between teachers and their students, from the perspective of the teachers, did contribute to science learning environments that helped students experience success. The authors suggest that multiplex relationships contribute to the investment of both teacher and student in the individual classroom. Positive teacher-student relationships in rural settings have been attributed to the positive academic achievement of Black students in general and Black male students, in particular (Moore, 2006). There is a dearth of literature exploring Black students' learning experiences in rural school contexts. Specific to the current study are the lived experiences of Black students in rural middle school science contexts. The following section will serve to provide background pertaining to middle school science experiences for Black students in the United States.

Middle Grades Science and Black Students

The selection of a middle grades classroom for this study is driven by research pertaining to early adolescents and their propensity towards making lasting decisions about their science interests before they reach high school (Calabrese-Barton et al., 2013). This decision-making period of an adolescent's life plays into how he or she sees himself or herself as an individual (Holcomb-McCoy, 2007). Holcomb-McCoy (2007) specifically stated this period of an adolescent's life is when "[a]dolescents begin to look around them, to their status among their peers, to clues they receive from adults, and even to the larger society and media, for messages about who they are and what they could become" (p. 256). This stance is highly significant for Black students and Black male students in particular given the repeated negative narrative in education research literature and society in general, concerning Black male students and Black people in general. What Parsons, Travis, and Simpson (2005) iterated is that cultural congruency in classrooms serving Black students is important toward enhancing student achievement in science education.

Parsons, Travis, and Simpson (2005) explored the science learning environments for eighth-grade urban students. The authors specifically investigated through the lens of Black Cultural Ethos (BCE) the learning contexts as perceived by the students and their relevance to student achievement. BCE is described as a West-African understanding and interpretation of the world for Black people. BCE represents specific ways of making meaning that are rooted in the norms, values and beliefs of Black people. Three tenets of BCE, communalism, verve, and movement were discussed in this study related to student preferences. Greater achievement was observed for the students in this study who experienced the intervention that included elements of communalism, verve, and movement within their learning context. This aspect of cultural congruency is one way that seems to enhance the science learning environment for Black middle grades students. Design-based instruction is another form of instruction noted to improve the science learning of Black students.

Mehalik, Doppelt, and Schuun (2008) explored the science achievement gains of varied gender, ethnicity, and socioeconomic status levels of urban eighth-grade middle school students under scripted inquiry instruction compared to design-based instruction. The authors believed prior to implementing their study that students would be more engaged and motivated in their science classrooms using the design-based approach to science instruction. Students in 46 science classrooms were tasked with building electrical alarm systems which required students to combine science content pertaining to electricity and design engineering practices. The Black students in the study showed pre-post-test knowledge gains that were eight times higher using the design-based approach compared to the scripted guided inquiry approach. The results for Non-Black students showed double knowledge gains using the design-based approach compared to the inquiry approach. The Black students were learning better using the design-based approach, the authors mentioned specifically low achieving Black students.

Categorical divisions of students based on race and their pre-test scores divided students into low-achieving, medium-achieving and higher-achieving groups. Twenty-one percent of the Black students in the lower-achieving group increased their post-test scores to be classified in one of the higher achieving groups by the end of the design-based instructional period. Additionally, 15 percent of Black students overall shifted into the highest achievement group under the design-based approach. The study did not isolate student results by ethnicity and gender together. In general, lower-achieving and moderate-achieving male students also benefited from the design-based instructional approach. This student-centered approach utilizing design engineering practices to teach electricity concepts helped Black students learn science content in a more effective way. Therefore, the concept of being Black and male in a rural middle school science classroom impacts the lives experienced by Black male students and their beliefs about themselves as science students.

Black Students and General Science Education

With regard to science education and Black students, Atwater (2000) noted key components that attribute to the academic achievement and persistence of Black students within the discipline of science. These factors included "teacher expectations, teacher interactions with black students and communities, science curricula, and schooling practices" (Atwater, 2000, p.155). This non-inclusive list of recurring factors listed in the literature that contribute to positive strides for Black students within science education are among other factors that would be described as "good teaching" and elements necessary to achieve "science for all" (Ladson-Billings, 2009; Moore, 2006; National Research Council, 2012).

Parsons (2003) stated that classroom instruction is "value-laden" and "... can create or perpetuate a context that is familiar or alien to the learner, which in turn, influences the extent to which learning occurs." (p. 24). This concept in education literature in general, that the way in which students are taught makes a difference in how students relate to the content, is especially true for Black male students and how they connect to science (Moore, 2006), self-identify as being a "science person" (Kane, 2012a) or even how they position themselves to be considered science experts within their science classrooms (Rascoe & Atwater, 2005). The standards and practices that are followed within a science classroom setting can function as gatekeepers for some students to enter (or not) into the science culture created in their classroom.

The authors of the *Framework for K-12 Science Education* (*Framework*) advocated for a curriculum that integrates content knowledge with scientific practices. Such an integration includes calling for students to collaborate with other students and/or work individually to construct arguments, develop models, communicate knowledge or findings in varied ways and in general perform in ways that scientists and engineers perform on the job in their particular disciplinary area. The authors of the Framework have a vision in which a curriculum inclusive of these features combined with quality science teachers, adequate resources and equitable science instruction work together to provide every student with a quality science education (NRC, 2012). Specifically, an education that may lead some students, traditionally marginalized or not, into a future science career and prepare others to be able to use the content knowledge and scientific practice skills to make informed and evidence based decisions in their lives.

Normative Scientific Practices

Normative scientific practices in the classroom frame what science is, who can be considered a science expert, and how a "science person" should perform within that classroom. These practices have evolved over several decades based on the prominent view at the time of what science education should look like for students in American schools (Berland et al., 2016). Duschl (2008) stated that varied positions have existed regarding what science learning should look like from as early as logical positivism and Thomas Kuhn and a disciplinary matrix, to reform efforts of the 21st century. Duschl made note of these shifts in science education going from expecting students to learn about the "what" of science knowledge to learning of the "how" and "why" of science. Rather than focusing only on the facts and rote memorization, students are asked to know how we come to know what we know about science and "why we believe it" (Duschl, 2008, p. 2). In more recent years the National Research Council of the National Academies developed *A Framework for K-12 Science Education* (*Framework*), a guiding resource for the creation of our nation's science education standards (NRC, 2012). The *Framework* is the most recent shift pertaining to science education and student expectations, an extension of doing science that focuses on scientific practices as a means of aiding students in constructing and applying scientific knowledge (Berland et al., 2016).

The *Framework* provides a research-based approach to science education with the consideration of scientific and engineering practices, crosscutting concepts, and core ideas as essential elements of a quality science education curriculum. The goal of the committee who crafted the *Framework*, as noted below, was to develop a guiding source that would serve students and society well.

> "The overarching goal of our framework for K-12 science education is to ensure that by the end of 12th grade, *all* students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering

> to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology" (NRC, 2012, p. 1).

According to the NRC, the science education reform efforts prior to the *Framework* failed to accomplish goals of this nature. One reason for this was attributed to a lack of organization in the system used to guide science learning and science learning expectations in the classroom. The authors of the *Framework* asserted that the three essential elements listed above, including scientific practices, must be integrated in tandem into the "...standards, curriculum, instruction, and assessment..." (p. 2) in order for science education to achieve the aforementioned goals. Although not every state in America has adopted the national science standards, which are based on this conceptual framework, many states have a modified version of them. Thus, the three essential elements of a quality science education, as conceived in the *Framework*, are relevant to multiple state school districts and their respective science education curricula.

Specific to this study are the eight essential practices of science education within the *Framework*. The eight science practices noted by the National Research Council in the *Framework* are the following: 1) Asking questions, 2) Developing and using models, 3) Planning and carrying out investigations, 4) Analyzing and interpreting data, 5) Using mathematics and computational thinking, 6) Constructing explanations, 7) Engaging in argument from evidence, and 8) Obtaining, evaluating, and communicating information

(NRC, 2012). These science discipline-specific practices can be categorized into larger, overarching practices, such as investigations, analyzing and interpreting data, modeling, and discourse. As stated by Buxton (2006) and Duschl (2008) these practices iterated by the NRC have established themselves as relevant practices for authentic science learning over several decades and in other countries, such as the United Kingdom.

Science education reform

The general flow of science education reform efforts were and are influenced by the events happening in the country and around the world at the time, and are also influenced by the perspectives of varied leading scholars in the field of science education. The launching of Sputnik, the flux of the American economy, the desire to cultivate scientifically literate citizens, global advancement and influence, a drive to fill science, technology, engineering, and mathematics (STEM) jobs, cultural perspectives of science, and social perspectives of science learning have all created some version of science education reform (AAAS, 1990; Driver, Leach, Millar, & Scott, 1996; McGinn & Roth, 1999; NRC, 2012; Rudolph, 2002).

The results of the reform efforts of the 1960's were science classrooms that focused on reinforcing science facts (Schwab, 1962). Reform efforts between 1950-1970 also focused on science as process, students performing like scientists would perform (Duschl, 2008). In the 1990's science education reflected some aspect of science facts as a primary focus (Carlsen, 1998) but more emphasis was placed on investigations and modeling as scientists would perform and the idea of science, scientific knowledge, and scientific practices as relevant to the social aspects of living within a community (Marx et al., 1997; NRC, 1996; Warren & Roseberry, 1995). During the early 2000's increased emphasis was placed on scientific thinking and reasoning, where students were expected to think in a non-linear fashion as scientists do when working in the field (Chinn & Malhotra, 2002; Songer, Lee, & McDonald 2003). Similar to what John Dewey (1910) expressed about science classroom practices, Duschl (2008) advocated for science classrooms that involve more than what is known about science and extend science learning toward inquiry pertaining to how one comes to know what they believe they know about science. The evolution and refinement of the systems that govern science education in the US have brought us to the ideas presented above within the NRC's *Framework* for science education, a refined amalgamation of the research, beliefs, perspectives, and values related to quality science education over the last several decades.

In our current stage of science curriculum reform, specifically in the US, the notion of performing science as scientists would perform science is the leading position taken when referring to a quality science education. Parsons, Travis, and Simpson (2005) stated that "... ways of knowing and interacting as well as norms, beliefs, and values are required in learning science..." (p. 187). What they are specifically speaking to is the culture of science and I take it a step further to emphasize the idea that classroom science culture differs from one classroom to another (Carlone, 2012). Thus, the science culture created and sustained in a science classroom positively or negatively facilitates access into the world of science for all students in general, and Black male students in particular. The culture of a science classroom is primarily framed by the main teacher; however, society and history have already influenced this culture and continues to do so every day.

Thus the stance I take in this research study, as with authors of science identity research, is that the normative scientific practices of a science classroom are gatekeepers for some students to gain access (or not) into the culture of science at large (Carlone, 2012; Kelly, 2007).

Scientific practices in the classroom

Practices under the *Framework* that fall under the overarching topic of discourse, are significant to the undergirding themes of this study. Specifically, as discourse is defined by Kelly (2007) below, argumentation and explanation building are connected to "... forms of life which integrate words, acts, values, beliefs, attitudes, and social identities..." (p. 444).

> Therefore, the study of discourse processes in science education should properly include a definition of discourse as using language in social contexts and, as Gee (2001a) argued, connected to social practices, "ways of being in the world ... forms of life which integrate words, acts, values, beliefs, attitudes, and social identities as well as gestures, glances, body positions, and clothes" (p. 526). (Kelly, 2007, p. 444)

Research literature on argumentation in science classroom environments speak to the structure, process and analyses of scientific argumentation (Manz, 2015). Manz (2015) wrote that evaluating these aspects of argumentation can aid in improving the way in which argumentation is performed in science classrooms and also broaden teachers' understandings regarding the utility of argumentation in the classroom. Specifically, Manz stated that "[o]rganizing classrooms around argumentation encourages students to interact directly with each other, as opposed to directing conversation exclusively to the teacher, who in turn, evaluates comments." (p. 9). In this vein of considering knowledge-building as a social activity, this study aims to explore an aspect of argumentation in general and classroom scientific practices in particular, that concerns student beliefs about their science-student selves as it relates to practices such as argumentation. Studies have shed light on what such practices can do for students and the challenges that students face authentically executing these practices, but few studies have explored what these practices do to students and why some students may participate in these practices while others do not (Seda Cetin et al., 2018). More specifically, looking at how students' beliefs about their science-student performing selves are influenced by the practices enacted in science classrooms.

Bell and Linn (2000) utilized a curriculum based on scientific argument designed to explore if middle school students would engage in knowledge integration. The authors define knowledge integration as a process by which students establish their conceptual understandings of a phenomena, apply their existing ideas to new ideas and reevaluate these ideas with new evidence to reflect a more scientifically-sound explanation of these phenomena. This complex process occurred in the sample of middle-school students they worked with in their study. The authors conclude that the reason for some student engagement in this process may be rooted in how some students view the nature of science; whether students believe that what is stated in a textbook "... will always be true..." (p. 812). If students do not believe that science changes, they are likely to be rigid in thinking that they can contribute anything new to the field or the understanding of a phenomena. Thus, less likely to engage in scientific practices such as argumentation or scientific modeling in the classroom.

In a more recent study involving high school students, Seda Cetin, Eymur, Southerland, Walker, and Whittington (2018) shared that as students participated in Argument-driven Inquiry (ADI), most were engaged and voiced that they found the practice useful because they had the opportunity to interact and collaborate with their peers in an academically-focused format which allowed them to consider multiple perspectives and representations of data on the chemistry concept. However, students who did not take a positive position regarding their ADI experience noted that they were concerned that the feedback/critiques from their peers would not be fair and thus "... causing them to have lower grades than [they] might have received from their instructor." (p. 489). The scientific viewpoints of each student in the study student groups were reported as being shared within the group and evaluated equally. This study took place in a Turkish high school, ethnically homogenous, which brings to the forefront a possible difference for Black male students in an American classroom in the rural southeast.

As Mutegi (2013) mentioned, would Black male students be impeded by an inferiority mindset, or would the influences of America's racial history or the expectations established in their middle-school science classroom by their teacher and peers be a factor in their access to science? Seda Cetin et al. (2018) noted that students' perspectives on scientific writing changed from negative to positive by the conclusion of their study, however, the students were not asked questions to understand why their thoughts about writing may have changed over the course of their experience with ADI.

Although their study spoke to thoughts that students had as a result of engaging in the scientific practices, students did not speak to their personal beliefs about their ability to accomplish these tasks or to perform as an engaged science-student in these practices. The current study aims to explore the area of student beliefs about self as it relates to normative scientific practices in a middle grades classroom. This study will also use a social psychology analytical lens to expound on the association between beliefs and attitudes.

Student beliefs, behaviors, and normative practices

A study specific to pro-environmental behavior in high school students (De Leeuw, Valois, Ajzen, and Schmidt, 2015) made a poignant and relevant reference to a psychology study by Ajzen, Joyce, Sheikh, and Cote (2011). The authors asserted the following about the beliefs that people, including students, hold and the influence of these beliefs on behavior patterns.

> They argued that instead of trying to make sure that people have accurate information, we need to identify the subjective beliefs people hold towards the issue and how these beliefs affect their intention and behavior. Only then is it possible to either challenge beliefs that impede the adoption of the desired behavior, strengthen those who support it, or facilitate the development of new beliefs that promote the desired behavior (p. 128).

This point of view suggests that Black male students in a rural science classroom may behave as science students in specific ways as a result of the normative scientific practices employed in their classroom. Therefore, the act of a teacher giving students an explanation of performance standards or lesson objectives and a rationale for the lesson tasks may not be enough to get them to engage in the practices expected of science students in their class.

The limited body of research in science education specifically speaking to student beliefs about their science-student-selves led to looking into a related discipline, mathematics, and the relationship found between student beliefs of self and the normative practices in mathematics classrooms. Relevant to this study is research concerning how students in mathematics classrooms perform as math students in response to the sociomathematical norms valued and implemented in their mathematics classroom. Research in the discipline of mathematics, particular to the influence of sociomathematical norms, has been referenced since the late 20th century (Yackel & Cobb, 1996). Yackel and Cobb's primary claim was that student learning is positively supported in a classroom in which the teacher establishes sociomathematical norms and guides students in understanding and engaging in these norms. McClain and Cobb (2001) built on the initial work of Yackel and Cobb in a study that documented first-graders in one classroom. The study revealed that the sociomathematical norms established in their classroom and intentionally implemented by their teacher, Ms. Smith, contributed to the development of positive mathematical dispositions among students. These positive characteristics resulted in students who believed in their mathematical intellect and joined their teacher as an active resource and source of mathematical knowledge in their classroom.

Moenikia and Zahed-Babelan (2010) made the point in their study concerning the correlation between mathematics attitudes, motivation, intelligence quotient and math achievement for 1670 students in Iran, that student performance in mathematics is intrapersonal in nature. Thus, suggesting that a student's performance in math is a direct reflection of his or her beliefs in self and his or her personal thoughts about mathematics knowledge and abilities. Relevant to this study, the authors assert that a student's negative attitude toward mathematics is related to attitudes (including beliefs) held about the discipline, more than "math anxiety" or "math avoidance" (Moenikia & Zahed-Babelan, 2010, p. 1538). I take this a step further in applying it to science learning and although researchers as Fordham and Ogbu (1986) spoke to "acting white" as influential in Black students' schooling performance, a student's personal beliefs about his science- or math-self plays a significant role in his level of achievement in the discipline.

In the study by De Leeuw et al. (2015), the authors reported that it was more important to high school students to see individuals doing things that reflect a pro-environmental stance than someone simply saying that they believed in protecting the environment. The student sample also communicated that if given useful tools to be able to behave in more eco-friendly ways then they would be more pro-environmental. This study showed how some factors may influence students' science-related behaviors. Looking more at actual science classroom behaviors and intentions of students, Schmidt, Rosenburg, and Beymer (2018) specifically called attention to the minimal number of research studies that explore student responses to specific characteristics of a science learning environment. The authors chose to explore student engagement and the contextual science learning environment factors that facilitated consequential student beliefs and behaviors. The authors found that beyond intentionally planned learning tasks structured to elicit specific performance expectations from students, "... it is critically important for science teachers to support students' perceptions of relevance or importance, as well as students' interest and enjoyment of learning activities" (p. 35). This notion suggests that teachers must first aim to identify what students believe to be important regarding the normative practices employed in their classrooms. The student intentions and behaviors expressed in the De Leeuw et al. (2015) study in addition to the studies referenced in this section show a need to explore student beliefs as it relates to specific classroom issues, values, or norms.

Research studies that discuss scientific practices and science students include studies exploring student performance as it relates to a specific practice. Pierson, Clark, and Sherard (2017) conducted a study on the modeling practices among eighth-graders in a science classroom. The authors stated that students' beliefs about modeling as practice develop as a result of "... instructional scaffolds, students' epistemic aims, and the social norms of the classroom." (p. 1063). As emphasized by (Shim & Kim, 2018) social norms of the classroom are created and maintained by the teacher, students, and as Brandt et al. (2010) stated, by historical influences of science culture and race relations in America and in American schools. Therefore, exploring what student beliefs are about their science-student-selves in a rural science classroom can result in expanding the body of knowledge on factors affecting the cognitive, behavioral, and/or affective elements of student learning in science classrooms.

Although not a US school study, Shim and Kim (2018) reported that the classroom behavior of eighth-grade Seoul Korea science students was influenced by the way in which the students made sense of what was going on in their classroom during scientific group modeling activities, what performing science looked like in their classroom. As the students better understood their science-student roles and science classroom practices, their science learning and attainment of scientific knowledge practices changed. These changes reflected a shift in students' epistemological and positional framing. Additionally, the authors concluded that students' framing shifts also influenced their perceptions of themselves, peers, and their learning environment. As stated in this study, there is little research that explores the interactions between student beliefs and expectations and classroom practices.

The relationship between beliefs and attitudes

In alignment with multiple studies mentioned in the previous section, student beliefs were linked with their subsequent behaviors, attitudes toward the subject, and sociopsychological responses to the classroom norms and expectations. Moenikia and Zahed-Babelan (2010) explored student attitudes and their intrapersonal performance in mathematics. The authors included student beliefs under the banner of attitude. Relevant to the current study and as supported by Eagly and Chaiken (2007) and Moenikia and Zahed-Babelan (2010) a similar lens was used to contribute to the literature pertaining to science-student beliefs and their enacted-selves as it concerns their affective expressions, intrapersonal expressions, interpersonal expressions, and cognitive expressions.

In one vain of attitude theory, attitudes include affect, behavior, and cognition. Similar to the definition of rural within research education, the definition of attitude has varied and has included memories, judgments, and evaluative representations (Albarracin, Johnson, Zanna, and Kumkale, 2005). For the purpose of this study the work of Eagly and Chaiken (2007) was used to define attitudes in this study. Whether conscious or unconscious, attitude references the three elements of evaluation, attitude object, and tendency. These elements viewed together lean on an individual's tendency to evaluate a situation, phenomenon, or entity. "Evaluation refers to all classes of evaluative responding, whether overt or covert, or cognitive, affective, or behavioral." (Eagly & Chaiken, 2007, p. 583). Therefore one's attitude toward an entity can include "... evaluative aspects of beliefs and thoughts, feelings and emotions, and intentions and overt behavior" (p. 583). For this study, attitudes include the expression of one's beliefs and thoughts, feelings and emotions, and overt behaviors. The attitudes that the study participants possessed pertaining to their science-selves in response to the normative scientific practices enacted within their science classroom were explored in this study.

Enacting scientific practices in the classroom

An important aspect of normative scientific practices and their influences on the beliefs of science students is how these practices are enacted in the classroom. The example of scientific argumentation is used here to situate the case that although the idea of implementing scientific practices is beneficial to achieving the goals stated by the authors of the *Framework*, the way in which these practices are enacted influences the science learning within a classroom. This influence can positively or negatively affect the way in which students see and enact their science-student-selves in the classroom.

Science education researchers have expressed that an integral yet lacking aspect of science learning should be scientific argument. Argumentative discourse, as stated by Driver, Newton, and Osborne (2000), in science classrooms provide students with an opportunity to think critically about what it is to do science. Additionally, the authors asserted that without this aspect of science learning, students are deprived of the opportunity to discuss and generate ideas as scientists within the field do and have done. Thus, underscoring the essential social process of science knowledge formation (Chi, 2009; Kelly, 2007; Resnick, Michaels, & O'Connor, 2010). Manz' (2015) stance extended this viewpoint of the utility of argumentation in the classroom to consider the perspective of sociocultural researchers. This position emphasizes "... students' participation in negotiating and adapting (rather than enacting or adopting) practices and [the need to] explore the ways that students' goals, established practices, and communities interact with the practices that are the target of instruction" (p. 2).

The following statement by Manz (2015) is the guiding lens for this study regarding the way in which normative practices can influence Black male students' beliefs about themselves as science students in a science classroom community in a rural middle school setting. "Practices shape not only how people act, but also what objects are considered important, what they are important for, which other practices are sensible, and how social relations are conceived" (p. 4). This stance suggests that the normative scientific practices valued in a science classroom can influence the lens by which Black male students view themselves and their science student voice, abilities, knowledge, and contributions in a science classroom.

Theoretical Framework

Science Identity

Several studies suggest that one's competency, ability to perform in science and mathematics, and recognition by family, friends, and science professionals interacts with one's race, ethnicity, and gender identities to influence one's aptitude toward developing a science identity (Carlone & Johnson, 2007; Farland-Smith, 2009; Hazari, Sonnert, Sadler, & Shanahan, 2010; Moore, 2006). I propose that the beliefs held by the Black male student study participants in response to the normative scientific practices that they experience contribute to their enacted science identities. The construct of science identity is defined in this study as a person's inclination toward scientific activities and practices, their ability and desire to acquire the knowledge and skills necessary to conduct scientific investigations, and their identification with the notion of being a "science person" (Carlone & Johnson, 2007; Farland-Smith, 2009; Moore, 2006).

The everyday desirable and authentic identities of people should be linked to a student's constructed school and science identities (Carlone et al., 2011; Kane, 2012b; NRC, 2012). Through the exploration of identity construction that resides at the cross-roads of being Black and being a performer of mathematics, Danny Martin (2007) recognized that the consequence of identifying with both groups creates real and perceived barriers to access the discipline of mathematics for Blacks. Parsons et al. (2012) acknowledged that this conflict with border crossing also exists between Blacks and science education. Thus, the potential that this conflict exists for Black male science students in a rural middle grades science classroom is plausible and will be explored in this study.

Carlone and Johnson (2007) showed how the science identity formation of a group of women of color was influenced by their race and gender. The authors state that competence, performance, and recognition were factors that influenced the science identity formation of the participants in their study. Specifically, they mentioned how recognition by others as being a "science person" was notably the most important factor. Science education scholars describe a science identity as a fragile entity that can be made stable through habitual efforts that access one's science identity, cause one to perform scientific activities, and permits one to experience being recognized for their science-person attributes (Carlone & Johnson, 2007). Each of the aforementioned science identity stabilizing factors can be experienced within a rural middle school science classroom via the normative scientific practices employed within that classroom. This suggests that the science identity of a Black male middle grades science student is constructed and can be visualized in response to the normative scientific practices experienced in a science classroom.

Gilbert and Yerrick (2001) explored science classroom discourse, identity and student beliefs within a rural lower track science classroom. The findings of this study revealed that race was a factor in placing students in lower track science classes. Once in a lower track science classroom students perceived science and themselves from a deficit perspective beyond the influence of instructional practices. This perspective was reinforced by the classroom teacher beliefs about lower track students. The complexity of the classroom culture was explained as an interaction of "...society, identity, and power manifest in diverse individual and collective belief systems" (p. 594). The authors also discussed being disturbed by their observation of "... overt efforts of school officials to socialize students into believing that the path to school success involves submission and passively following directions" (p. 589). These sociocultural patterns influenced the way that students positioned themselves in their science classroom and also how they chose to perform within their classroom. This current study aims to explore the beliefs held by Black male science students concerning their science-student-selves and the normative scientific practices that they experience in a rural middle school science classroom. The Gilbert and Yerrick (2001) study showed that sociocultural theory would be an appropriate lens to use in explaining the science classroom stories of Black male students.

Sociocultural Theory

Race and gender influence the science identity of individuals of color. However, as stated by Weissglass (2002) concerning mathematics education, many factors influence student learning in general. These factors include the "role of schools, race, gender, mathematics, language, culture, class, and assessment", among others (Weissglass, 2002, p. 35). Therefore, to tell a more complete story of the science learning experiences of Black male middle school students in the US, institutional factors and norms placed upon these students must also be explored. Sociocultural theory is a lens through which the institutional factors that play a role in the science learning experiences of Black male students can be explored. Sociocultural perspectives in science education research refer to the social interactions that occur within varied institutions and cultures (Lemke, 2001). The White Anglo-Saxon middle class norms within some classroom contexts and the behavioral expectations placed upon students in middle school and secondary school classroom settings oftentimes exist in conflict with being Black and being male in the classroom (Stinson, 2006).

Sociocultural theory historically was established by Lev Vygotsky (Cole et al., 1978). It has evolved to include activity theory and cultural-historical activity theory. In this research study, sociocultural theory is positioned to speak to the norms within the institution, the specific rural middle school in particular, and schooling in general, that the Black male students are expected to engage in and abide within. According to Scott and Palincsar (2013), students learn while interacting within varied contexts; however, viewed through sociocultural theory, those interactions occur within a larger institutional structure that also impacts student learning. Therefore, beyond the practice of group-work, instruction and how students engage in practice socially, aspects of the classroom culture influence how students will engage. A sociocultural perspective suggests that student interactions and action-responses to instructional expectations occur as a result of institutional and cultural norms and practices. In this case, the classroom and general school norms may influence how Black male students see themselves as science students while engaging in the expected normative scientific practices in their science classroom.

In summary, the Black male student and how his beliefs about his science student self are influenced by the normative scientific practices that he experiences in a rural science classroom will be explored in this study. The umbrella topics concerning Black (male) students and their educational experiences in US schools in general, in rural middle school science settings, and the normative scientific practices within these settings will help to fill a void within the research literature. This void specifically concerns the lived schooling experiences of Black male students in rural school contexts. The next chapter will explain the methods that will be used to acquire and analyze the data needed to fill this void.

CHAPTER THREE

METHODOLOGY

The purpose of this study was to better understand the science-student beliefs held by four Black male students in a rural middle grades science classroom. This study also proposed to observe the day to day occurrences in a rural middle grades science classroom to determine what normative scientific practices were experienced by four Black male students and how these practices influenced their beliefs in their science-student-selves. The following research questions served to achieve these research study goals: 1) What beliefs do Black male middle grades students have about their science-student-selves at the start of a cells unit in a rural school setting? 2) What normative scientific practices do Black male students in a rural middle school classroom experience during a cells unit? and 3) How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a cells unit of study in a rural middle grades science classroom?

Glesne (2011) described qualitative research as research related to the study and interpretation of the stories of people, i.e. their actions, interactions, relationships, and meaning making. Thus, qualitative inquiry methods provide data that can be interpreted by the researcher in order to make sense of this specific learning context and how certain scientific practices influence science-student beliefs. Such research can be performed in multiple ways and via varied methods or combination of methods. The qualitative method employed in this study was case study using ethnographic tools.

Case Study

Yin (2014) spoke of case study as a credible method to use when the research question is written as a 'how' or 'why' statement, when the phenomenon being studied concerns observed behavior essentially out of the control of the researcher, and if the topic is contemporary. The research questions listed in the section below speak to an inquiry into how Black male student beliefs are influenced by context-specific practices as well as the classroom experiences and beliefs of Black male students in a rural middle school science classroom. The inquiries mentioned include a 'how' statement and the contemporary nature of making real-time observations of students and their engagement with normative scientific practices in their classroom support the decision to use case study as a research method. Within the two classrooms that the teacher and students governed, the researcher did not have any control over the daily instructional choices or the personal responses of the student participants, additionally supporting the use of case study methodology.

Yin also described case study as a research method used to conduct in-depth analysis of individuals, small groups, organizations, communities and relationships, among others. Case study methodology in general, is a common qualitative method of choice in education research, including science education research. Within science education, this method has been used to explain a varied list of phenomena from teacher beliefs pertaining to classroom instructional choices to the thoughts a third-grade boy has about his enactment as a scientist inside and outside of school. In a more recent study, specific to normative scientific practices as described by the *Framework*, Shim and Kim (2018) used case study to conduct an in-depth study into the epistemological and positional framing of eighth-grade middle school boys during the process of engaging in scientific modeling practices. Shim and Kim discovered that the students' perceptions of these practices influenced how they engaged and positioned themselves within their small groups.

Tucker-Raymond, Varelas, Pappas, and Keblawe-Shamah (2012) also utilized case study in exploring the "nuance and complexity of individual responses" from children in first through third grade regarding their engaging in the work of a scientist and expressing their thoughts about these events through the authors' version of the Draw-A-Scientist Test, Being-A-Scientist (BAS) (Varelas, 2012, p. 85). The methodological choice of case study provided a closer look into the BAS interview results of a study participant's thoughts about his performing as a scientist inside and outside of school and his drawing representation of those occurrences. It allowed a glimpse into how the student viewed scientific practices and himself as he engaged in scientific practices. The studies referenced above reiterate the utility of case study method in delving into the lived and highly nuanced science classroom experiences of young students.

The science learning environment experiences and beliefs of four Black male students in a middle grades science classroom were the focus of this case study. The units of analysis in this study were the four Black male student participants, Jay, Kyle, LT and Mikel. This study privileged the voices of Jay, Kyle, LT and Mikel, allowing them to explain in their own words how they see themselves in this particular science classroom context. This qualitative ethnographic case study also utilized the following ethnographic tools, field notes, observations and interviews, to explain the science classroom culture and the lived experiences of Jay, Kyle, LT, and Mikel in two rural middle school classrooms.

Ethnography

There are ways and understandings that are specific to a context that shed light on the behaviors, identities, and beliefs of those who reside within it. Ethnography and the use of ethnographic tools, such as interviews, field notes, and observations, are a rigorous and inductive process suitable for explaining the classroom context and the Black male student experiences within two rural middle grades science classrooms taught by the same teacher. Specifically exploring aspects of these particular classroom cultures to better understand the normative scientific practices that situate what science is in these classrooms, who is considered to be scientifically knowledgeable, and who has access to science (Carlone, 2012). LeCompte and Schensul (2010) defined ethnography as "a systematic approach to learning about the social and cultural life of communities, institutions, and other settings..." (p. 1). Therefore, the use of basic ethnographic research tools to explore the practices and beliefs of the inhabitants of a rural middle grades science classroom aided in answering the previously mentioned research questions for the current study.

As visualized in two middle school science classrooms taught by the same teacher, culture and people are innately complex subjects and topics of study within anthropological and educational research because of the unanticipated nature of social interactions within people groups (Spradley, 1980). Ethnography served as a tool that has been and is used to describe a culture or people group (Glesne, 2011). Therefore, unearthing patterns and themes during the exploration of a specific context or cultural group furthers the growth of research knowledge pertaining to the complexity of human behaviors within a cultural group and/or specific context (Anderson-Levitt, 2006). An example of this is evident in a study by Kane (2012a) as she described the science identity formation of a third-grade African American male student as part of a larger ethnographic study. Within the study, the study participant verbally explained during individual interviews the way he saw himself as a science student, science person, and scientist. His responses revealed the interconnected way in which his world's inside and outside of school shaped some of his ideas about himself as a science student, science person, and scientist, thus shaping his science identity. The author emphasized that "... we would not know about the connections children are making with school and science unless we engaged them in conversation." (Kane, 2012a, p. 40). The findings of this study further speak to how the use of ethnographic tools in this study will privilege the voice of Black male students in describing their specific science learning environment and how they see themselves as science students in a particular context.

Creswell (2013) suggested that the use of case study in combination with ethnographic methods would provide a rich description of the classroom culture related to the scientific practices and the experiences of Black male middle school students in a single classroom context during a specific unit of study. According to the ethnographic case study dissertation work of Lucinda Sohn (2015) on the influence of science instructional practices within a high school science classroom learning environment, "ethnographic tools provide the foundation for revealing how people make meaning from life." (p.59). The use of ethnographic tools in this study served to facilitate the development of a rich description of the science classroom context, what Black male students' science learning experiences look like in this classroom, and the normative scientific practices that take place within this classroom. This chosen methodology works to provide a better understanding of the context and the participants within this specific classroom context. It will also highlight the thoughts and beliefs that the participants have about their science learning environment and their science-student-selves as it relates to normative scientific practices. Table 3.1 below shows the research design for this ethnographic case study.

Table 3.1

Ethnographic Multiple Case Study Research Design

Ethnographic Multiple Case Study Research Design
Research Questions 1) What beliefs do Black male middle grades students have about their science-student-selves at the start of a unit of study on cells? 2) What normative scientific practices do Black male students in a rural middle school classroom experience during a unit of study? 3) How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a unit of study in a rural middle grades science classroom?
Propositions The normative scientific practices of a science classroom are gatekeepers for some students to gain access (or not) into the culture of science at large (Carlone, 2012; Kelly, 2007). "Practices shape not only how people act, but also what objects are considered important, what they are important for, which other practices are sensible, and how social relations

are conceived." (Manz, 2015, p. 4).

Sociocultural perspectives in science education research refer to the social interactions that occur within varied institutions and cultures (Lemke, 2001).

Units of Analysis

Four Black male student participants

Data to Proposition Logic

Explanation building

Criteria for Interpreting the Findings

Relying on theoretical propositions

Type of Case Study

Ethnographic multiple case study

Case Boundaries

- Participant data collection over the course of one unit of study.
- Normative scientific practices
- Black male students' perceptions of their science student selves as it relates to the normative science practices experienced during a unit of study as identified by the researcher and study participants.

Setting and Participants

As previously mentioned, this study is situated in a rural county due to the dearth of literature that speaks to better understanding Black male students and what they believe about their science-selves in response to the normative science classroom practices in this context. Selecting the rural county of interest for this study started with a review of the school locale definitions as stipulated by the National Center for Education Statistics (NCES). Secondly, US Department of Education (USDE) rural and low-income program eligibility data on the US Department of Education website was reviewed for eligible counties in the southeastern US. The website noted Blumenthal county (pseudonym), a county in the southeastern region of the US, as an eligible county. Furthermore, the school locale designation for Blumenthal county was searched under public school districts on the NCES website and Blumenthal county is listed as a rural county. Blumenthal county district details from the year 2000 US census report, fiscal data from 2013-2014 and district data from the 2015-2016 school year that is published on the NCES website, reports 15,132 individuals under the age of 18 and 10,476 students. The county population under the age of 18 was 3.8% Hispanic during the 2015-2016 school year. I lived in this county for six years which gave me insight into the county and its population. Therefore, convenient sampling (Etikan, Musa & Alkassim, 2016) was used to select the county for this study.

Although it is not specified by the NCES, the range of rurality among US rural schools is worth mentioning. There are rural school districts whose students lack access to technology, qualified teachers, and discipline-specific textbooks, among other quality school resources. Some rural schools utilize local farms and community resources to teach their curricula and enhance instruction. Whereas others do not have access to community resources that can be easily accessed to enhance their curricula. Blumenthal county school district had modern technology available for its schools. The middle school chosen for this study had qualified teachers, discipline-specific textbooks, and access to local fisheries, a school chicken coup, garden, and other resources to enhance their curricula. Blumenthal county is a rural county that does not exist in isolation compared to some other rural county school districts.

According to the NCES, there were 16 schools in Blumenthal county and three of these schools served middle grades students. The middle school with the most diverse racial demographics was Reese Middle School (RMS, pseudonym). This middle school was chosen as the research site for this study because it had the largest population of Black students among the three middle schools within Blumenthal county. Data from the NCES (2014-2015) show 21.30% for RMS, 1.87% for Winteroaks Middle (pseudonym), and 3.28% for Advent Middle (pseudonym). The selection of this middle school, for this reason, provided for a larger possible sample size of Black male students.

The NCES classified RMS as a regular public school with a school locale designation of town (fringe). School data from the NCES (2015-2016) reported that RMS had 798 students, 51% male and 49% female. Racial demographics for the same year showed 0.00% American-Indian/Alaska Native, 1.38% Asian, 21.30% Black, 5.76% Hispanic, 0.00% Native Hawaiian/Pacific Islander, 65.54% White, and 6.02% two or more races. The student population eligible for free or reduced lunch was 58.40%. The 2017 South Carolina State Report Card for RMS reported that 63.3% of the student population live in poverty. It also reported that 100.0% of students in grades 7 and 8 are enrolled in high school credit courses and 24.3% of their students were in gifted and talented programs. With regard to student attendance rate, student out of school suspensions and expulsions, students retained, and dropout rate, RMS reported a percentage of 95.6%, 0.5%, 0.2% and 0.0% respectively, for 2017. Lastly, the 2017 RMS state report card showed a student to teacher ratio in core subjects of 20.5 to 1 (RMS, 2017).

Teacher Participant

Although the location of this study was chosen after an online search was conducted as mentioned above, I met the teacher in this study during the 2017-2018 school year. This section is a personal account of how the researcher was introduced to the teacher in this study. This account will be described in first person. During the school year I worked as a university supervisor for my current university. One of the pre-service teachers assigned to me was paired with Mrs. Sunshine (pseudonym) for two semesters. During the multiple observations of my student teacher I watched Mrs. Sunshine interact with students and specifically mention to me Black male students in her class who she identified as being able to succeed in her advanced science class. She requested that the students be moved into her advanced class from her regular class. I observed the care and concern for students that she possessed and the "family"-like community that seemed to be created for students by Mrs. Sunshine and her seventh-grade science team-teacher.

During this year serving as a university supervisor, I also had the opportunity to observe Mrs. Sunshine teach and effectively use differentiated instructional strategies within her inclusion science class and in her regular science classes. She was also open to new research-based instructional strategies being used in her classroom by my student teacher. I was also privy to her work as director of the Women in Charge, science for girls, program that she started at the middle school. There was an obvious passion for the profession, science discipline, new teacher training, and student success that caught my attention. These observed characteristics of Mrs. Sunshine and learning of her multi-decade service in education resulted in an increased curiosity pertaining to the way in which Mrs. Sunshine taught science to students, specifically her Black male students.

After soliciting permission from the Blumenthal county school district, I was invited to conduct a pilot study with the middle school students that Mrs. Sunshine was scheduled to teach during the first session of summer school. It was during this time period that I learned more about Mrs. Sunshine's educational background. Mrs. Sunshine began teaching elementary school mathematics in Atlanta, GA in 1977. She spoke to being "fresh out of school" and teaching minority students with no teacher education preparation pertaining to teaching minority students. During this time period her principal felt that she would be well suited to teach pottery as an elective to a group of seven Black male students who had been labeled by other school personnel as "problem" kids. Mrs. Sunshine stated that she didn't know why her principal felt that she wouldn't have any trouble with this group of students, but that was what happened, she built a trusted rapport with the seven Black male students in her elective.

It was because of her relationship with her students that during the 29 serial murders of Black men and boys in Georgia between 1979 and 1981, Mrs. Sunshine was asked by the FBI to ask her students questions about the body of one of these Black males. The body of one of these Black males washed up near the home of one of her seven Black male students. Mrs. Sunshine expressed that her students were in heightened emotional states because of these murders taking place where they lived. These students shared their thoughts with Mrs. Sunshine and she expressed being moved to help them and other students process their own feelings regarding these tragedies. While we talked one morning during the summer session and she shared this story, she also shared that she had no idea how to deal with this situation as a new teacher, she just knew that she had to help her students during this period of their lives.

Working with Mrs. Sunshine during the summer gave me an opportunity to see her differentiate instruction for a select group of male students (Black, Hispanic, and White males) that were strategically placed in her Core ELA and Core Math class by the summer school administrators. Her ability to differentiate instruction and attend to the instructional needs, and needs in general, of her students was acknowledged by her school administrators and fellow colleagues. Mrs. Sunshine began teaching sixth- and seventh-grade science in 1988 at an elementary school in Atlanta, GA. She continued to teach science until 2005. Her career was split between Atlanta, GA, Charlotte, SC (pseudonym) and Charleston, SC. She became certified as a Master Teacher Science Trainer and garnered accolades related to her work in moving the notion of "science for all" forward in her classroom and later in the school district she worked for in Charleston, SC.

Mrs. Sunshine served as Science Department Chair at the middle school that she taught at in Charleston. She also served in the following capacities while in Charleston, district-wide science literacy team, Women in Charge club sponsor, SREB leadership team, Princeton review site coordinator and Saturday scholars site coordinator. Mrs. Sunshine had a personality trait that moved her to try something new periodically. Between 2005 and 2008 she worked as a teacher coach. She then went back to teaching science in a Charleston county middle school until 2014. In August of 2014 Mrs. Sunshine moved to Charlotte, SC and began teaching at Reese Middle School.

A poignant statement that Mrs. Sunshine shared with me about herself and her science teaching practices is that she believed that all students have the potential to learn, although they may learn at different speeds. She worked to provide students with time to complete their assignments. Mrs. Sunshine saw her role as a teacher as a facilitator, encourager, and lifelong learner. The lifelong learner trait was interesting to me because she verbalized that she learns from her students and lets them know that their idea was better than what she had been doing previously. Therefore, situating her students as science experts and contributors within their science community. I observed this during the summer session rocket building class periods. A student used a different, more effective, way to assemble the paper around the cylinder being used to build the frame for the rocket. Mrs. Sunshine acknowledged the student and his idea aloud in the class. She had high expectations for each of her students and if she recognized a way to help a student be more academically successful, she employed the necessary strategies to help them succeed. It is because of these observations that I sought to conduct this study with Mrs. Sunshine and her students.

Classrooms Observed

Two of Mrs. Sunshine's classes were observed during this study to retain at least four Black male student participants for the study. Variables such as different students, the time of day, and classroom dynamics may have influenced the classroom environment. Inquiry into such variations was outside the scope of this research study;

however, the researcher used the same observation tool within each classroom setting to provide context for the scientific normative practices that Black male students were experiencing in each classroom. During the pilot study, the use of the normative practices observation tool, field notes and classroom observations in each class revealed that there were no major differences in the science classroom practices experienced by the Black male student participants during the same unit of study.

The Black male student participants, Jay, Kyle, LT and Mikel (student-selected pseudonyms) were in Mrs. Sunshine's first and second period seventh-grade science classes during the 2019-2020 school year. In alignment with what Fetterman (2010) described as judgmental sampling, the final selection of the four Black male students were chosen based on the researcher's preliminary observations within the context and student responses to the what does science mean to you drawing prompt. The initial classroom context observation days, 9/5/19, 9/12/19, 10/3/19, and 10/8/19, confirmed that the practices employed were the same during first and second period, which mirrored what was observed during the pilot study. Additionally, the pilot study revealed that using the student drawing prompt of what the term 'science' means to students served best as a means of observing how students responded to the request rather than a tangible data source. Student reactions to the prompt during the pilot study revealed hidden feelings held by students about science and/or themselves as science students.

The what does science mean to you drawing prompt was given to all the students as to not single out the Black male students in Mrs. Sunshine's 2019-2020 science classes. Mrs. Sunshine had three general science classes and one advanced science class with at least one Black male student enrolled. Mrs. Sunshine gave the science drawing prompt as an assignment in these four classes after students completed their pre-unit diagnostic assessment for the cells unit. Mrs. Sunshine told students to complete the task for homework if they did not complete the drawing prompt in class.

After the initial four days of classroom observations, the three days that I spent with all of Mrs. Sunshine's students on their field trip to a local fish hatchery at the end of their ecology unit (9/26/19, 9/27/19 and 9/30/19) and after the science drawing prompt was given to students I compiled a list of possible participants. I met with Mrs. Sunshine to discuss the list of Black male students from four of her classes who I felt would be good study participants. I had a list of eleven Black male students to ask about their willingness to participate in the current study. I provided the study description to each Black male student and asked him if he was interested in participating in the study, see Table 3.2.

Table 3.2

List of Possible Study Participants

Student	**Class period**	**Observations**	**Science drawing prompt**	**His decision**
CJ	1st	• Asked and eagerly answered questions in class • Completed his work	Completed the drawing after pausing to think	Declined
Jay	1st	• Answered questions in class • Completed his work when he wanted to • Generally quiet	Did not complete the drawing	Yes

		• Called out for not completing ecology homework assignment		
LT	1st	• Answered questions in class • Completed his work • Generally quiet, often sleepy • Called out for not completing ecology homework assignment	Did not complete the drawing	Yes
LaTavius	1st	• Completed his work if he wanted to • Isolated at a single desk due to off-task behaviors • Talked in class • Called out for not completing ecology homework assignment	Did not complete the drawing	Declined
Mikel	2nd	• Completed his work • Engaged at the fish hatchery, asked questions during the visit • Asked and answered questions in class • Helped his peer answer a question correctly	Did not complete the drawing	Yes
Kyle	2nd	• Completed his work • Engaged at the fish hatchery, asked questions before, during and after the visit • Asked and answered questions in class • Commented "Yay, more science" when	Did not complete the drawing	Yes

		class period was extended due to a schedule change.		
Charles	2nd	• Asked scientifically sound questions and answered questions in class • Isolated at a lab station due to behavior	Absent and did not complete the drawing	*Note
Ned	8th	• Asked scientifically sound questions and answered questions in class	Struggled to complete his drawing. He asked me what he was expected to draw and looked at his classmate's drawing.	Declined
Nick	8th	• Completed his work • Generally quiet • Timid • Sometimes answered questions aloud	Completed the drawing without any response or questions	Yes*
Jamal	8th	• Completed his work • Social	Completed the drawing without any response or questions	*Note
Derrick	9th	• Completed his work • Advanced student • Generally quiet	Completed the drawing without any response or questions	*Note

*Note. Charles was absent on multiple days during the start of the cells unit and I was not able to ask him about participating in the study. I did not include Nick in the study because I had the confirmation of the four other students from the morning classes. I did not ask Jamal or Derrick because I had confirmation from four other students on the list.

Ultimately, their willingness to participate in the study, the response to the science drawing prompt, and my observations of each student in class and at the fish hatchery led to the final selection of Jay, Kyle, LT and Mikel as study participants.

Study Participants

Jay, Kyle, LT and Mikel collected the white sheet of paper for their science drawing prompt yet chose not to complete the science drawing task. None of them submitted this homework task the next day. This response could have been interpreted as a negative reflection of each student's interest in science. However, as posited earlier in this study and from the initial observations, more information was needed to draw any conclusions pertaining to the science classroom actions and science-student beliefs of Jay, Kyle, LT and Mikel.

Jay.

Jay was a 13-year old Black male student who described himself as being a quiet student who would sometimes talk in class. He liked animals, playing football and basketball and he liked to go to the gym with his Uncle who serves in the military. Jay said that he liked "working math... figuring out solutions and problems and stuff like that." As a student, he liked all of his classes except social studies and English language arts. When asked to describe himself as a science student, Jay said, "Um, happy, kinda like doing projects and stuff like that." Jay thought of himself as a creative person.

Kyle.

Kyle was a 12-year old Black male student who early in meeting him showed an interest in science. During one of the initial four observation days, Kyle yelled out in class, "Yay, more science" when his science period was extended due to a school-wide schedule change. Kyle shared that he liked to skateboard and he liked to go to zoos and aquariums when on vacation with his family. He liked being able to have what he called "a different experience" when he went to zoos and aquariums. He especially liked to learn about marine life. Kyle acknowledged that he did not always like science but he started to "see the things that you can do in science" and that changed his interest in science.

LT.

LT was a 13-year old Black male student. He was twelve years old at the start of this study and turned thirteen during the study. LT enjoyed school and science. He especially enjoyed reading Manga and watching anime. He liked to play a wide variety of video games. He treated playing video games as a competition with himself. He said that when he reached a level that he could not pass "the losing keeps me motivated." LT liked to play Gaga ball and Xbox with his friends. He was a student who recognized that he could perform well on tests without studying for them. "I studied it once before the test and then I kept getting A's and B's." He would sometimes forget his homework or forget to do his homework.

Mikel.

Mikel was a 13-year old Black male student at Reese Middle School (RMS). He liked to play sports and go fishing with his parents. Mikel was a self-described student athlete at RMS. He played football, basketball and baseball at RMS. He described himself as sometimes being quiet in class and sometimes not being quiet in class. He verbalized that he enjoyed school and sometimes enjoyed science. Mikel was physically expressive when in class and liked to move around in his seat. In a conversation, Mikel shared that he felt that his Mom and his teachers at RMS were looking out for him. "To help [me] get better in like situations... like in my grades, sports, and life." He believed that his Mom and teachers looked out for him in an effort to "protect [his] future." He believed in the motto for RMS to ROAR, to be respectful, on task, always stay safe and be responsible.

A Physical Description of the Classroom

Mrs. Sunshine's classroom was set up with eight large black-top lab stations positioned at the back of the room in a "U" shape. Students used lab stools when they sat at these lab stations. Some students were assigned to sit at these lab stations regularly. The first lab station at the front of the room next to the front door was Mrs. Sunshine's work station. There were six four-desk pods positioned in the center of the room, they took up the majority of the open space. There was an additional pair of desks also positioned in the center of the room. The front of the class had a standard dry erase board. This board was primarily used for announcements and/or instructions for students. The projector screen would regularly be pulled down over the dry erase board. Mrs. Sunshine primarily used the projector to display content from the elmo, microscope, or her laptop. There was also a television screen mounted on the wall in the corner of the classroom closest to the teacher's desk.

During instruction, students primarily sat in the four-desk pods in the center of the room. In early October Mrs. Sunshine decided to change the center desk pods around because of what she identified as too much side chatter from many students. The desks were then moved into four large C-shaped rows positioned in the center of the classroom. The desks were side-by-side in this arrangement. Initially, students were able to choose their own seats, but Mrs. Sunshine decided to move students based on her understanding of student needs and classroom management. This C-shaped arrangement lasted until the following week. Mrs. Sunshine felt that she could not see the faces of all of her students when they were positioned in the C-shaped desk arrangement. This began to interfere with her classroom management. The students were placed back into the four-desk pod arrangement.

As students first entered the classroom through door one of two they were expected to get any daily handouts from the "Get It" table. The second door was the exit door for students. The classroom was brightly colored with multi-dimensional artifacts and objects positioned around the room related to each of the seventh-grade science units. These objects included deer heads mounted on the wall, wooden fish on the wall, US flag, South Carolina flag, recycling posters, key words from the science units, living plants, living fish in a fish tank, safety zone, and motivational posters. Mrs. Sunshine intentionally arranged her classroom to show the sequence in which students would experience the units of study during the school year. The titles for the units and some vocabulary from each unit was positioned around the room. The students and teacher were instructed during the daily school announcements to say the pledge to the US flag and the pledge for the SC flag. The daily school announcements took place during the time designated for non-core and non-elective classes. Jay, Kyle, LT and Mikel were positioned in different parts of Mrs. Sunshine's classroom.

Jay's physical position in class changed based on Mrs. Sunshine's assessment of his initial groups' interactions. Jay sat in a four-desk pod at the front of the classroom with two of his friends. His two friends were white male students. During the course of the research study, both of Jay's friends were moved to a different four-desk pod. All three boys were separated from each other. Towards the end of the research study Jay was moved back into a different four-desk pod with one of his original group mates and another of his classroom friend's, a Black male student. Occasionally, Jay would move himself to a lab table to sit on his own. Whereas, LT sat in a group of four students at the second lab table behind Mrs. Sunshine's work station. His group included three white male students. He stayed in this position throughout the unit of study. The physical location of Kyle and Mikel in second period was similar to LT and Jay, respectively.

Kyle sat at the third lab station behind Mrs. Sunshine's work station. He worked at this lab station throughout every instructional period during the unit of study. His group included one white male student and two other Black male students. During non-lab instructional sessions, Mikel sat in a four-desk pod with three other students. He was originally seated with two of his peers he referred to as his friends and another student who Mikel said he was okay with. His group included a Black female student, another Black male student and a white male student. Mikel's group was changed mid-way through the unit of study when Mrs. Sunshine felt that student desks needed to be rearranged for the purpose of classroom management. Mikel's group was changed to include him and three Hispanic male students. He stayed in this group for the remaining instructional and lab sessions for the unit of study.

The Cells Unit of Study

Multiple topics of study were combined into larger units of study for seventh-grade science at RMS. This study focused on a smaller unit of study, cells, within a larger unit of study that also included body systems. Given the distinctive nature of these two topics of study, cells was considered one unit and body systems was considered a separate unit of study. The data collected from the cells unit answered the three study research questions so the unit on body systems was not included as an additional source of research data.

Data Collection

Science identity researchers (Varelas, 2012) emphasized that before the science identity of an individual is explored, the context within which the individual's identity is largely shaped must be described. Additionally, ethnographic researchers LeCompte and Schensul (2010) spoke to the influential significance of context on people behavior and thought. To establish a baseline for the science-student beliefs of Jay, Kyle, LT and Mikel at the beginning of their engagement in the normative scientific practices of the cells unit, attending to the first research question, multiple data sources were used. As previously addressed, the what does 'science' mean to you prompt was given to students at the start of the cells unit to observe student responses to the prompt and make the final selection of study participants. These responses provided a measure of viewing how Jay, Kyle, LT and Mikel might enact their science-student-selves. A brief "studenting" interview was conducted with the four study participants. Lastly, field notes and classroom observations were collected. The studenting interview, field notes and observations illustrated actions and/or inactions engaged in by Jay, Kyle, LT and Mikel related to what they believed about themselves as science students.

Interview Prompt

Each student in the four science classes identified as having at least one Black male student enrolled was asked to use varied pictures, drawings and text to depict on paper what science meant to him or her. The "what does science mean to you?" interview prompt was given as a way to determine if any hidden feelings about science and/or their science-self was held by the study participants. This task served as a selection tool for the final Black male research study participants. Potential Black male student participant reactions to this task request were observed and noted in Table 3.2. These responses in combination with other early classroom observations served as tools to select the final pool of participants.

Field Notes and Observations I

The continual collection of field notes and observations captured data within the case boundaries set in the above multiple case study research design. Field notes and observations for first and second period were collected to ensure that the context for both classrooms were captured. Classroom observations were typed into a single Word document and the field notes were contained in these documents and marked by brackets, see Appendix A to preview how field notes were recorded and bracketing was used. As described by Nespor (2006), the field notes for this study reflected the thoughts and/or observations of the researcher related to the study research questions. The field notes and observations addressing the first research question included the first twelve observation days of the cells unit. This was the first half of the cells unit. These observations and field notes focused on the events taking place within the classroom context and how Black male students were responding to these events. Explicitly, what was Mrs. Sunshine doing and saying and what were Black male students doing and saying in their classroom. These events included the daily classroom routines, instructional practices and expectations presented to students.

Studenting Interview

The studenting interview was conducted with each study participant in an adjacent classroom to Mrs. Sunshine's classroom. Each potential student participant was asked if he wanted to participate in the study and was given the student assent form that was approved by the university's internal review board (IRB). After accepting the invitation to participate, he was then asked to sit for the studenting interview. The Black male students identified as possible participants were asked to participate during each class period, starting with first period. Jay, Kyle and Mikel completed their studenting interview on 10/23/19 and LT completed his interview 10/25/19. Mrs. Sunshine allowed me to speak to students as time allowed on 10/23/19 because she had a substitute teacher covering her class. The next available date to continue with participation requests was 10/25/19.

The studenting interview (see Appendix B) served to determine what beliefs the study participant had about himself as a student, science student and how he believed his science-student-self was viewed by others (Varelas, 2012). The studenting interview results and field notes and observations I provided a baseline for understanding the science-student beliefs held by Jay, Kyle, LT, and Mikel within this context. The second research question was addressed by exploring the normative scientific practices experienced by Jay, Kyle, LT and Mikel in their respective classes. The field notes and observations for all twenty-five cell unit observation days for first period and all twenty-three days for second period, an observation protocol and a normative scientific practices card sort interview were employed to answer the second research question.

Field Notes and Observations II

The field notes and observations from multiple classroom observations for first and second period were collected during the cells unit. Twenty-five days were observed for first period and twenty-three days were observed for second period. The difference in the number of days observed was because study interviews were conducted on two additional days during second period. The field notes and observations captured what was happening within the classroom on a daily basis within the boundaries of the study research design. The field notes and observations during the cells unit highlighted the normative scientific practices that took place in the classroom, in alignment with the observation protocol described below.

Normative Practices Observation Protocol

In addition to field notes and observations II, an observation tool (Carlone, 2012, p. 17) was used during each classroom observation to provide a structure for classroom observations that would aid in developing a definition for normative scientific practices for Mrs. Sunshine's classroom (see Appendix C). This protocol was used during each day of the observed science unit until a point of data saturation was observed. The same top three practices were observed occurring and this pattern was not changing. Two additional days of data collection occurred to ensure that no new data were identified.

The study observations addressing the regularly occurring practices in Mrs. Sunshine's classrooms involved classifying what the students in the classroom were doing and/or being asked to do as described under the eight scientific practices of the *Framework*. As stated previously, the eight science practices noted by the National Research Council in the *Framework* are the following: 1) Asking questions (AQ), 2) Developing and using models (DM), 3) Planning and carrying out investigations (PI), 4) Analyzing and interpreting data (AID), 5) Using mathematics and computational thinking (MCT), 6) Constructing explanations (E), 7) Engaging in argument from evidence (ARG), and 8) Obtaining, evaluating, and communicating information (OECI) (NRC, 2012). The observation tool used to identify and record the occurrences of the valued practices in Mrs. Sunshine's classrooms was edited from the normative scientific practices observation protocol developed by Carlone (2012). The minor edits reflected abbreviated categories for the *Framework* practices, as written above, instead of the three more broad categories for observed practices in the Carlone protocol.

Additionally, during the pilot study it was observed that accounting for the *Framework* practices in real-time occurred best when three of the eight practices were unattached. Developing and using models was separated into two individual categories, as were planning and carrying out investigations. These designations were identified as DM, UM, PI, or CoI in the appropriate columns on the observations tool. Obtaining, evaluating and communicating information was separated into three individual categories and identified in the last category column as OI, EI or CI. This observation tool was printed out and a hard copy was used to record data for each class period on each observation day. The pilot study also revealed that data points recorded every five minutes within a class period accounted for instructional changes and lack of instructional changes during a middle grades classroom period. Based on the observation protocol results, a list of observed practices with descriptions was created. This information was used to develop the card sort interview.

Card Sort Interview

The frequently occurring normative scientific practices that emerged from researcher observations and the normative practices observation tool were evaluated for accuracy by conducting card sort interviews with Jay, Kyle, LT and Mikel. The card sort interview highlighted the normative scientific practices that each study participant felt occurred the most during the cells unit, attending to the second research question (Carlone, 2012, p. 18-19). Each card sort interview was video recorded with a microphone to collect clear audio for each video. As per the study IRB stipulations, only the hands of the boys as they organized their card selections were captured on video. A second audio recorder was also used to ensure the students' conversation about his selections were captured as supplementary to the video recording. The card labels and descriptions reflected the observed practices in Mrs. Sunshine's science classes. For example, obtaining information was observed as important in Mrs. Sunshine's classrooms. The card reflecting the obtaining information practice included examples of what that looked like in Mrs. Sunshine's classrooms (see Appendix D). The interview structure designed by Carlone et al. (2011) was conducted as designed, with three stages to determine the beliefs that Jay, Kyle, LT and Mikel had concerning the normative practices that took place in their science classroom. During the first stage, participants were placed in front of a table that had all of the practices cards spread out and they were asked to respond to the prompt, "In this science class, during the unit on cells, we were expected to". Each student was given the opportunity to read each card and then to specify whether they felt that that practice was something that happened regularly during the cells unit (Carlone, 2012). Depending on how he felt about that practice and its frequency of occurrence during the cells unit, each participant placed each card into a category of yes, no or maybe. Next, participants were asked to select three cards from the yes category that reflected the practices that they perceived to be most important in their classroom. Lastly, a semi-structured interview question was asked while the cards were accessible to student's in order to have each student identify any practice(s) that he felt would be included in his idea of a great science class.

The card sort interview provided an opportunity for Jay, Kyle, LT and Mikel to express his thoughts regarding the practices that took place in his classroom. During the card sort interviews, additional interview questions were used to solicit a deeper understanding of the perceptions of the science learning environment and experiences of Black male students in Mrs. Sunshine's classrooms. These questions were structured to answer the third research question. To attend to the third and final research question concerning how and to what extent these experienced practices influenced the science-student beliefs of Jay, Kyle, LT and Mikel, field notes and observations and the semi-structured individual interviews were collected.

Field Notes and Observations III

The field notes and observations III were a continuation of field notes and observations recorded to highlight the actions, thoughts, and words spoken by Jay, Kyle, LT and Mikel in his respective classroom. These field notes and observations may have signified a response to the scientific practices that took place within the current unit of study. The field notes and observations to attend to the third research question picked up after the first twelve observations for first and second period used to answer the first research question. The last thirteen observations for first period and the last eleven observations for second period were collected. As previously mentioned, the difference in the number of observation days was due to study interviews conducted on two days during second period. The field notes and observations during this time period served as points of further questioning used by the researcher during the semi-structured individual interviews. Any observations made during the entire study period served as possible references during the semi-structured interviews.

Semi-Structured Interview

The semi-structured interviews took place after Jay, Kyle, LT and Mikel identified the normative practices that they experienced the most during the cells unit of study. Interview questions included: Why did you select practice X to be important in your classroom during the cells unit? How do you feel when practice X happens? Who do you feel are the top three students in your class who do (X) well (you may include yourself if it applies)? and What happens in class that makes you feel that way about student A? Appendix E lists the semi-structured interview questions. Specific behaviors or words spoken by Jay, Kyle, LT, or Mikel over the course of the cells unit were isolated and used during the interview. Providing students with specific examples about their science-student words and/or actions was designed to help students see themselves performing as science students and/or scientists. Table 3.3 shows the data that was collected to answer each research question.

Table 3.3

Research Questions and Data Sources

	RQ1. What beliefs do Black male middle grades students have about their science-student-selves at the start of a unit of study?	RQ2. What normative scientific practices do Black male students in a rural middle school classroom experience during a unit of study?	RQ3. How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a unit of study in a rural middle grades science classroom?
Data sources	1. Field notes and observations I 2. What does science mean to you drawing with text (response to the prompt) 3. Studenting interview	1. Field notes and observations II 2. Normative practices observation tool 3. Card sort interview	1. Field notes and observations III 2. Semi-structured interview

Data Analysis

In order to address the first research question in this ethnographic multiple case study, field notes and classroom observations were collected and an audio-recorded studenting interview was conducted with individual student participants and analyzed. The student artifact ("What does science mean to you?") served as an interview prompt (Prosser & Schwartz, 1998) in which the responses from Jay, Kyle, LT and Mikel were observed and reported in Table 3.2. As previously mentioned, judgmental sampling was employed based on the observations made during this research task in combination with the four initial classroom observation notes collected prior to the start of the cells unit of study.

The studenting interview transcripts were the primary data source informed by the typed field notes and classroom observations I, which served as a secondary data source. The science drawing responses were a tertiary data source. Initial readings of the studenting interview transcripts and transcriptions of the field notes and observations I were analyzed to make note of any preliminary descriptive codes related to answering the first research question concerning the science-student-self of Jay, Kyle, LT and Mikel. The frequency of occurrence of the descriptive codes within the studenting interviews and the field notes and observations I documents were noted prior to In Vivo coding. Table 3.4 and 3.5 below include a sample of the coding that was completed.

Table 3.4

Sample Coding for Research Question One

	Mikel	**Kyle**	**Jay**	**LT**
OUTDOORS	1	3	1	1
SILENT	4	2	3	4
ENDURE	2			
ENJOY SCHOOL	1	1	1	
NON-SILENT	1		1	1
PLAYFUL	1			
HARD SUBJECT	4			1
ENJOY SCIENCE	1	2	1	
SCIENCE CHANGED	2			
GOOD STUDENT	3	2	3	2
PERFOMANCE BRAGGING	2			
SOCIAL INTERACTIONS	2			
BEHAVIOR	3	1	5	3
BAD BEHAVIORS			1	
EXPECTATIONS	4			1
SCHOOL EXPECTATIONS			1	
PROTECTION	2			
FUTURE PLANS	3			
OUTSIDE INFLUENCES	2	2		
SELF-EXPECTATIONS	1			
NOT AN EXCEPTION		1		
FAMILY		1	1	
AVERAGE STUDENT		5		
FRIEND		1		1
GOOD SCIENCE STUDENT	3	2	2	3

Table 3.5

Descriptive Code Frequencies for Research Question One

Kyle

Date(s)	**Descriptive Code**
10/23 (2), 11/06	Raising hands
10/23 (2), 10/25, 10/28 (2),	Answering questions

10/31 (2), 11/01, 11/04 (4), 11/05	
10/25 (2), 11/06	Doing the work
10/25 (2)	Team/working together
10/28	Early science school experience
10/31	Analyzing information
10/31	Curious
10/31	Connecting home to school science
10/31	Smart
10/31	Minimizes peer compliment
11/01	Team leader
11/01	Helper
11/04	Recalling prior knowledge
11/05	Completed homework
11/06	Excited about the work

Mikel

Date(s)	**Descriptive Code**
10/8, 11/01	Helps friends/peers
10/8	Classroom helper
10/8	Distracted
10/8	refocused
10/23	Raising hands
10/23, 10/28, 11/04, 11/05	Answering questions
10/25(3), 10/31, 11/01	Doing the work
10/25, 11/01	Leading in a group
10/25	Working together
10/25	Seek teacher approval
10/30, 11/06	Movement
10/30	Curious
10/31 (2), 11/01	Quick worker
11/04, 11/06	Quiet
11/04	Recalling prior knowledge
11/05	Proud of self
11/05	Expressive

In Vivo coding was used to analyze the studenting interview transcripts to highlight the words of each participant in describing his beliefs about his science-student-self. Words or phrases in each transcript that stood out to the researcher were noted in numerical order (Saldaña, 2013). The In Vivo codes were typed into an excel spreadsheet and analyzed for recurring themes. An In Vivo code from the studenting interview that represented a science-student belief theme was used as the primary theme heading to maintain a focus on student voice. These In Vivo theme headings were then used as category headings for the descriptive codes from the field notes and observations I documents to answer the first research question. The coding results of the field notes and observations I were used to confirm or refute the themes identified by each participant in his studenting interview. Figure 3.1 displays an example of this coding process for Jay.

Figure 3.1

Example coding process for initial science-student beliefs (Jay)

I: Do you feel like you're a good science student?
Jay: Umhm
I: Yeah, why?
Jay: Because like, I'm not as talkative. And like sometimes quiet and still be able, be able to do my work and pay attention.

Descriptive Codes
Good Student(3); Silent (3); Focused (3)

In Vivo Codes
"I'm not as talkative" (D)
"Sometimes quiet" (D)
"Able to do my work" (C)
"Pay attention" (D)

Field Notes and Observations I

Date(s)	Descriptive Code	2nd round
10/23, 10/28 (2), 10/31 (2), 11/01, 11/04, 11/05 (2), 11/06	Doing the work	C
10/29, 10/30 (2), 11/04, 11/06	Off task	C
10/30	Quiet	D
11/01	Slow to complete work	C

The coding of the data sources were conducted manually for the first and second cycle of coding. The codes were typed into an Excel spreadsheet or a table to aid in analysis. The codes were then analyzed to identify any recurring themes regarding the beliefs that the Black male student participants had concerning their science-student-selves during the cells unit (Saldana, 2013).

To identify the normative scientific practices that Jay, Kyle, LT and Mikel experienced in his science classroom, within this specific rural context, multiple data sources were analyzed. Field notes and observations II, a normative practices observation tool, and card sort interview transcripts and photos were manually coded for pattern recognition (Saldana, 2013) and categorized based on the frequency of occurrence. The patterns used were the practices as listed in the *Framework* with the edits described earlier. The use of the practices as the patterns served to identify the scientific normative practices that occurred the most within the science classroom context. Additionally, the practices acknowledged by Jay, Kyle, LT and Mikel as practices that they experienced the most during the unit were also identified.

These codes represented the extended normative practices as listed in the *Framework* and in this study. The field notes and observation II, normative practices observation tool, and card sort interview transcripts and video served as primary data sources. Each data source informed the other and thus together answered the research question pertaining to the normative practices experienced by Black male students in a rural middle school science classroom. In order to achieve ethnographic validity

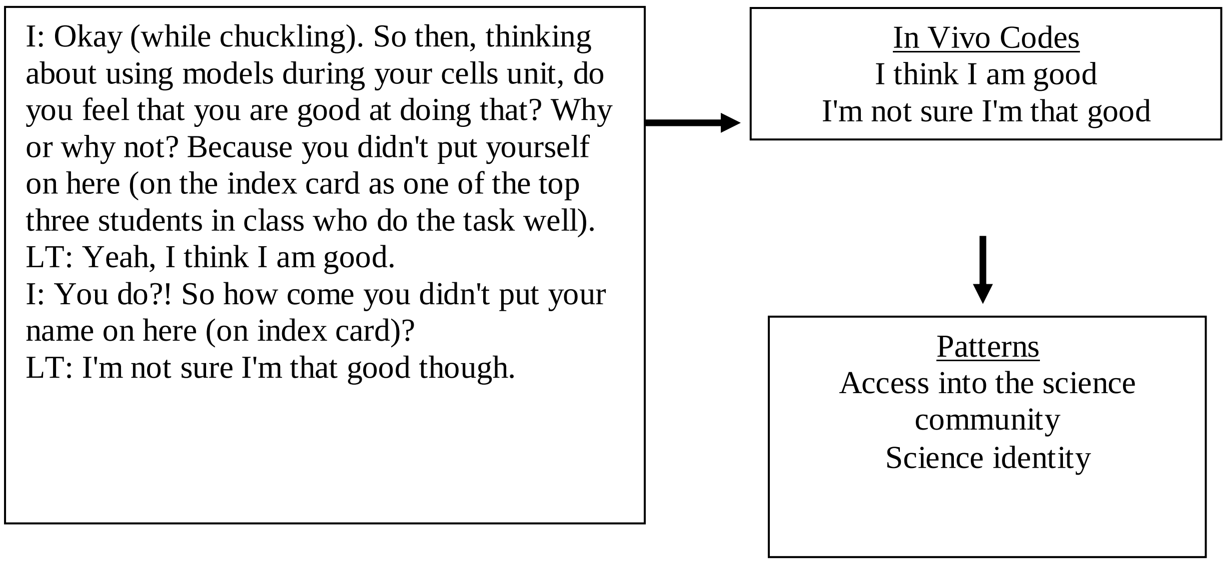
(Fetterman, 2010), triangulation of these varied data sources was utilized. The triangulation of data allowed for a data source to be used to confirm or not the findings from another data source.

Pattern recognition is a means of analysis used in ethnographic inquiry and case study inquiry. To achieve ethnographic reliability, identifying patterns and quantifying observed patterns within the data took place (Fetterman, 2010). A card sort interview was also conducted with Mrs. Sunshine at the end of the cells unit to provide another lens regarding the observed normative scientific practices that took place during a cells unit of instruction.

Attending to the third research question specifically addressed the beliefs Jay, Kyle, LT and Mikel had about their science-student-selves concerning the experienced normative scientific practices in their respective classroom. The field notes and observations III and the semi-structured interview responses informed this query. The audio-recorded semi-structured interviews were transcribed and the transcriptions served as the primary data source. The transcriptions were coded using In Vivo coding to highlight student voice. The In Vivo codes were compiled in an excel spreadsheet for each participant. Pattern coding was used during the second round of coding to identify patterns in student data pertaining to the themes related to the study propositions and theory outlined in the study research design. Student access to science, what students considered important, student science identity and student interactions within their classroom context were the patterns used to analyze the interview transcripts. As previously mentioned, ethnographic reliability was achieved by identifying patterns and quantifying observed patterns within the data (Fetterman, 2010). Figure 3.2 displays the coding process used for the student semi-structured interview transcripts.

Figure 3.2

Example of the coding process for the semi-structured interviews (LT)



Specific occurrences during the observation period were used during the semi-structured interview to provide examples of student actions or behaviors in response to the experienced normative practices.

Another lens was used to further analyze the data after the semi-structured interviews and the field notes and observations III were coded based on the four pattern codes. Social psychology thematic categories related to attitudes were used to further analyze the semi-structured interview and field notes and observations III data. The relationship between beliefs and attitudes influenced the selection of the categories of affect, behavior and cognitive processes to analyze the data (Eagly & Chaiken, 2007). The results of the first research question revealed that confidence, behavior and expectations were descriptors for the science-student beliefs held by Jay, Kyle, LT and Mikel. The pattern coding results for the data for the third research question revealed some aspects related to these notions of their science-student beliefs from the first research question but there seemed to be more that students were expressing pertaining to their affect, interpersonal behaviors, intrapersonal behaviors, and decision-making processes while engaging in the practices that they each identified as their top three practices. Therefore another level of analysis was conducted to answer the third research question. Intercoder reliability was employed at this stage to contribute to the reliability related to the categorization of the codes selected during the second round of pattern coding into the aforementioned attitude domains. Intercoder reliability in this study will be discussed in the following section pertaining to study trustworthiness.

The field notes and observations III were manually coded using the pattern codes identified above after the semi-structured interview transcripts were manually coded. The codes established in the interviews and in field notes and observations III were then typed into an excel spreadsheet and the associated normative practices identified during the analysis of the second research question were included. A sample of this coding process for LT is shown in Table 3.6.

Table 3.6

Field Notes and Observations III Pattern Coding with Associated Practices

Number	**Note/Observation (LT)**	**Associated Pattern**	**Practice (if applicable)**
1	LT is falling asleep as he is supposed to be completing tasks	SI	
3	LT got an 85% and said that he didn't even study once for his quiz. "I guess my memory capacity is" [getting better]...	SI (memory capacity)	

6	[LT was comfortable raising his hand to respond to question asked by MB again. Jay was completing the task yet, is quiet.]	A, SI	
8	Jay and LT copying down text from video screen where MB stopped the video to review cell theory. The place to write the info was at the bottom of the sheet.	A, CI	OI, CI, EI
9	LT's analogy: the filter of the air conditioner	A, SI	CI, E
10	LT: Like the air conditioner. The filter keeps the dirt and stuff from coming in and lets the clean air through.	A, SI	E

Note. Associated Patterns, (A) Access to science community; (SI) Science Identity; (CI) Considered Important; (SoIP) Social Interactions with Peers; (SoIT) Social Interactions with Teacher. Practices, (OI) Obtaining Information; (CI) Communicating Information; (EI) Evaluating Information; (E) Constructing Explanations.

The patterns were then analyzed based on the normative scientific practices experienced by Jay, Kyle, LT and Mikel. A summary of the processes of data analysis for the data collected in this study is shown in Figure 3.3, Figure 3.4 and Figure 3.5.

Figure 3.3

The Process of Data Analysis for Research Question 1

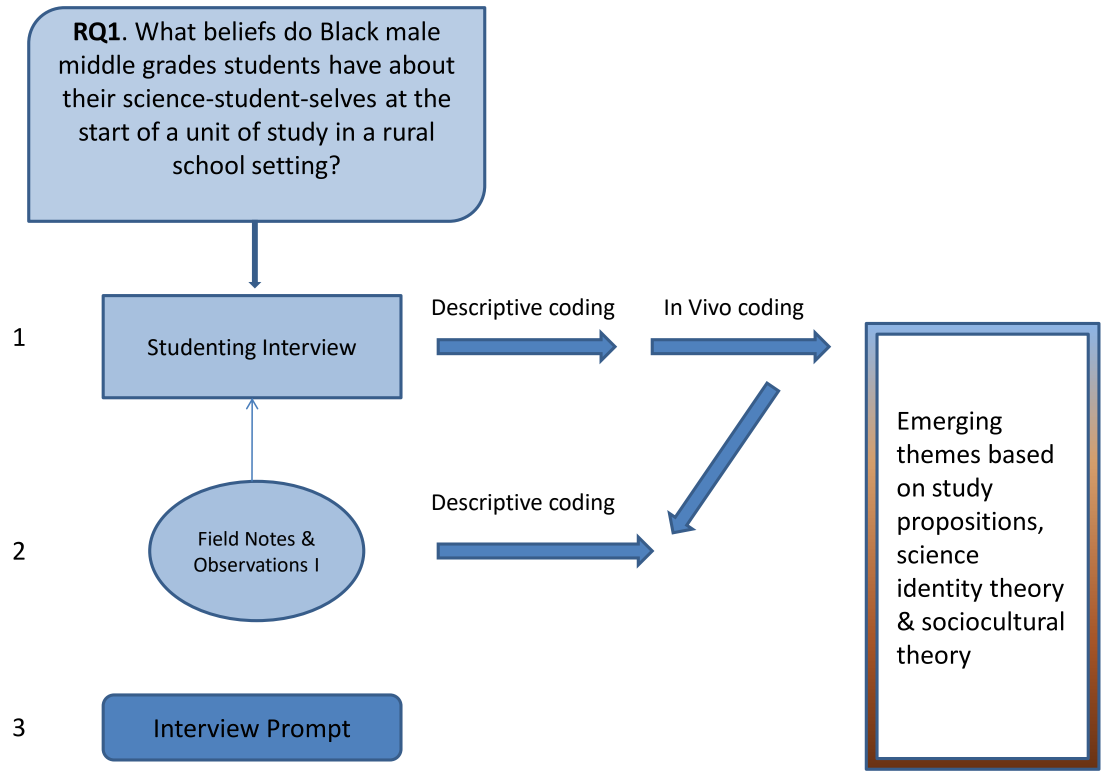


Figure 3.4

The Process of Data Analysis for Research Question 2

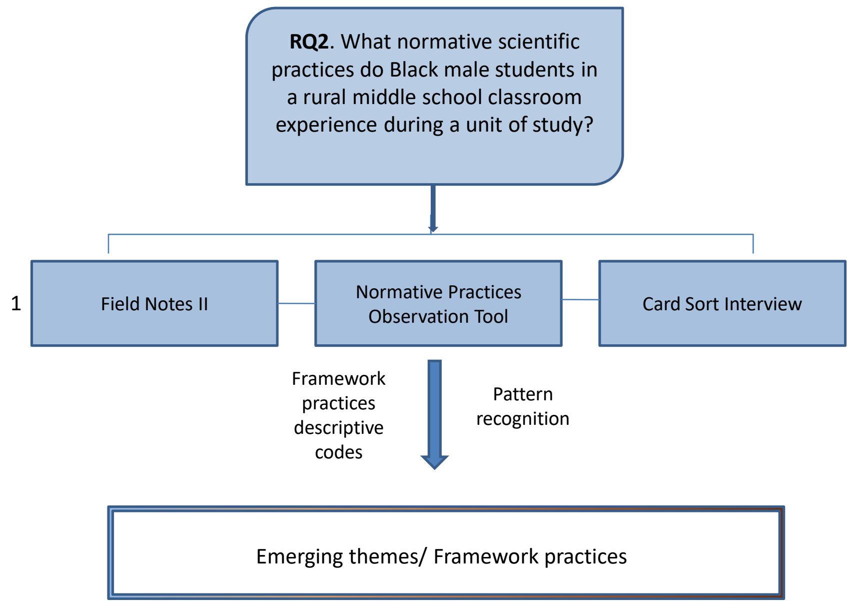
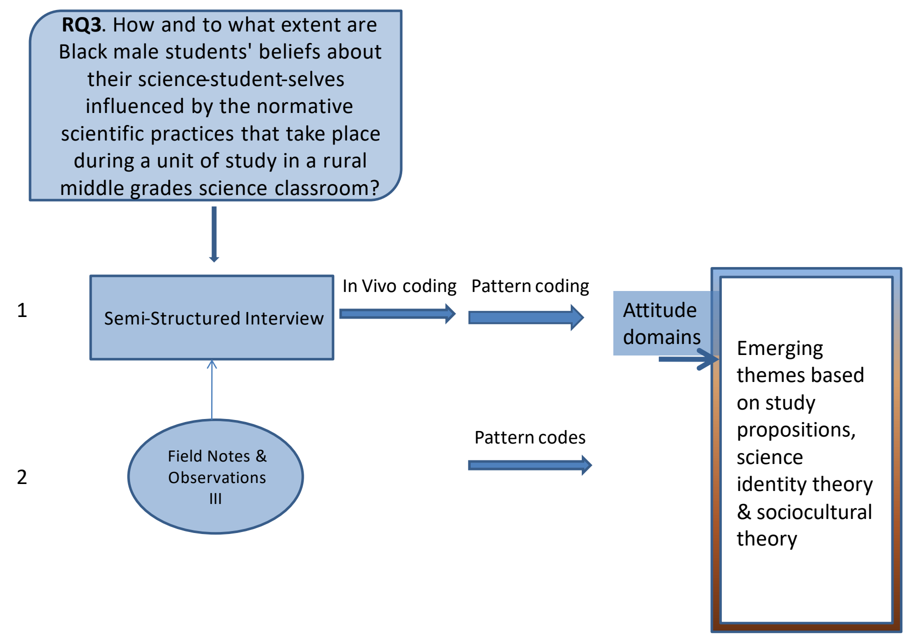


Figure 3.5

The Process of Data Analysis for Research Question 3



Measures of Trustworthiness

In qualitative research (including case study research) having a clear plan for one's research process contributes to the trustworthiness of the study. Such that the interpretations and findings of the study have merit when tested against criteria that speaks to the quality of the study (Glesne, 2011; Yin, 2014). Measures of trustworthiness within this case study, credibility, transferability, dependability, and confirmability, were addressed in the following ways. The credibility of this study was addressed by using explanation building as a data analysis technique. Additionally, using pattern coding and quantifying those patterns added to the study credibility by addressing ethnographic reliability (Fetterman, 2010). Explanation building as a reflection of the study's theoretical propositions provided a means of evaluating whether the findings may be believed to be true. In addition to credibility as a means of improving study trustworthiness, the ability to relate the present findings to another setting, transferability, can also increase the trustworthiness of a study.

Transferability

The transferability of the findings of this qualitative study is situated under what Margaret Eisenhart (2009) mentioned as appropriate generalizations for qualitative studies. Her position differed from that of Lincoln and Guba (1985) cited above. Eisenhart (2009) supported the notion of some scholars who state that it is appropriate to make generalizations from the findings of qualitative inquiry. Contrary to this view is the position that the purpose of qualitative research is not to make explicit generalizations at all (Polit & Beck, 2010). The rational for generalizations drawn from the findings of this study, gleaned from Margaret Eisenhart (2009) and Harry Wolcott (2005), is that there are appropriate types of generalizations suited for a given research study. In this study, generalizations were made with regard to the types of normative scientific practices that took place in two middle grades science classrooms and the science-student beliefs that four Black male students had regarding the normative scientific practices they experienced in those classrooms. Such generalizations were based on similarities between these contexts and other science classroom contexts and the related beliefs of Jay, Kyle, LT, and Mikel and their science classroom learning experiences. These research findings provided additional insight into the lived science classroom experiences of four Black male students and students in general.

Dependability

The dependability of the findings of this study relied on a clear procedure, a clear chain of evidence, and providing the interview questions used with the participants. This process contributed to making this study one that can be reproduced. Lastly, in an effort to increase trustworthiness, confirmability was achieved through the inclusion of a case study protocol, a researcher subjectivity statement, and member checking. Member checking occurred with the use of the card sort interview (Carlone, 2012). The results of the participant selections during the card sort interview confirmed (or not) the researcher observations regarding the most important practices that occurred during the cells unit of study. Including the case study protocol showed that the thoughts and ideas for the study were established before the fieldwork began. Additionally, a subjectivity statement, included in chapter one, clearly acknowledged the potential biases that the researcher possessed prior to conducting the study. These biases could have informed the interpretation and reporting of the findings. The above outline was fulfilled to achieve trustworthiness in this study, specifically attending to measures of the credibility, transferability, dependability, and confirmability of the study findings.

Intercoder reliability

As previously mentioned, intercoder reliability (ICR) was used to address the reliability of the categorization of the In Vivo codes into attitude domains conducted by the researcher. Although intercoder reliability within qualitative research is a topic of contention and not commonly included in qualitative studies (MacPhail, Khoza, Abler, & Ranganathan, 2016; O'Connor & Joffe, 2020), for the purposes of this qualitative study it was employed as an additional measure of study trustworthiness. ICR is defined as "a numerical measure of the agreement between different coders regarding how the same data should be coded." (O'Connor & Joffe, 2020, p. 2). Within this study, ICR provided a way to confirm the reliability of the way the primary researcher categorized student participant In Vivo codes within the four attitude domains of affective, behavior-interpersonal, behavior-intrapersonal, and cognitive. These domains served as the themes used to describe how the normative practices experienced by Jay, LT, Kyle, and Mikel influenced their enacted beliefs pertaining to their science-student-selves.

Jay's semi-structured interview In Vivo codes were analyzed in context by the primary researcher. The codes that were placed into the pattern code groupings of access to science, what students considered important, student science identity and student interactions were categorized into one or more of the four attitude domains. This procedure was explained to the second coder, an assistant professor of Educational Psychology. The educational background of the second coder included cognition, affect, psychological testing, and personality. The educational background and area of expertise of the second coder influenced the selection of the second coder for the measure of ICR for this study.

The first and second coders categorized Jay's semi-structured interview In Vivo codes on their own. The first coder stopped categorizing codes after the first five codes and the first coder (designated by a 1) and second coder (designated by an X) category selections for each of the first five codes were analyzed for differences and understanding of the thought process for category selection, see Table 3.7. The measure of agreement for each selected category was calculated. This resulted in a ICR score of 71.4%.

Table 3.7

Intercoder Agreement Comparison for Five InVivo Codes

In Vivo Code (Jay)	**Intercoder 1**					**Intercoder 2**						**If 2, 1 in**
	A	**B**	**C**	**D**	**N/A**	**A**	**B**	**C**	**D**	**N/A**	**Agreement**	**agreement**
We have to get information to like do projects and stuff				1			X		X			1
You're not gonna know what the information is				1					X		1	
Bored	1					X			X			1
I don't feel like doing all of it	1					X					1	
You have to figure out the information				1					X		1	
											Total Scores=	7
											Total Agreement=	5
											% agreement=	71.4

Note. A= affective; B= behavior-inter ; C= behavior-intra; D= cognitive

The coders verbally discussed the two In Vivo codes that had one point of agreement out of two total points of agreement selected. This discussion revealed that the first and second coders' educational backgrounds, areas of expertise, and scholarly biases influenced their category selections for each In Vivo code. For example, the code "bored" was understood as a feeling, thus both coders categorized it as affective. However, the second coder also believed that "bored" can be a feeling that manifests in body or mind, where being bored is a reflection of an unsettled mind. Therefore, the second coder also selected cognitive as a category for this code. These recognized differences in the thought processes and thus the way the categories were chosen for each code, and being able to choose more than one category per code, led to calculating intercoder reliability as any measure of agreement by both coders for each In Vivo code. Each In Vivo code was identified as a "data unit" and therefore agreement on each data unit was calculated (O'Connor & Joffe, 2020, p. 2).

The first coder used the analysis and understandings of the first five codes to categorize the remaining In Vivo codes for Jay's interview. The categorical results for the first and second coder were compared in Table 3.8 and the ICR score was calculated as 83.1%.

Table 3.8

Intercoder Reliability Percentage Agreement

In Vivo Code (Jay)	Intercoder 1					Intercoder 2					Total scores	Data Unit of Agreement
	A	**B**	**C**	**D**	**N/A**	**A**	**B**	**C**	**D**	**N/A**		
We have to get information to like do projects and stuff				1			1		1		1	1
You're not gonna know what the information is				1					1		1	1
Bored	1					1			1		1	1
I don't feel like doing all of it	1					1					1	1
You have to figure out the information				1					1		1	1
You'll probably get an 'F'				1						1	1	0
They're always the first one's to answer questions		1		1			1				1	1
In the middle				1						1	1	0
I can easily find information			1	1				1	1		1	1
I know what page it is				1					1		1	1
I don't know				1					1		1	1
I don't know				1					1		1	1
They're always like "how did you already finish"		1		1			1				1	1
I don't know				1					1		1	1
Be more fun	1					1					1	1
More entertaining	1					1					1	1

We would be making models then actually doing it		1		1		1		1	1	1
More entertainment	1				1				1	1
I would have something to entertain me	1			1	1			1	1	1
Fun	1				1				1	1
Bored	1				1			1	1	1
You have to communicate with your group		1		1		1		1	1	1
Write like what the protists and cells look like				1				1	1	1
We were supposed to draw		1						1	1	0
I used to like to draw			1		1				1	0
It don't really mean nothing to me	1			1	1				1	1
Boring	1				1				1	1
Like draw protists			1				1		1	1
I been raising my hand			1				1		1	1
You'll probably get an 'F'				1				1	1	1
You have to like figure out on your own				1				1	1	1
Communicate with people in your group		1		1		1			1	1
To help you		1		1			1		1	0
Find answers				1				1	1	1
They all like to talk a lot		1		1		1			1	1
They like to research		1		1		1			1	1
I know how to communicate	1							1	1	0
They'll know it but they won't really say it		1		1		1			1	1
They'll be quiet		1				1			1	1
Speak up louder		1					1		1	0
I don't know				1				1	1	1

I do a lot of talking			1					1	1		1	1
We all communicate well		1		1			1				1	1
We like to talk in a group		1		1		1	1				1	1
I don't know				1					1		1	1
I'm always like the first one or second one finished			1	1			1		1		1	1
We still have to have the evidence		1		1			1		1		1	1
I already know where to find it			1						1		1	0
It's in my notes				1					1		1	1
You probably wouldn't find the right answer				1					1		1	1
You just wrote a random answer down				1				1			1	0
The evidence shows that you actually have researched it			1	1				1			1	1
You looked for it			1	1				1			1	1
They can find information fast		1		1			1				1	1
They don't like talk too much		1				1	1				1	1
I'm good at finding information			1	1		1			1		1	1
They finish it but they wouldn't have the evidence		1					1		1		1	1
I could have the evidence			1	1						1	1	0
I do the most searching			1			1		1			1	1
	11	**18**	**12**	**39**	**0**	**15**	**17**	**10**	**29**	**3**		
										Totals:	59	49
											% Agreement=	83.0508475

According to Graham, Milanowski, and Miller (2012), a general guide for most areas of study is a measurement of at least 75% agreement between coders. Using this guide, the procedure used to categorize the In Vivo codes into the four attitude domains was reliable. After the calculation of ICR, the first coder used the same procedure to complete the analysis for the semi-structured interviews for Kyle, LT and Mikel.

Although ICR provided support for an aspect of data analysis for this study, if this were to be conducted again the following items should be addressed. Clear definitions and boundaries for each attitude domain should be established before codes are categorized by each coder. Include an odd number of coders to help identify any tendencies toward one way of understanding versus another. Lastly, include coders from diverse backgrounds. Increased diversity among coders would provide a wider lens regarding the interpretation of codes in a similarly designed research study.

CHAPTER FOUR

RESEARCH FINDINGS

Data were collected to attend to the three research questions for this study. 1) What beliefs do Black male middle grades students have about their science-student-selves at the start of a unit of study in a rural school setting? 2) What normative scientific practices do Black male students in a rural middle school classroom experience during a unit of study? and 3) How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a unit of study in a rural middle grades science classroom? The data sources for the first research question included researcher field notes, classroom observations and the studenting interview. Field notes, the normative practices observation tool, and the card sort interview were the data sources for the second research question. Lastly, a semi-structured interview, field notes and classroom observations were the data sources for the third research question. This chapter will address the findings of this study for each research question.

As iterated in chapter one, highlighting student voice was a priority for this research study. Therefore, in alignment with Emdin (2012a) and Brand, Glasson, and Green (2006) this chapter discusses the findings of each student participant individually and then provides a cross case comparison of the findings for Jay, Kyle, LT and Mikel. This structural formatting privileges the science learning experience of each study participant. Additionally, this formatting speaks to the general science student beliefs held by four Black male middle school students in a rural school context.

Black Male Student Beliefs About Self

At the beginning of the science unit on cells, Jay, Kyle, LT and Mikel completed a studenting interview through which each participant was able to share his thoughts about himself as a student in general and as a science student, in particular. Eight studenting interview questions were posed to each participant (See Appendix B). As previously mentioned, Jay, Kyle, LT and Mikel were also given the science drawing task as a prompt and their responses were recorded in Table 3.2. Their responses to the prompt and the initial four days of classroom observations influenced the decision to ask them if they wanted to participate in this study. Each student collected the white sheet of paper to complete the task but chose not to complete the task. The field notes and observations from the first twelve days of the observation period were recorded in a single document and analyzed together. The findings from the studenting interviews and the field notes and observations I are noted in the following sections for each participant, see Appendix F and G for coding data for these two data sources. In Vivo codes from each participants' studenting interview were used as category headings. The In Vivo codes used were specific to each student and his interview in order to maintain a focus on the individual voice of each student as he described himself. The summary at the end of this section will provide context regarding the similarity and/or differences between the In Vivo codes for each student.

Jay: Studenting Interview

Four out of forty-five In Vivo codes from Jay's studenting interview were used to describe his beliefs about his science-student-self at the start of the cells unit (see

Appendix H). The four codes represented the major themes that emerged about how Jay described his science-student-self. Jay stated that he enjoyed projects and working on interesting things, he liked to draw, he does the work that he is instructed to do and that he is not as talkative as he could be. These descriptions were represented by the four In Vivo codes. His science-student self is described by what he enjoys about science, what he does in science class, and his behaviors in class.

"I Like Working on Interesting Things"

Jay expressed that he enjoyed science. "I like projects and stuff like that and working on interesting things." Three times during his interview, Jay mentioned that he enjoyed projects. His interest in animals and being able to figure things out, essentially problem solving, were also part of how he described his science-student self. Part of what appealed to him in doing projects was that he was able to be creative.

"I Like to Draw"

Jay shared that he thought that Mrs. Sunshine saw him as a creative person. He said, "I like to draw and make new stuff. Showing what I'm talking about... like colorful." He believed that this creative aspect of his science-student identity was visible to his teacher. The work that Jay completed in class was also something that he believed was visible to others in his classroom.

"I Do My Work"

The response that Jay gave about how his peers see him as a science student was first, "I don't know" and after giving him time to think about it he commented, "that I do my work." Jay's explanation was that, "... because like I'm used to answering questions all the time like that." Doing his work included communicating answers to questions asked by Mrs. Sunshine in class. This practice was visible to his teacher and his peers. Jay expressed that paying attention in class and doing the work assigned to you were important aspects of being a science student.

"I'm Not as Talkative"

Jay also noted that a good science student should not be too talkative. He said that a good science student, "[l]ike they can talk but not be too talkative. But um, pay attention, be able to do their work." He then described himself as a good science student because "I'm not as talkative. And like sometimes quiet and still be able to do my work and pay attention." According to Jay, these behaviors, paying attention and not being too talkative were important aspects of being a good science student. Although Jay expressed these beliefs in his interview, the initial field notes and classroom observations showed a different version of how he enacted these practices.

Jay: Field Notes and Observations

Jay liked working on interesting things in class, drawing, doing the work that he was assigned and not talking too much in class. During the initial classroom observations for this study Jay was observed doing the opposite of some of these practices. His practices displayed a somewhat different type of science student. Eight of the nine descriptive codes that came from field notes and observations I were categorized into one of three In Vivo codes from Jay's studenting interview (see Appendix I). This process served to identify the observations by the researcher that supported or negated how Jay described himself. There were no field notes or observations applicable to the In Vivo code "I like working on interesting things." The frequency of occurrence of the descriptive codes within field notes and observations I were also identified. The remaining descriptive code was coded into a category that falls outside of the scope of this current research study. Therefore only three of the four In Vivo codes will be referenced in this section.

"I Like to Draw"

Jay mentioned his affinity for drawing in science class. The singular instance that was noted in the initial classroom observations of Jay drawing spoke to his creation of an onion cell drawing. Jay and his classmates were tasked with drawing the onion cells as seen under the microscope. Jay completed this task as expected with his own details regarding the look of the onion cell under the microscope.

"I Do My Work"

During the microscope protists lab Jay worked as a team member in his lab group. He engaged in the work that he was tasked to complete with his lab group members. Jay was observed on ten different occasions during the initial observation period doing the work that he was assigned. However on one occasion he was slow to complete his work. Jay was noted five times to be off task during this initial observation period. It was also referenced that he did not complete one of his homework assignments. There were times that Jay did his work and there were times that he did not complete his work as instructed.

"I'm Not as Talkative"

The amount of talking that Jay did that was captured in the field notes and observations I was minimal. On October 30th Jay was sitting in a different seat in his group and was especially quiet at the time of the observation. Two days prior to this Jay was reprimanded by Mrs. Sunshine for being mischievous while working at the lab station with his group. Mrs. Sunshine warned the group that they would get a referral if they touched or pulled on a cord attached to the eye wash station in class. Jay's observed behavior was sometimes aligned with how he described a good science student and sometimes it was not aligned with his description.

Kyle: Studenting Interview

Four of the forty In Vivo codes from Kyle's studenting interview were used to describe his beliefs about his science-student-self at the start of the cells unit (see Appendix H). Kyle stated that he likes to be able to learn new things. He can be a good student and a good student can possess talents that go beyond science. He also brought in the notion of emotions toward being considered a science nerd. His science-student self is described by his enjoyment of science topics, especially marine life, the range of qualities pertaining to being a good student and the internal battle that occurs if you are good in science.

"I Like to be Able to Learn New Things"

The inquisitive nature of Kyle was displayed early in his studenting interview. When describing himself, Kyle expressed his enjoyment of going to zoos and aquariums with his family because "[i]t's like a different experience." He was able to "study animals" and "discover new things" when on these vacations with his family. Therefore, Kyle's statement "I like to be able to learn new things" accurately depicts his science-student self. When asked to describe himself as a science student, Kyle responded, "I like to study animals and how they work and function and other things. But I really like marine life." When referencing things in class that he also would enjoy, Kyle mentioned "hands-on learning," "dissecting things," and "finding out how frogs work." His interest in science and discovering new things as a science student was evident during his studenting interview.

"I Can Be a Good Student"

As a student at RMS Kyle stated, "I feel like I can be a good student." He didn't always think this way about himself as a science student. "I didn't really like science, but now, now I see the things that you can do in science. It's like, I like it more. And I can make better grades on the stuff I do." In this statement Kyle expressed that his perspective about the utility of science changed and thus his interest in science and his academic performance in science also changed. Kyle's academic performance in science may have changed because of a shift in the way he viewed the usefulness of his science skills and scientific knowledge but the perceptions of others also influenced how he saw himself as a science student.

"Talents in Them"

Kyle spoke of his perceptions of the views held by his teacher and peers regarding him as a science student. Kyle felt that his teacher thought of him as "like a regular student." His idea of a regular student was described as "[t]hey can have talents in them, but sometimes it's not particularly in like science or something. Like other things, like music or sports or something." In addition to being considered an average student by his teacher, Kyle felt that his peers viewed him "as like a friend that knows how to work and focus on school like with science." "I could help them or they could help me or something." The social interactions described by Kyle were mutually beneficial with regard to his and his peers' science learning environment. Kyle also articulated some form of conflict that may exist in him related to peer perceptions of his science self.

"Don't Wanna Show Their Emotions"

Kyle expressed positive social interactions between himself and his peers in science but he also stated, "[i]t's like keeping quiet about something, but they could be like really good at science. But it's like when they get good grades and stuff they don't want to feel like such a nerd against their friends or something." This view is in contrast to Kyle being the friend who knows how to work, focus in science and help his fellow science classmates. Kyle did not explain this in first person language, he positioned it as a someone else. This choice may be explained by the following statement spoken by Kyle.

> "... but you can see all these other groups of people like talking about science and stuff and wanting to like learn more. But you want to learn more and go in that same group but you don't want other people talking behind your back about it." (10-23-19, p. 5)

To some degree, Kyle may have been trying to hide his emotions about his science-student identity to avoid encountering negative reactions from his peers. The field notes and observations of Kyle during the first part of the study seemed to support his expressed beliefs about his science-student-self.

Kyle: Field Notes and Observations

Kyle liked to be able to learn new things. He considered himself a good student who possessed talents in science and amongst his peers. However, he also verbalized an internal conflict that may have existed in himself regarding being good in science and being viewed by his peers as a nerd. During the initial 12 classroom observations for this study Kyle displayed actions that supported his descriptions of his beliefs about his science-student-self. All fifteen descriptive codes were categorized under one of the four In Vivo codes from Kyle's studenting interview mentioned in the previous section (see Appendix I). This process served to identify the observations by the researcher that supported or negated how Kyle described himself in his studenting interview.

"I Like to Be Able to Learn New Things"

In class Kyle showed that he was excited about the work that he was doing in science class. Students were creating a graphic organizer to help them gather and organize evidence to create their argument for helpful versus harmful bacteria. Kyle yelled out, "ohhh, this is fun!" He also found connections between his home life and school when he stated during the protists notes-labeling session, "Oh, yeah that was on Spongebob." Kyle noted that one of the characters had one. He seemed to be working to make connections with what he was doing in science class and what he either understood or was learning about outside of school.

Kyle's curiosity and tendency to analyze the information given to him by Mrs. Sunshine during instructional periods was seen during a lesson introducing protists. Kyle commented after Mrs. Sunshine wrote the term photosynthetic on the notes sheet being projected on a screen, "It's gonna have light because of the 'photo'." He continued to engage during this class session by asking Mrs. Sunshine, "Are we going to see germs?" He asked this after seeing the euglena that Mrs. Sunshine was labeling on the notes sheet. Kyle showed through asking questions and analyzing information provided by his teacher that he was interested in learning new things. His practice of asking and answering questions were aspects of being a science student in this context that classified him as a good student.

"I Can Be a Good Student"

Kyle raised his hand to answer questions asked by Mrs. Sunshine regularly. During the initial observation period, Kyle was observed answering questions thirteen times over the course of seven observation days. He was observed consistently completing the work assigned to him. When Mrs. Sunshine asked students on a particular day, who completed their homework, Kyle raised his hand. Kyle also showed his good student character during a class session on cell theory. He was able to recall prior knowledge pertaining to information obtained during a cell theory scientists video assignment. Kyle showed that he could be a good science student in this context and that he possessed other qualities beyond knowing scientific content.

"Talents in Them"

In his science class, Kyle was observed working well with his group members, being a leader when completing group tasks and helping his group when they were in need of additional help. Students were assigned to use microscopes to identify, draw and label protists. Kyle seemed happy to try and find the different protists during this lab session. He led his group in this task and asked for help when needed, so that his group could accomplish their lab assignment. Kyle was seen to be fully engaged in his science learning context.

"Don't Wanna Show Their Emotions"

Although Kyle was engaged in his science learning context, asking and answering questions correctly and working well in his lab groups he still seemed to possess some measure of insecurity concerning his science-self being acknowledged by his peers. Mrs. Sunshine paused during an instructional period discussing protists to talk with the class about their increasing scientific knowledge and their new and improved vocabulary knowledge. A student in Kyle's class yelled out, "Kyle's smart." Kyle responded, "Not really, it's just common sense." Kyle quickly minimized his peer's compliment about his science knowledge and science-self. He may have been embarrassed to be identified as a smart science student in front of his friend's in the class. His peer's comment was loud and shared with the entire class. This classmate was not a student who Kyle sat with at his lab station or who he interacted with as he did with his friends in the class. At this stage of the study, Kyle displayed his interest in learning new things, his talents in science and in teamwork and his sensitivity to peer acknowledgement of his intelligent science-self.

LT: Studenting Interview

Three In Vivo codes from LT's studenting interview were used to describe his beliefs about his science-student-self at the start of the cells unit. LT steadily answered questions posed by Mrs. Sunshine. His ability to recall new information and prior knowledge came easily and he described this ability casually by saying that "... there's these questions I know." According to LT, his ability to recall information is because "sometimes I remember." He references his notion of memory capacity and its influence on his responses in class and his performance in his science class. Lastly, LT enthusiastically described himself as a good student because "I got the silence thing on lock!" LT's communication skills, his knowledge and his practice of being a quiet student were the ways he described himself as a science student.

"Questions I Know"

LT stated that "... there's these questions that I know, that sometimes I raise my hand." He found himself knowing the answers to questions asked by Mrs. Sunshine in class about the science content and choosing to communicate his answer aloud in class. However, although he described his science-student self as a communicator, with some reservation LT stated, "okay, so I think that I'm good at [science] but I don't think I'm good at [science] at the same time. So like it's kind of mixed." His beliefs about his abilities to perform well in science were mixed because of how he felt he performs when given new information.

"Like in class we were learning about something new. So like, I'm completely lost." His feelings about not completely understanding new information created uncertainty in his science-student abilities. This measure of reservation concerning his knowledge and skills continued when LT was asked about how he felt about the new cell theory scientists information. He responded, "I kind of understand it but then when we go deeper it gets a little bit confusing, but then I learn more." He also stated "I kind of know the vocabulary." At this stage of the study LT was describing the dualistic nature of his science-self. He later communicated that this duality was due to the scope of his memory.

"Sometimes I Remember"

LT stated "certain things jog my memory... and sometimes I try to think of something and then jog my memory... I have to get my memory capacity up so that I can be like a science student, a good science student." This sentiment about his memory came up twelve times during the studenting interview. LT attributed his ability to answer questions and recall prior knowledge to his capacity to remember things. "Something triggers in my brain to make me remember." LT believes that his brain works in a way that helps him to remember some things and when he doesn't remember then he is not able to answer science content questions. He then feels that he is not a good science student when this happens. Although LT spoke frequently about his memory capacity and his propensity to answer whole-class science content questions, he also mentioned his tendency to be a "kind of quiet student."

"I Got the Silence Thing on Lock!"

LT commented that he can be a good student at RMS because "I got the silence thing on lock!" He described himself as "that silent type of student that you know doesn't talk." This quality was highlighted as being a positive descriptor of a good student and a good science student. His thoughts on how his teacher and peers view him was also as "that quiet type" of student. However, with regard to how Mrs. Sunshine might view him as a science student he felt that she might think of him as a "kind of quiet student but not really that quiet." Which may speak to some awareness of his propensity to regularly answer questions asked by Mrs. Sunshine in class. This awareness was reflected in the researcher field notes and observations. There were not any notations of LT being a quiet student in his science class.

LT: Field Notes and Observations

Using the field notes and observations for the first twelve days of classroom observations supported LT's studenting interview results that described his ability to answer questions and remember scientific information. The field notes and initial observations did not support his notion of being a quiet student. His propensity to raise his hands to answer whole-class questions were noted during this observation period. Eleven descriptive codes resulted from the first round of analysis and nine of these codes were categorized into "questions I know" or "sometimes I remember." The remaining two codes described LT's personality not his beliefs about his science-student-self. LT was observed returning a writing utensil to its owner. This gesture was labeled as a display of his considerate personality. LT also used humor, unrelated to science content, in class. This was also noted as an aspect of his personality.

"Questions I Know"

LT was observed regularly completing the work that he was tasked with completing during the initial observation period in class. He raised his hand to answer whole-class questions asked by Mrs. Sunshine. He asked for help when needed and took ownership of getting his work completed in class. When students were tasked with obtaining information via watching a video on bacteria, LT revisited his Know-Want to know-Learn (KWL) chart and made adjustments to his K column. LT's memory and ability to recall knowledge was also observed during the initial observation period for this study.

"Sometimes I Remember"

Mrs. Sunshine asked the entire class, "Does anyone know what pathogen means?" The students had not been introduced to this vocabulary term. LT repeated the word pathogen multiple times as if to try and recall what he could remember about the word pathogen. He was not able to recall the definition. During this observation period I noted five times that LT seemed sleepy. He would have his eyes closed or his head would drop. His sleepiness could have attributed to his ability to recall information during class time.

Mikel: Studenting Interview

Mikel's beliefs about himself as a science student at the start of the cells unit were mixed. Three In Vivo codes seemed to encompass his expressed range a feelings in his science class. Mikel's statement that "now we gotta write" highlighted the changes that he was experiencing now that he was in seventh-grade science. These were changes taking place with regard to work demands in his science class. However, even though he stated that science was getting harder for him, he was still experiencing success in his seventh-grade science class and he said, "I brag to students" when he would do well on minor grade science assignments. The fact that he was proud about getting good grades in his science class at the same time that science was getting harder seemed to be influenced by varied expectations. Mikel said that there were "a lot of expectations." He mentioned his thoughts on how he was perceived by his teacher, his peers and himself. The perceptions of the people in his life and Mikel himself, were important to him. He did not want to disappoint his Mom or the teachers who cared about him. This code spoke to the perceived external expectations of self and others on who Mikel should be as a student in general and as a science student, in particular. These three In Vivo codes from Mikel's interview provided a picture of who Mikel was as a science student.

"Now We Gotta Write"

Mikel commented that "it [science] used to be my favorite subject but like it's gotten harder and it's not interesting no more." He expressed the way that science has gotten harder for him is that "now we gotta write." Mikel was expressing how his experiences in science classes prior to this first semester of seventh-grade were different. This difference led him to mention four times that science has gotten harder for him. He said, "like it's [science is] cool, but I don't like it." "Like the lower grades like fifth, fourth, I'm used to doing hands-on stuff like every day." The performance expectations in his current science class required him to write more instead of having more hands-on experiences. Although he was feeling that science was getting harder he was still getting good grades in science.

"I Brag to Students"

Mikel was getting good grades and in that excitement he said that sometimes "I brag to the other students, but like not to make them feel bad." His bragging reflected if he got an A on a science minor assignment. He would brag to his friends. Mikel showed a confidence in his abilities to perform well in his science class. This measure of confidence at the start of the cells unit seemed to be influenced by self-expectations of what a good science student should do and the perceived expectations that others had about him as a science student.

"A Lot of Expectations"

Two responses from Mikel, "I hope she think I'm good" and "I hope they think I'm a good student" speak to what he wanted the perceptions of his teacher and his peers to be regarding him as a science student. Mikel stated that a good science student should be "[l]ike into science, like take notes, study them over the night, then come back, get an A on their test and then brag to the other students." In this statement he expresses that there are expectations that he has in his mind regarding what a good science student should look like. Although he stated in his studenting interview that science isn't his favorite subject anymore, he still expresses a desire to "get good grades" in his science class and meet the expectations of himself, his teacher, and his peers.

Mikel: Field Notes and Observations

The field notes and observations of the first twelve days of the cells unit were analyzed to address how Mikel enacted his science self at the start of the unit. The seventeen descriptive codes were categorized using the three In Vivo codes from the studenting interview transcripts mentioned above. Thirteen of the seventeen codes were categorized during the second cycle of analysis. The remaining four codes were not applicable to the three In Vivo codes. How I recorded and observed Mikel enacting his science self will be described below.

"Now We Gotta Write"

Although Mikel noted multiple times in his studenting interview how much harder science was becoming, the field notes and observations showed the opposite regarding his level of engagement and actions in class. Mikel's notion of a change in the performance expectations in his seventh-grade science class impacting how he felt toward science was only noticed once during the twelve initial observation days. Prior to the start of the cells unit, when the students were working on their ecology unit, I noted how Mikel was distracted from the work and had to be encouraged to refocus. After the cells unit started Mikel was engaged and recalling prior knowledge when Mrs. Sunshine asked whole-class questions. During the cell theory scientists review, Mikel recalled quickly the microscope scientist who "looked at bacteria on teeth." He recalled this knowledge without having to look at his notes from the previous class period. His confidence in his abilities to perform the instructed tasks and engage in class discussion were visible during the start of the cells unit.

"I Brag to Students"

His confidence in his abilities was visible in the way in which Mikel completed the tasks expected of him in class quickly and as instructed. One morning Mrs. Sunshine asked who completed their homework and Mikel proudly yelled out that he did his homework. He did the work as instructed and during whole class discussion or question and answer periods would raise his hands and answer questions posed by Mrs. Sunshine. Mikel was observed raising his hands and answered questions seven of the twelve initial observation days. On two occasions Mikel was also observed taking ownership in his lab groups. Students were working on a cell theory scientists project and Mikel took lead of the project and eventually he was doing all the work. A few days later, while using the microscope to identify protists, Mikel took more responsibility working in his group. Sometimes seemingly taking jobs from his other two lab mates. He seemed excited about the hands-on work and being able to work in groups. The field notes and observations also showed how Mikel's confidence and actions were influenced by his teacher and peers.

"A Lot of Expectations"

The cell theory scientists project was an example of Mikel seeking out the approval of his teacher Mrs. Sunshine. Mikel brought his group's completed timeline to Mrs. Sunshine to get her to comment on their work and he then asked her what was next. Regarding his interactions with his peers, his actions supported his studenting interview statement that he wanted to be seen as a good student by his peers. During the microscope protists lab, Mikel went to another group to help them locate the protists under the microscope since he was able to locate the organisms at his own lab station. Mikel also served as a classroom helper prior to the start of the cells unit. His social interactions with his teacher and peers showed how important their perceptions of him as a science student were to him. This section provided a baseline for how Jay, Kyle, LT and Mikel saw his science-student-self at the start of the cells unit. The next section of this chapter will report the findings regarding the normative scientific practices that were experienced and observed taking place during the cells unit.

Cross-Case Summary

Although Jay, Kyle, LT and Mikel expressed their science self in their own words, as seen in Table 4.1, there were two themes that emerged to describe their collective beliefs about their science-student-selves. One additional theme was observed to describe an aspect of Mikel and Kyle's science-student-selves.

Table 4.1

Individual Student Beliefs

Jay	**Kyle**
(A) "I like working on interesting things"	(A) "I like to be able to learn new things"
(B) "I like to draw"	(B) "I can be a good student"
(C) "I do my work"	(C) "Talents in them"
(D) "I'm not as talkative"	(D) "Don't wanna show their emotions"
LT	**Mikel**
(A) "Questions I know"	(A) "Now we gotta write"
(B) "Sometimes I remember"	(B) "I brag to students"
(C) "I got the silence thing on lock"	(C) "A lot of expectations"

All four boys expressed a confidence in their abilities as a science student. They also voiced that behavior mattered in how they conceptualized their science-self. Additionally, Mikel and Kyle emphasized that his science-self was based on his self-imposed expectations of himself and/or the expectations of others.

I Have Confidence in My Abilities as a Science Student

Jay, Kyle, LT and Mikel each shared that there were certain things that he knew about himself and his abilities as a science student. Similarly, Jay and Kyle knew that they possessed an interest in learning about what they described as interesting things in science. Jay liked working on projects and drawing in his science class. It was because of his interests and his choice to pay attention and do his work in his science class that he said he believed that he was a good science student. Kyle liked to learn about animals, especially marine life and to "discover new things". These interests contributed to Kyle having a growing affinity toward science and thus he believed that he was also a good science student.

LT knew that he could oftentimes remember science content and would subsequently answer science content questions that Mrs. Sunshine would pose to the entire class. He expressed that there are "these questions I know, that sometimes I raise my hand...". When he knew the information, LT felt that this reflected his ability to be a good science student. Differing from Jay and Kyle, LT felt that when he didn't know the science vocabulary or content then he wasn't a good science student. He was the only student who verbalized this idea of duality in his beliefs about his science-self. Mikel showed his confidence in his beliefs about his science-self when he said that he bragged to students about his minor grades in his science class. He would brag when he got A's and B's in science. Mikel was also observed doing a dance in class when he got a good grade on an assignment in his science class. Jay, Kyle and LT also mentioned that their science-student-self was marked by features of their behaviors in their science class.

Behavior Matters

As it related to student behaviors, Jay and LT stated that they are good science students because they are quiet science students. Jay said that he is not as talkative in his science class and that is why he felt that this attributed to his good science-student-self. LT ardently shared, "I got the silence thing on lock!" as a reason for him being a good science student. Jay and LT would answer questions in class, which seems to contradict their silent science-student-selves, but they were referring to how they positioned themselves in general in their science class. They did not regularly speak out of turn, rather they raised their hands and/or spoke when Mrs. Sunshine asked science-related questions to individual students or the entire class.

Kyle also mentioned an aspect of behavior when he referenced his science-student beliefs. Kyle shared in third person vernacular that sometimes they "don't wanna show their emotions" about being "really good at science" because it might make them feel like a science nerd compared to their friends. He went on to say that feeling this way would interfere with you wanting to learn more in your science class. You would act like you don't want to learn more because "you don't want other people talking behind your back about it." This sentiment highlighted that Kyle's enacted science-student behaviors may have been stifled by this notion of behaving like a science nerd. The last theme that emerged from the data sources for the first research question of this study was that Mikel and Kyle's beliefs about their science-student-selves revolved around expectations.

The Expectations of Self and Others Influences My Science Self

Mikel stated that "now we gotta write" when he mentioned why science was getting harder for him. He expressed that science used to be his favorite subject but the increased expectations placed on him in his seventh-grade science class caused him to start to lose interest in science. "I think it's just like it got harder and it's like I lost interest in it." Mikel lost some interest in it but was also bound to choosing to do well in science because he felt that his Mom and some of his teachers at RMS wanted him to stay focused, be a good science student and protect his future. He respected their desire to see him "not give [his] future away." The expectations placed upon Mikel were motivating factors in the development of his beliefs about his science-student-self.

Kyle's beliefs in his science-student-self were influenced by the viewpoint of Mrs. Sunshine. Kyle believed that Mrs. Sunshine saw him as a "regular" student who might be good in science but was also good in other things "like music, sports, or something." Kyle believed that he was a good "regular" science student but that he also possessed talents beyond just science. Jay, Kyle, LT and Mikel established a brief foundation for their beliefs about their science-student-selves at the beginning of the cells unit of study. The next section addresses the second research question.

Normative Scientific Practices Experienced by Black Male Students

As mentioned in Chapter 2, *A Framework for K-12 Science Education* (*Framework*) lists eight practices iterated by the National Research Council (NRC) that help to extend the science learning experiences of students. The eight science practices noted by the NRC in the *Framework* are the following: 1) Asking questions, 2) Developing and using models, 3) Planning and carrying out investigations, 4) Analyzing and interpreting data, 5) Using mathematics and computational thinking, 6) Constructing explanations, 7) Engaging in argument from evidence, and 8) Obtaining, evaluating, and communicating information (NRC, 2012). In this study, three of these practices were separated into two or three individual practices because of how classroom instruction occurred within the classroom. For example, the practice of obtaining, evaluating, and communicating information was interpreted as three practices, obtaining information, evaluating information, and communicating information. This provided for a more accurate description of the practices occurring during periods of classroom instruction. During the pilot study of this larger study, I realized that students were not always being asked to obtain and communicate information at the same time. Neither were students planning the investigation that they were carrying out. The pilot study building a rocket investigation was planned by the teacher and students were following the teacher's step-by-step instructions to build their rockets. Therefore in this larger study the practice of planning and carrying out investigations was interpreted as two individual practices, planning investigations and carrying out investigations. Lastly, developing and using models was interpreted as two practices, developing models and using models. The remaining practices that combine two activities were observed as occurring together during the pilot study and the larger study. This resulted in twelve extended *Framework* practices instead of the original eight practices. Table 4.2 shows the list of practices and the abbreviations for each practice used in this study. Descriptions for each practice that were specific to the cells unit that Jay, Kyle, LT and Mikel experienced are also included in Table 4.2.

Table 4.2

Extended Framework Practices with Abbreviations and Descriptions

	Practice	Abbreviation	Description
1	Asking Questions	AQ	In this science class, we are expected to: **Ask Questions** -YOU come up with your own scientific questions. -YOU ask questions about the science topics that you can explore in class.
2	Developing Models	DM	In this science class, we are expected to: **Develop Models** -YOU design a scientific model that you then use to better understand a topic.
3	Using Models	UM	In this science class, we are expected to: **Use Models** -YOU use a model to better understand a topic. -Examples: a. Using the microscope b. Using 4 people to show high to low concentration c. Cell analogy project
4	Planning Investigations	PI	In this science class, we are expected to: **Planning investigations** -YOU create a lab investigation on your own or with your group to conduct.
5	Carrying out Investigations	CoI	In this science class, we are expected to: **Carrying out investigations** -YOU do a lab investigation. -Examples a. Microscope onion slide lab b. Protists lab c. Bacteria helpful and harmful
6	Analyzing and Interpreting Data	AID	In this science class, we are expected to: **Analyze & Interpret Data** -YOU collect information and try to make sense of it. -Examples a. You analyze your gummy bear lab data

			b. You watch Amoeba sister video and answer questions based on what you watched. c. You read and watched articles and videos on bacteria.
7	Mathematics and Computational Thinking	MCT	In this science class, we are expected to: **Using Mathematics and Computational Thinking** -YOU work with numbers and use them to better understand a topic. -Example a. Measurements you collected during your gummy bear lab.
8	Constructing Explanations	E	In this science class, we are expected to: **Constructing explanations** -YOU use scientific words to explain why something happens. -YOU explain using scientific evidence why you think something happened.
9	Engaging in Argument from Evidence	ARG	In this science class, we are expected to: **Engaging in Argument from Evidence** -YOU use scientific evidence to justify why you believe something about a topic you are studying. -Example a. Bacteria is harmful and Bacteria is helpful project
10	Obtaining Information	OI	In this science class, we are expected to: **Obtain information** -YOU get information from your teacher, a video, a slide, an article, or some other source. -Examples a. Class notes b. Reading an article c. Amoeba sister video d. Flocabulary games
11	Evaluating Information	EI	In this science class, we are expected to: **Evaluate information** -YOU analyze text and/or data to get meaning from the text or data to help you better understand a topic. -Examples a. Flocabulary read and response

			b. Flocabulary quiz and game c. Amoeba sister video viewing sheet
12	Communicating Information	CI	In this science class, we are expected to: **Communicate information** -YOU verbally explain, or write, or draw, or use numbers, or create slides to explain what you know or understand about a topic. -Examples a. DSQ b. Answering teacher questions c. Lab sheets

Card Sort Interview

During the cells unit in Mrs. Sunshine's seventh-grade science classroom Jay, LT, Kyle and Mikel expressed how they experienced the extended practices of the *Framework* during their individual card sort interviews. In the card sort interview (see Appendix D) each student identified which practices they experienced during the cells unit, the practices they did not feel they were expected to do during the cells unit and the practices that they delegated to a maybe category. Each practice was written on one side of an index card with a description of the practice on the back of the card. The descriptions used are listed in Table 4.2 above. The card sort interview results are shown in Table 4.3.

Table 4.3

The Scientific Practices Experienced by Jay, LT, Kyle and Mikel

	Yes	**No**	**Maybe**
Jay	CI, EI, MCT, OI	CoI, DM, UM	AID, AQ, ARG, E, PI
LT	AID, CoI, DM, EI, OI, PI, UM	CI, MCT	AQ, ARG, E
Kyle	AID, AQ, ARG, CI, CoI, E, EI, MCT, OI,	-	DM

	PI, UM		
Mikel	AID, AQ, ARG, CI, EI, MCT, OI, UM	E	CoI, DM, PI

Table 4.3 provides the results of the yes, no, maybe category student responses for each student's interview. I asked each student to respond to the prompt, "In this science class, during the unit on cells, we were expected to." Each interview resulted in a different variation of the practices experienced during their class unit on cells. Jay and LT were in the same science class whereas Kyle and Mikel were in the same science class. In general, all four students expressed that they were expected to obtain information and evaluate information. Three student participants expressed that they were expected to engage in the following practices during the cells unit, communicating information, mathematics and computational thinking, analyzing and interpreting data and using models. Two of the four students expressed that asking questions, engaging in argument from evidence, carrying out investigations and planning investigations were expected of them during the cells unit. Lastly, only one of the four participants stated that constructing explanations and developing models were expected of them during their unit on cells.

Each of the student participants had a different perception of what they were not expected to do during the cells unit. Jay did not feel that he was expected to carry out investigations, develop models or use models. Kyle felt that he engaged in every practice to some degree during the cells unit. LT stated that he did not engage in communicating information or mathematics and computational thinking. Mikel felt that constructing explanations was the only practice that he did not engage in during the cells unit. The card sort interviews for Jay, LT, Kyle and Mikel also showed that the student's had different ideas concerning the 'maybe' category.

The 'maybe' card sort interview category presented as a category that may have been interpreted differently by Jay, LT, Kyle and Mikel. Therefore, I asked each student why they chose to place the cards specific to each practice in the maybe category. Jay said that he chose analyzing and interpreting data, asking questions, engaging in argument from evidence, constructing explanations, and planning investigations for the maybe category because he felt like he sort of had to do those practices during the cells unit versus his 'yes' category selection where he said he definitely had to do those practices during the cells unit.

I: So you chose the maybe category, like do you feel like you sort of had to do that?...

Jay: Umhm

I: Do you feel... so this category is like you sort of had to do these things during the cells unit.

Jay: Umhm

I: Okay, okay. So you still feel like you did some of these things but that was it. But the one's in your yes, you definitely had to do.

Jay: Umhm

Kyle placed developing models in the maybe category because it was a practice that may be good to do but not for him. Kyle replied, "... [s]o, even if I do learn from developing models I really wouldn't get how to like do it...". LT placed asking questions, engaging in argument from evidence, and constructing explanations in the maybe category because he felt that he couldn't remember if he had to do them during the cells unit, "...I was thinking like, did we do those things?". Mikel said that he chose carrying out investigations, developing models and planning investigations for the maybe category because "... like we do it, but then, like sometimes we don't." Jay, LT, Kyle and Mikel each had their individual thoughts on what practices they experienced during the cells unit. However, when each participant was asked to select the top three practices they felt like they were expected to do during the cells unit, an overlapping of experiences occurred as shown in Table 4.4.

Table 4.4

Top Three Scientific Practices Experienced by Jay, Kyle, LT and Mikel

Jay	Obtaining information Evaluating information Communicating information
Kyle	Obtaining information Evaluating information Communicating information
LT	Using models Obtaining information Analyzing and interpreting data
Mikel	Analyzing and interpreting data Using models Mathematics and computational thinking

Jay and Kyle selected obtaining information, evaluating information, and communicating information as the top three practices that they experienced during their cells unit. LT also chose obtaining information as one of his top three practices experienced during the cells unit. LT and Mikel chose analyzing and interpreting data and using models as two of the top three practices that they experienced during the unit on cells in their seventh-grade science class. Mikel also stated that mathematics and computational thinking was one of the top three practices that he experienced during the cells unit. Tables 4.3 and 4.4 reveal that each student had his own perception of what he was expected to do during the cells unit.

Jay and Kyle shared the same thoughts regarding the top three practices experienced during the cells unit which represented practices occurring in first and second period. However, LT and Mikel who were in first and second period, respectively, had different thoughts pertaining to the top three practices that they experienced. This difference also supports the notion of nuanced science learning experiences for Black male students in the same classroom. It also suggests that students may have a preference for certain practices more than others.

Prior to conducting the card sort interview with Jay, LT, Kyle and Mikel, I observed the practices occurring during the cells unit and used the normative scientific practices (NSP) observation tool to determine the frequency of occurrence for each practice. The use of the NSP observation tool provided a researcher perspective on the practices occurring during the cells unit. This action speaks to perceived differences and or similarities in the science learning context that may exist for students, a researcher and a classroom teacher. Highlighting that the learning intentions specified in science instructional plans might be interpreted differently for students. Thus students are not necessarily experiencing what we plan for them to experience, suggesting the importance of student-teacher communication.

Normative Scientific Practices (NSP) Observation Tool

The edited NSP observation tool (Carlone, 2012) was used by the researcher during sixteen classroom observations during the cells unit in Mrs. Sunshine's seventh-grade science class, see Appendix C. No new information was collected after fourteen class sessions. Two additional days of data collection were conducted to ensure that a point of saturation was reached regarding the practices taking place during the cells unit. Tables 4.5 and 4.6 show the frequency of occurrence for each of the extended *Framework* practices during the instructional periods that took place during her first period and second period classes.

Table 4.5

NSP Observation Tool Results, First Period

	First period	
	Practice	Percentage
1	Communicating information	35.8
2	Obtaining information	31.6
3	Evaluating information	12.5
4	Analyzing and interpreting data	8.7
5	Carrying out investigations	4.8
6	Mathematics and computational thinking	1.8
6	Engaging in argument from evidence	1.8
7	Using models	1.2
8	Developing models	0.9
8	Constructing explanations	0.9
9	Asking questions	0
9	Planning investigations	0

Table 4.6

NSP Observation Tool Results, Second Period

	Second period	
	Practice	Percentage
1	Obtaining information	33.5

2	Communicating information	33.2
3	Evaluating information	11.1
4	Analyzing and interpreting data	6.8
5	Carrying out investigations	6.2
6	Developing models	2.2
6	Using models	2.2
7	Mathematics and computational thinking	1.8
7	Constructing explanations	1.8
8	Engaging in argument from evidence	1.2
9	Asking questions	0
9	Planning investigations	0

The slight differences between class period percentages for the frequency of occurrence for different practices was a reflection of the slight degree of instructional variation that occurred during instructional periods. Oftentimes a reflective practitioner recognizes areas of instruction that could be changed to help students better understand the content. Mrs. Sunshine would sometimes alter her instruction based on her observations regarding how or if students were understanding the material. There were also times when a class period was interrupted or extended because of expected and unexpected school events and/or schedule changes. Although these things explain the slight differences between the percentages, the general pattern of observed practices is the same for first and second period.

The results of the NSP observation tool for first period and second period matched the top three practices selections for Jay and Kyle. The top three practices occurring during the cells unit were observed to be communicating information (35.8%), obtaining information (31.6%) and evaluating information (12.5%) for first period. Second period differed only slightly, obtaining information (33.5%), communicating information (33.2%) and evaluating information (11.1%). Asking questions and planning investigations were the two practices that were not noted as occurring during the cells unit. The remaining extended *Framework* practices occurred at lower frequencies during the cells unit.

The remaining practices occurred less than 10% of the time during the cells unit. LT and Mikel selected using models as one of their top three practices which based on the NSP observation tool was observed at a frequency of occurrence of 1.2% and 2.2% respectively during first and second period observations. LT selected obtaining information as one of his top three practices which was within the top three practices noted by the NSP observation tool. LT and Mikel also chose analyzing and interpreting data as one of their top three practices. The NSP observation tool reported analyzing and interpreting data as the fourth most prevalent practice expected of students during the cells unit for first and second period, 8.7% and 6.8%, respectively. Mikel's top three practices also included mathematics and computational thinking. Based on the NSP observation tool, mathematics and computational thinking occurred at the same percentage for first and second period, 1.8%. The analysis of the field notes and observations II data resulted in similar results compared to the NSP observation tool.

Field Notes and Classroom Observations

All of the field notes and classroom observations were analyzed for pattern recognition pertaining to the extended *Framework* practices occurring during the cells unit, Table 4.7 and 4.8.

Table 4.7

Observed Normative Scientific Practices, First Period

First period		
	Practice	Percentage
1	Communicate information	44.9
2	Obtain information	31.0
3	Evaluate information	10.6
4	Analyze and interpret data	5.1
5	Carrying out investigations	2.8
6	Mathematics and computational thinking	1.4
6	Using models	1.4
6	Constructing explanations	1.4
7	Engaging in argument from evidence	0.9
8	Developing models	0.5
9	Asking questions	0
9	Planning investigations	0

Table 4.8

Observed Normative Scientific Practices, Second Period

Second period		
	Practice	Percentage
1	Communicate information	44.1
2	Obtain information	28.4
3	Evaluate information	13.2
4	Analyze and interpret data	5.9
5	Carrying out investigations	3.4
6	Constructing explanations	2.0
7	Mathematics and computational thinking	1.5
8	Using models	0.5
8	Engaging in argument from evidence	0.5
8	Asking questions	0.5
9	Developing models	0.5
9	Planning investigations	0

The percentages for practices observed during first and second period differed slightly because of the slight degree of instructional variation that occurred during instructional periods. These percentages were also compiled from the field notes and observations for all of the classroom observations. There were no time segment limits used for the field notes and observations as were used with the NSP observation tool. This provided more data points and was a result of what students were doing and expected to do during the cells unit. It included what the teacher was doing and expecting students to do in response to her actions and/or instructional requests. It is also important to note that more practices data were collected via classroom observations than with the NSP observation tool alone. The top three practices were still the same according to the NSP observation tool and the analysis of the field notes and observations II.

The most prevalent practices expected of students for first and second period were communicating information (44.9%, 44.1%), observing information (31.0%, 28.4%), and evaluating information (10.6%, 13.2%). The remaining nine extended *Framework* practices occurred six percent or less of the time during the observation periods during first and second period classes. Analyzing and interpreting data (5.1%, 5.9%) and carrying out investigations (2.8%, 3.4%) were the next practices noted to occur most frequently in the field notes and observations collected during the cells unit. These two practices were also noted as the fourth and fifth most prevalent practices occurring during the cells unit using the NSP observation tool. LT and Mikel also chose analyzing and interpreting data as one of their perceived top three occurring practices during their cells unit.

First period observations showed no occurrences of asking questions and planning investigations. Whereas, only planning investigations was noted as not occurring during second period. Asking questions was noted as occurring during the cells unit during second period because Kyle asked a question related to plants and the previous unit on ecology during the cells unit. Kyle stated, "I was watching National Geographic about ants. Would a plant ever have a defense system in it so things wouldn't eat it?" (11/25/19, p. 2). Students were observing a video on plants, photosynthesis and cellular respiration prior to starting their cellular respiration foldable notes when Kyle raised his hand to ask his question.

Jay, Kyle, LT, and Mikel provided their thoughts concerning the practices that they experienced during their cells unit. Their experiences were compared with the researcher observations and field notes to address the second research question for this study. Mrs. Sunshine was asked to participate in a card sort interview because she also existed as a participatory agent in the classroom during the cells unit instructional periods.

Mrs. Sunshine's Card Sort Interview

After using the NSP observation tool to calculate the frequency of occurrence of the extended *Framework* practices, I conducted a card sort interview with Mrs. Sunshine and asked her what three practices she believed students experienced most during the cells unit, see Table 4.9 and 4.10.

Table 4.9

Mrs. Sunshine's Card Sort Interview Results

	Yes	No	Maybe
Mrs. Sunshine	AID, AQ, CI, CoI, DM, E, EI, OI, UM	PI	ARG, MCT

Table 4.10

Mrs. Sunshine's Top Three Scientific Practices

Mrs. Sunshine	Carrying out investigations Analyze and interpret data Communicate information

Mrs. Sunshine felt that she exposed students to nine of the twelve extended *Framework* practices: analyzing and interpreting data, asking questions, communicating information, carrying out investigations, developing models, constructing explanations, evaluating information, obtaining information and using models. She did not believe that she gave students the opportunity to plan an investigation. She also expressed that although students may have been asked to engage in argument from evidence and perform mathematics and computational thinking, it was to a lesser degree when compared to the other nine practices.

During the card sort interview with Mrs. Sunshine, she stated that carrying out investigations, analyzing and interpreting data and communicating information were the top three practices expected of students during the cells unit. Jay and Kyle also selected communicating information as one of their top three experienced practices. LT and Mikel selected analyzing and interpreting data as one of their top three experienced practices during the cells unit. Jay, Kyle, LT and Mikel expressed their thoughts regarding the practices that they experienced during the cells unit. When prioritizing their top three choices for the practices that they experienced most during the cells unit, their thoughts aligned more so with the researcher collected data than with Mrs. Sunshine's thoughts. Carrying out investigations was the single practice noted by Mrs. Sunshine that neither

Jay, Kyle, LT nor Mikel noted as being on their list of top three practices experienced during the cells unit.

Section Summary

The second research question for this study was worded to focus on the normative scientific practices that Jay, Kyle, LT and Mikel experienced during the cells unit. The differing results of the participants, researcher and Mrs. Sunshine showed how the lived experiences and perceptions varied among inhabitants of the same space. These results support the need to highlight what the student participants experienced because that was their reality in their science classroom and they were engaging in and responding to that reality. Jay and Kyle's realities, related to the practices that they experienced during the cells unit, aligned with the observed practices reported via the use of the normative scientific practices observation tool. Jay was in Mrs. Sunshine's first period and Kyle was in second period, which provided a member check for the researcher observed practices during first and second period. The observation tool accurately reported the practices that Jay and Kyle experienced the most during the cells unit.

LT and Mikel were in Mrs. Sunshine's first and second period, respectively, and they reported experiencing two out of three of the same practices the most during the cells unit. They experienced analyzing and interpreting data and using models the most. Kyle also believed that these two practices occurred during the cells unit but he did not feel that they occurred most often for him. Jay did not note either of these practices as a practice that he was definitely required to engage in during the cells unit. This showed that the science classroom lived experiences of the four Black male participants were similar and different. Again, speaking to the importance of highlighting student voice to better understand the science learning contexts for Black male students and students in general.

Although the instructional intentions of a classroom teacher may be clearly expressed in the daily lesson plans these intentions may not align with what students are actually experiencing in class. The intentions of Mrs. Sunshine and her own beliefs and lesson plans regarding the practices that occurred during the cells unit differed from what the student participants believed that they were expected to do during the cells unit. Her beliefs also differed from the results of the normative scientific practices observation tool. Communicating information was the only top three practice selected by Mrs. Sunshine that was also selected by Jay and Kyle as a top three practice. Communicating information was also observed by the researcher as a top three practice. Analyzing and interpreting data was identified by Mrs. Sunshine, LT and Mikel as a top three practice. Using the normative scientific practices observation tool in isolation was not enough to determine the primary practices that signified what it meant to learn science and be a science expert during the cells unit in Mrs. Sunshine's seventh-grade science class.

The observation tool was one lens. The expressed experiences of Jay, Kyle, LT and Mikel were other lenses used to describe what science meant and what a science expert looked like in Mrs. Sunshine's class during the cells unit. Multiple lenses are needed to accurately depict the expectations placed upon students in a science class. Specifically given the notion that these expectations can influence how students enact their science-student-selves within the classroom. The next chapter section reports how the practices experienced by Jay, Kyle, LT and Mikel influenced how they viewed themselves as science students during the cells unit.

Black Male Student Beliefs and Normative Scientific Practices

The second section of this chapter showed the normative scientific practices that Jay, Kyle, LT and Mikel experienced during the cells unit that Mrs. Sunshine taught her seventh-grade science students. Although I observed and reported obtaining information, communicating information, and evaluating information as the top three occurring practices during the cells unit, only Jay and Kyle selected these three practices as the top three practices that they experienced during the cells unit. LT felt that he experienced using models, obtaining information and analyzing and interpreting data the most during the cells unit. Mikel expressed analyzing and interpreting data, using models and mathematics and computational thinking as the top three practices that he experienced during the cells unit. The answers to the semi-structured interview questions posed to each participant during his interview revealed his thoughts about himself and his actions in class as it related to his top three experienced practices.

The semi-structured interviews and the field notes and observations data were collected and analyzed to speak to the third research question. How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that they experience during a unit of study in a rural middle grades science classroom? The field notes and observations from the last thirteen observation days for first period and the last eleven observation days for second period were used to answer the third research question. The responses from Jay, Kyle, LT and

Mikel were analyzed using InVivo coding followed by pattern coding. In Vivo coding was used to again highlight student voice. In alignment with Saldaña (2013) the pattern codes were chosen to organize the words of the study participants into meaningful codes directly related to the propositions established in the research design. The pattern codes reflected the study propositions and theories used in the current research study. Access (or not) into the culture of science (Carlone, 2012; Kelly, 2007), science identity (Carlone & Johnson, 2007; Farland-Smith, 2009; Moore, 2006), what the student participants considered important (Manz, 2015), and social interactions with Mrs. Sunshine and their peers (Lemke, 2001) were the pattern codes used in the data analysis of the data sources for the third research question, see Appendix J.

Operationalizing the four pattern codes provided definitions to aid in data analysis and in reporting the findings. Access (or not) into the culture of science was viewed as instances where Jay, Kyle, LT or Mikel felt like they were part of (or not part of) their science learning community. Times when they felt (or not) that they were accepted contributors to the knowing and the doing of science in their science classroom. Science identity reflected student abilities and desires to acquire science knowledge and skills. The things that the student participants considered important could include actions, practices, behaviors or interactions. Lastly, the social interactions that Jay, Kyle, LT and Mikel had with their teacher and their peers when experiencing these practices during the unit were analyzed. The following sections will report the beliefs Jay, Kyle, LT and Mikel had concerning his own access, science identity, what he considered important and his social interactions as it related to the top three normative scientific practices that he experienced during the cells unit. As mentioned in chapter three of this study, in order to further highlight the beliefs and attitudes Jay, Kyle, LT and Mikel held about their science-student-selves the three basic domains of attitudes via a social psychological lens were used to analyze the data (see Appendix K).

Jay

Jay experienced obtaining information, evaluating information and communicating information the most during the cells unit. Jay voluntarily chose to complete the work assigned to him related to these practices. This gave him access into his science community. However, Jay stated multiple times concerning obtaining and communicating information that he was bored when he was expected to only do these practices. His boredom could have kept him from being a part of his science community but it was important to Jay to get good grades and not get an F on something because he chose not to obtain, evaluate, or communicate information. Jay did not have anything to say about how Mrs. Sunshine might have felt about his abilities in these practices. However, his social interactions with his peers, especially pertaining to communicating information were important in shaping what he believed about his science-student-self and his peers during the cells unit.

As stated above, the findings from Jay's semi-structured interview and field notes and observations III showed his measure of access into his science learning community, aspects of his science identity, what he considered important during the cells unit, and how he viewed his social interactions with his teacher and his peers. The findings from the first research question revealed that Jay believed in his confidence as a science student and that his behavior mattered as a science student. The social psychology attitudinal analysis for the third research question revealed that Jay's expressed attitudes about his science-student self revolved around affect, his behavioral decisions as a science-student, his social interactions with his peers, and what he thought was important about enacting his science-student-self.

Affective Expressions

Jay's affect during the cells unit included being bored and not wanting to do the work and believing that he could be having fun when engaging in a practice like using models. Using models was not one of the practices that Jay listed as the top three practices that he experienced during the cells unit. Jay stated that it would "be more fun" and be "more entertaining" if he was able to use models more often during his science class. Pertaining to his boredom, he stated twice that he was "bored" when expected to obtain information and again when expected to communicate information. He had little desire to mainly gather information from his science notebook or other resources and reproduce that exact information in verbal or written form.

He said he was bored "because I don't feel like doing all of it" and "because I'm still sleepy... especially in the morning." He was also observed taping other papers into his science notebook instead of following along with Mrs. Sunshine as she provided vocabulary terms for the students to copy down onto their mitochondria diagram sheet. Although he was bored and sometimes sleepy he was also observed completing the cell unit instructional tasks that required him to listen and/or read to obtain information, communicate information and evaluate information (FN, 11/11/19; FN, 11/14/19; FN, 11/15/19; FN, 11/26/19). Jay watched the videos that Mrs. Sunshine would play expecting students to listen and acquire information prior to completing a notes sheet, project or lab assignment during the cells unit. He still felt that it was important that he did the work expected of him. In the behavioral domain of attitudes, Jay expressed interpersonal and intrapersonal behaviors related to his chosen top three occurring normative scientific practices.

Behavioral Expressions

Intrapersonal behaviors expressed by Jay were commonly worded as statements of confidence pertaining to his science-student-self and the actions that he knew he took during the cells unit. Jay was confident in saying "I know how to communicate," "I do a lot of talking," and "I been raising my hand" to answer questions asked by Mrs. Sunshine. Jay said, "a lot of people are like, they'll know it [an answer] but they won't really say it, they'll be quiet." Additionally, Jay confidently said, "I already know where to find it" when referring to searching for information or researching information. It was important to him that you found proof to support your answer. "The evidence shows that you actually have researched it." "Like we can have the answer but we still have to have the evidence...". Jay said, "I could have the evidence" and "I'm good at finding information." He was confident in his abilities to get the evidence or find the information needed to feel like part of his science classroom community. Jay also mentioned, "I'm always like the first one or second one finished" and for this reason his peers would also say that he did well with communicating information during the cells unit.

Also pertaining to Jay's behavioral actions during the cells unit, Jay did what was asked of him and nothing more. It was important to him to complete his work as expected by Mrs. Sunshine. Jay completed the work expected of him when instructed to complete a flocabulary cells unit review assignment on his chromebook (FN, 11/14/19) and when completing his cell organelle analogies powerpoint project (FN, 11/15/19). Jay completed what was asked of him however, as with the cell organelle analogies project he did what was asked and did not add any additional features to his project (FN, 11/15/19). Jay did not have much to say about the interpersonal relationship between himself and Mrs. Sunshine concerning how she might view his science-student behaviors during the cells unit. However, he did express how he and his peers interacted during the cells unit.

The interpersonal behavioral expressions displayed by Jay centered around acceptable science-student behaviors between Jay and those he identified as being the top three students who perform his top practices well. He noted how "they all like to talk alot" and "they like to research". Jay said, "Cause like we all communicate well because we like to talk in a group and stuff like that." Specifically, Jay felt that communicating within a group could help you find answers more than trying to figure things out on your own. "Because like while you're doing an assignment by yourself, you have to like figure out on your own and when you're in a group you can like communicate with your um, like people in your group to help you." A large amount of Jay's conversation about being expected to communicate information revolved around his tendency to be social with his friends in class. Juxtaposed to this notion of group science discourse being acceptable in his science class, Jay also spoke about not being too talkative in class as an attribute.

Similarly to what Jay mentioned during his early unit studenting interview about himself, he also referred to his peers who did well with the practices as being quiet science students. Jay stated that students known to be good at evaluating information "they don't like talk too much." Jay again equated being good in science with being quiet in science.

Jay also identified ways in which his peers viewed his science-student self when he engaged in the practices. Jay believed that his peers felt that he did well with evaluating information because "I do the most searching." He also stated "they're always like how did you already finish?" These were positive perspectives. I observed an alternative view of his peer interactions when one of Jay's group mates asked him why so much of his notes sheet was blank. It wasn't until this student asked Jay about his notes that he asked his elbow-buddy for his notes sheet to then copy down the vocabulary that he was expected to have filled in on his flow chart notes sheet (FN, 11/26/19). These specific behaviors expressed by Jay can be explained by his cognitive processes related to engaging in his top three practices.

Cognitive Expressions

Jay expressed that his science-student actions were the result of three things: his desire to get scientific information needed to complete the tasks asked of him, not wanting to get an F grade on an assignment, and because he possessed the skills to do the work. Getting information was important to Jay because "you're not gonna know what the information is" if you don't obtain it from a source. Jay felt that if you didn't evaluate information then "you probably wouldn't find the right answer" or "you just wrote a random answer down". He also believed that communicating information could help you "find answers". It was important to Jay to be able to find the correct answers. According to him, having the information that you needed helped you get good grades and this was also important to Jay.

After a quiz covering cell theory, the microscope, protists, and bacteria, I asked Jay about his grade and if he studied for the quiz. Jay only missed one question on the quiz, he got a 95% and said "yes" he studied for the quiz (FN, 11/08/19). Additionally, Jay stated that "you'll probably get an F" if you don't obtain information or communicate information. He did not want to get an F. Jay spoke of what he was capable of doing and that being a reason why he would engage in his top three practices.

Jay said, "I can easily find information, like in my notebook", "I know what page it is," "I could have the evidence" and "I already know where to find it," when referring to obtaining information and evaluating information. These practices gave Jay access into his science classroom culture. He also stated "I know how to communicate" and "I'm good at finding information when he spoke about communicating information and evaluating information, respectively. Jay reasoned that because he had the above skills, he did well during the cells unit when engaged in his top three practices of obtaining, communicating, and evaluating information. Kyle also selected these three practices as his top three practices.

Kyle

Kyle experienced obtaining information, evaluating information and communicating information the most during the cells unit. He confidently accessed his science learning community during the cells unit through his use of these three practices. Kyle believed that he did well at performing each practice although he may not have done as well as some of his peers. To Kyle, being a good science student meant that he did well with obtaining, evaluating, and communicating information to get good grades and to be able to help himself and his peers better understand the content. He felt that his teacher could see that he answered science content questions correctly and was a good student. Ultimately, engaging in these three practices during the cells unit allowed Kyle to feel that he could succeed in science. Analysis of Kyle's semi-structured interview transcript and the field notes and observations III revealed additional traits expressed by Kyle about his science-student-self.

The findings from the first research question revealed that Kyle believed in his confidence as a science student, that aspects of behavior mattered as a good science student, and that expectations pertaining to who he was as a science student extended beyond being good in science. The social psychology attitudinal analysis for the third research question revealed that Kyle's expressed attitudes about his science-student self revolved around affect, his behavioral decisions as a science-student, his social interactions with his teacher and peers, and why he thought it was important to enact his science-student-self as he did in class.

Affective Expressions

Kyle expressed his feelings and emotions about his science-student-self as a student confident in his ability to obtain information and confident in his ability to be a good student able to succeed. Kyle also expressed that he had a desire to be able to do well in class and get good grades. He stated, "like when [Mrs. Sunshine's] explaining something I'd try to get what she's saying and like try to remember the things and like clues that you can use." Kyle also showed how he would use context clues to help himself remember science content.

> "[Mrs. Sunshine] was saying like the cell membrane it could be like a door and it can like allow or like a security guard that can allow things to go in and out. So I can obtain that information to know how to like remember a clue or something in real life that can help me." (Interview, 11/21/19).

In the above quote Kyle articulated that he was able to listen to Mrs. Sunshine provide science analogies and retain that information to help himself remember the function of the cell membrane.

When asked about obtaining information and evaluating information, Kyle shared that evaluating information was important to him because "if you can't evaluate the information that is given to you then you could probably make like not the grade that you want to make.". Kyle mentioned five times his belief in engaging in obtaining or evaluating information so that he could get the grade "as I want". Kyle stated, "if you like, if you had like the grades that aren't failing but you didn't really like... then if you obtain like even more information then you could succeed even more in tests and quizzes and stuff." Kyle emphasized that getting the good grades that he wanted was important to him in his science class and during the cells unit.

Additionally, Kyle communicated, "I feel comfortable when I know that I can like do a certain thing and it can be like easy for me." He conveyed a confidence in his ability to do what he called "adapt". Kyle explained that adapting meant that he was able to learn new things and the byproduct was that that new thing, "it's easier". His adaptability was linked to his desire to succeed and get good grades in science.

Kyle also expressed a notion of care regarding the science-student success of his peers. Kyle felt that he and certain students could help each other and be good science students. "They know that I can help them and like they could help me if I didn't understand something." Kyle wanted to share his science-student knowledge with others so that they too could feel that they were also good in science. "They know that, if I can be like a good studying student and they could be one too then um, when they study alot then we could all like help each other." This also showed Kyle's confidence in his abilities as a science student. He could help his peers better understand science content and they could help him. He wanted to be someone who others could depend on. During his interview about communicating information Kyle felt that his peers would say he communicated information well "because when they need help then they know that they could depend on me or someone to like help them out at like anytime."

Counter to this position, Kyle noted a time when he did not feel confident during the cells unit. "It can be kind of uncomfortable because like if I can't get as much information as I can and it'll be kind of hard for me to understand how to do this and that." He was uncomfortable when he felt that he didn't understand the content because of a lack of information. He was secure in his abilities and things came easy to him when he would obtain information from his teacher, a peer, a book, or some other resource. Kyle's actions and his interactions with his peers and his teacher were also displayed during the cells unit.

Behavioral Expressions

Kyle's intrapersonal behaviors reflected actions that centered around what he knew he could do and would do in class. He confidently stated, "I am good at obtaining information because when it comes to science I can like know these certain things and I can like adapt to it quickly." Kyle gave himself authority to be an expert in his science class. "I could be like talkative and people need to like know, if they don't understand what things in like science could be, like the material." He said, "I could probably like tell them what [Mrs. Sunshine's] trying to say in like a way that they could understand." Kyle believed that he was good at communicating information. He also believed that Mrs. Sunshine would support his beliefs pertaining to his actions in class. "[S]he knows that I can succeed in like science and stuff. She knows that if I raise my hand then it could probably be right because I study a lot in like things that I really don't know." Kyle exhibited confidence in his science-student-self.

Additionally, Kyle spoke of his efforts to try, to focus, to engage in tasks where he could help himself. His way of paying attention and studying hard was to help him understand a topic that he may have been confused about.

> "Yeah, um because like I used to get like really confused about what a mitochondria is and like the plant and stuff, so when I analyzed information like how [Mrs. Sunshine] had like one topic about the mitochondria, then I knew that since I didn't really know it that well, then this is like a good time to like analyze and to know. And [Mrs. Sunshine] was like teaching that topic then that would be a good time to evaluate what she's saying and so I could understand it my way so I could get it." (12/2/19).

Kyle used the practice of evaluating information to help himself feel successful in science. He used this practice to access science learning in his class. The notion of being focused and studying new information to learn something new was a significant part of Kyle's science identity.

The desire to focus, to make an effort to try, and to learn science content during the cells unit was evident in the above quote by Kyle. He "didn't really know" about mitochondria and plants and he verbally acknowledged that he didn't know this content. He then stated that he wanted to be able to "get it" and evaluating the information that his teacher was giving him would help him get it. It was important to Kyle that he gained understanding about science content. "I feel that when I'm like evaluating information then I can, sometimes if I don't know something then like I think I like work with it and decode it somehow, so I can understand how it works."

These behaviors were summarized by Kyle when he described what obtaining information during the cells unit looked like, "when [Mrs. Sunshine's] explaining something I'd try to get what she's saying and like try to remember the things and like clues that you can use." His science-student-self identified his desire to obtain information to understand and recall scientific knowledge and his ability to evaluate the information for clues to further help him understand the content. Kyle's science-self was also visible during a lesson on plants when he asked Mrs. Sunshine a question pertaining to plants and ants. Kyle stated, "I was watching National Geographic about ants. Would a plant ever have a defense system in it so things wouldn't eat it?" (FN, 11/25/19). Kyle was evaluating the information being given to him by his teacher and making connections with science content knowledge that he acquired outside of school. Although these actions supported Kyles' success as a science student in his class he still balanced these actions with the idea that he had to be quiet in class while obtaining information. Being quiet during this practice helped him achieve success.

Kyle mentioned what obtaining information in class was like, "[i]t's really just like, being quiet and like looking for like clues or like hints that the teacher gives you...". Kyle framed this behavior as a way to get the information that he needed to be able to be successful during his cells unit. This was the only time that Kyle referenced being quiet in relation to his science-student behaviors.

Kyle was just as confident in his beliefs about his actions as a science student as he was in his beliefs about what his teacher and peers felt about his abilities as a science student. However, his comments started out timid when he was first probed about his peer interactions. Kyle stated, "I don't really know what they could be thinking or like tell. Like saying that Kyle can be like a good B and C student or something." When probed further Kyle stated that his peers might say something like "he could maybe be like a good student or like a good person that can like study hard and like help them or something." He also stated, "[t]hey know that I can help them and like they could help me if I didn't understand something." Helping his peers and his peers helping him were part of how Kyle saw his science-student-self.

Kyle's interpersonal behaviors largely focused on the notion of success for himself and for his peers. He also praised his peers for their positive accomplishments in class. During a lesson on cellular respiration, Kyle told another Black male student, "[t]hat's a pretty tough thing to remember David. Good job!" (FN, 11/25/19). Kyle expressed that he and his peers could help each other so that they could learn, understand and succeed together.

When referencing his interactions with his teacher, Kyle felt that Mrs. Sunshine would know that he was a good science student who could succeed because he would pay attention in class, do well, and he could make good grades. "I think she does because like I'm normally answering questions that I know and she knows that I can like adapt to it easily and like master it." He felt that his ability to answer science content questions during the cells unit and his ability to learn new things were evident to Mrs. Sunshine. Moreover, Kyle said "she knows that I, I'm like a good student and she knows that I pay attention a lot and I can make good grades." Kyle's actions mirrored his thoughts pertaining to why he engaged in the practices expected of him during his cells unit.

Cognitive Expressions

Kyle's rationale for his science-student performance focused on what he wanted for himself. He stated in multiple ways that if he did not engage in the practices expected of him then he would not be able to succeed, he would not understand the information that Mrs. Sunshine was giving him and that he could "possibly fail". Getting good grades was important to Kyle. "I think that I could maybe possibly fail a test or like not get a good grade as I want on something from not obtaining information from the things that I should be focusing on." He also said, "if I don't evaluate information then I could make like a bad grade or something like I don't want to make." Kyle wanted to study hard and be confident that he really knew the science content. "I'm just making sure that I really know it." Kyle wanted to experience success. He noted the things that he was able to do that helped him succeed and "be a good science student".

Kyle made "I can do" statements that described his thought process concerning his enacted science-student-self. He stated, "I can obtain that information...", "I can like know these certain things...", "I can get like the good grades that I want.", and "I can learn new things that I haven't learned before and it's easier." He also indicated that he could find ways to help himself learn the content, that he can be a good science student, that he can look for clues, and that "[he's] normally answering questions". These statements suggested that Kyle's beliefs about what he could do influenced his enacted science-student-self. While he also experienced disappointment because of a grade, putting his hand over his face after seeing his low quiz grade (FN, 11/08/19), he still believed that he could accomplish the tasks asked of him, study hard, and learn new things in his science class.

Ultimately, Kyle's actions and thoughts were rooted in purpose. Kyle expressed that his purpose for enacting his science-student self was that he wanted to learn, he wanted to succeed, he wanted to get good grades, and he wanted to be able to help his classmates and his classmates to help him better understand science content. LT also expressed purpose in choosing to enact his science-student-self as he did during the cells unit.

LT

LT experienced using models, obtaining information and analyzing and interpreting data the most during the cells unit. He felt that he did best obtaining information. He believed that he had strengths and weaknesses concerning the use of models and analyzing and interpreting data. These feelings provided restricted access into his science learning community. It was important to LT that he could use these normative scientific practices to engage in class, to help him better understand science content and to help him gather information that would help him to successfully complete his required assignments. LT believed that he was able to recall information well because he had a good memory and that this attribute was beneficial to the development of his science-student-self. Analysis of LT's semi-structured interview transcript and the field notes and observations III revealed additional traits expressed by LT about his science-student-self.

The findings from the first research question revealed that LT believed in his confidence as a science student and that aspects of behavior mattered as a good science student. The social psychology attitudinal analysis for the third research question revealed that LT's expressed attitudes about his science-student self revolved around affect, his behavioral decisions as a science-student, his social interactions with his teacher and peers, and why he thought it was important to enact his science-student-self as he did in his class.

Affective Expressions

LT's feelings and emotions during the cells unit were situated in what he deemed as helpful, in his duality in abilities, and in being bored at times during the cells unit. LT iterated the notion of being helped by engaging in certain practices. He said "if you like don't use models then like it's gonna be more hard to explain things." LT felt that using physical models was helpful to him, it gave him access to his science community. "I feel like yeah this is gonna help me with like science and stuff. And like, since I did it [used models] last year, and it helped me out last year... yeah, I think it's gonna help me out." In particular, LT and his peers used a gummy bear lab to help them better understand the difference between osmosis and diffusion. LT said "The gummy bear was helpful for osmosis and diffusion. How it helps me... is to like remember if something's low concentrated and high concentrated." LT found these practices helpful in his access to science learning but felt that he was not always good at using models.

Pertaining to the duality of his abilities, LT only sometimes expressed confidence in his ability to engage in obtaining information, using models, and/or analyzing and interpreting data. This duality in his science-student beliefs largely stemmed from LT's struggle with learning how to use science equipment and not with his ability to complete a task or learn science content. LT stated, "[y]eah, I think I am good" at using models. However he said, "I'm not sure I'm that good though." He felt that his ability to use models fluctuated. He referenced using the triple-beam balance to weigh the gummy bear in the osmosis lab. He said that sometimes he would "instantly just go the heaviest" beam instead of starting with the smallest scale. He was referring to the physical use of the science apparatus and not the gummy bear as his model.

When LT talked about using the microscope to find the onion cell and the protists, he again referred to having trouble sometimes finding the specimen. Although there were times where he did find the specimen and was able to use the microscope to complete the lab investigation questions correctly. "More of the yes part is like, I can find it. I can like kind of find where it is but then like... but then it gets a bit hard...". LT confidently noted that he was good in math and "I would think that I could use my math skills for other than math and like in science." However, similar to his experience with the microscope LT felt confused during the gummy bear lab calculations. "Um, I felt like it got a bit confusing because like we had to switch from millimeters to centimeters to grams, so yeah." He again expressed feelings of being confident in his abilities and sometimes not being confident.

Rarely was LT bored in his science class. Nevertheless, he expressed boredom when he shared about his experience using the triple-beam balance. His boredom was framed within his completion of the task and not having anything else to study.

> "Yeah, I think I am a little bit good at it because when I got bored in like class from like studying. Like when I studied almost everything I put the pencil on my hand and tried to balance it out on my finger... like yeah, this is balancing right here (said in humor, as a joke)." (Interview, 11/21/19).

LT's affective expressions provide one lens regarding his science-student-self. His behavioral expressions offer another layer to understanding his beliefs about his enacted science-student-self.

Behavioral Expressions

The intrapersonal behaviors shown by LT centered around things that he felt he struggled with, things that he identified that he would do in class, and being a quiet student who did not get in trouble. When LT was observed in class during the gummy bear lab discussion section he communicated that his prediction about what would happen to the gummy bear was not correct. He expressed this to Mrs. Sunshine when she asked him about his prediction. LT said that he reported that his prediction was not correct and backed it up with evidence to support it (FN 11/20/19). LT analyzed his lab data and made adjustments to his initial prediction based on the data that he collected. He showed his ability to do well when instructed to analyze and interpret data. He believed that engaging in this practice was "expected" and that it was important to do your own research so that you did not "agree with the wrong statement."

Moreover, LT believed that his peers would say that he did well obtaining information because his table mates, Shawn, Ned and Charles, have seen him skim read. "I've displayed that I can obtain information very well with skim reading." His way of skim reading was not "skipping words" but "like me going through the passage very fast and trying to find what matches." He would skim read to answer discussion questions for a cells unit assignment. LT also noted traditional "good student" traits as characteristics of his science-student-self.

In response to LT mentioning that he is silent in his science class he stated "[w]ell there's one thing about not getting in trouble and another thing is that I really don't have nothing else to talk about." Although LT noted his tendency to be a quiet student, he also expressed, "I answered the questions correctly." LT was not quiet when it concerned his science knowledge and contributing to the science learning environment in his class.

LT was a student who delighted in working with his tablemates. LT's interpersonal behaviors showed how he interacted with his peers in mutually beneficial ways. However, these interactions were not void of contention. LT shared that he was sometimes confident when working in groups and sometimes he was not confident. Again, these instances of insecurity occurred when LT was working with science equipment.

LT mentioned the practice of collecting data or research to then draw a conclusion when he discussed his group's cell organelle analogies project. He worked well with his group member and they were able to successfully complete the cell analogies project.

> "Because once on the, I think it's called cell analogies, where we have to fill in the blanks, yeah, cell analogies project... me and Shawn filled in the blanks by switching up the information, analyzing the information and going to like other places [the internet and their science notebook]... We just switched it up and then if we didn't think it was right then we'd choose another one and then um if it's true then we put it down." (12/2/19).

During this project he and Shawn were expected to find appropriate analogies to represent the organelles of the cell. For example, LT's analogy given during a class session for the cell membrane was "[l]ike the air conditioner. The filter keeps the dirt and stuff from coming in and lets the clean air through." (FN, 11/11/19). Shawn and LT helped each other during this task.

An example of teamwork with some contention occurred in an example that LT provided of when he used the microscope in his group and would sometimes have trouble finding a specimen.

> "Okay, so like... kind of like a yes and then a tiny bit of no. Because like when Ned had it focused [the microscope] with his glasses on I was like Ned could you like take your glasses off because like if you have your glasses on you can see it and that doesn't mean that me, Shawn and Charles can see it. So if he takes his glasses off, he couldn't see it and then so I was like... "Hey Ned let me do it" and he was like 'Okay' and then I was like trying to find it but then I only found like one single tiny cell. And then I like moved it two inches and then it disappeared. I can like kind of find where it is but then like... then it gets a bit hard..." (11/21/19).

In the above quote LT experiences some frustration with his group member but ultimately comments on the struggle that he had using the microscope which could have influenced how his peers viewed his ability to use models well. His opening statement, "... kind of like a yes and then a tiny bit of no." spoke to his duality concerning his confidence when interacting with his peers.

Regarding his interactions with Mrs. Sunshine, LT said "[y]eah, I think so" to his teacher believing that he used models well. Then he said, "I don't really think so but like... I don't really look up and around so yeah I think..." to the same notion. He felt that she did think he was good at the practice but because he didn't look around class at his teacher he wasn't really sure. Contrarily, LT was sure that Mrs. Sunshine believed that he did well obtaining information because of his actions in class.

LT noted that Mrs. Sunshine would say that he does well obtaining information because "I answer the questions correctly." On multiple occasions, LT raised his hand to answer whole-class discussion questions posed by Mrs. Sunshine (FN, 11/18/19; FN, 11/19/19; 11/25/19; FN, 11/26/19; FN, 12/03/19). A sample of how comfortable LT was answering questions can be seen in the excerpt below.

> Mrs. Sunshine: "Does anyone know the process that converts light into energy?"
>
> LT: "That process is photosynthesis." [Mrs. Sunshine asked LT to answer this question, he was still writing down his homework for the week. But he popped his head up, repeated the question that Mrs. Sunshine asked and then provided the correct answer.] (FN, 11/18/19).

LT's fluctuation in his assessment of his science knowledge and skills was also reflected in his perceptions about his science-student-self.

Cognitive Expressions

LT's thoughts regarding his enacted science-student-self centered around the notion of duality in his abilities, the utility of the practices for academic advancement, and the advantageous aspects of engaging in the practices expected of him versus not engaging in these practices. LT got an 85% on the quiz that reviewed cell theory, the microscope, protists, and bacteria. When I asked him if he studied for the quiz he said that "[he] didn't even study once". He commented on his memory capacity being better than he thought (FN, 11/08/19). LT's ability to remember science content was also part of his science-student identity. Even with these experiences of success LT said, "I think I am good" and "I'm not sure I'm that good though." He still expressed himself as being partially confident in his science-student-self.

It was important to LT that using models could help him remember science content. In the following quote, LT connected a future job, what he had seen on TV and movies and what a scientist might need to do to explain why he wanted to be better at using models in his class.

> "So if I have like a job to balance things out, like on those movies and TV shows like those merchants, for the balancing beams... for that, they try to trick the person. So yeah, I don't really want THAT to be my job but like... If you're trying to weigh, like if you're a scientist and trying to weigh something and you have to use a triple beam balance or another scale... that's why." (11/21/19).

Getting better at using models was a way for LT to feel like he could be better in science. LT's interests outside of class continued to influence his thoughts regarding his science-student-self inside his science class.

LT used an animated character reference to describe how he viewed analyzing and interpreting data. "[I]f someone says that this character is powerfuller than this other character and you searched it up and then you get confused and you don't interpret the data or analyze it then you'll agree with the wrong statement." According to LT, analyzing and interpreting data incorrectly or not at all could cause you to make a mistake or have the wrong answer. He felt that it takes "a little bit of work" to do well analyzing and interpreting data. His access into his science community via this practice was viewed through his interest in animated books and TV series.

Additionally, LT stated that it was important to him to obtain information because "[t]he teacher would call on me for an answer and then I wouldn't know" and "I'd get it wrong and then I'd get a zero or something like that." If he did not obtain information during the cells unit LT felt that he would not be able to answer questions asked by his teacher correctly and that he could potentially get a bad grade on an assignment. It was important to LT that he answered questions correctly.

Mikel

Mikel experienced analyzing and interpreting data, using models, and mathematics and computational thinking the most during the cells unit. Each practice allowed him access into the culture of science within his science class. Using models provided him with the most excitement in class because "whenever we use hands-on I get excited." His science identity was described as that of an engaged student who was good in math, good at doing his science work, a student who took good notes and was sometimes in the mood to do his work and sometimes not in the mood to do his work. Ultimately, getting good grades in science was important to Mikel. He believed that his teacher saw his performance of the three practices positively and because of his grades and taking good notes, so did his peers. Further analysis of Mikel's semi-structured interview transcript and the field notes and observations III revealed additional traits expressed by Mikel about his science-student-self.

The findings from the first research question revealed that Mikel believed in his confidence as a science student. Additionally, he believed that the expectations pertaining to who he was as a science student were influenced by his perceptions about being a good science student and the perceptions of others about his performance as a good student. The social psychology attitudinal analysis for the third research question revealed that Mikel's expressed attitudes about his science-student self revolved around affect, his behavioral decisions as a science-student, his social interactions with his teacher and peers, and why he thought it was important to enact his science-student-self as he did in class.

Affective Expressions

Mikel's affective expressions as a science student reflected his confidence in his science-student-self, his thoughts about the perceptions of others toward his science-self, and his emotional reactions within his class. Mikel confidently believed that he had access into the knowing and doing of science via his top three practices. Mikel stated, "I know what I gotta do," "I had to do it by myself," and "I get what's going on." Multiple times Mikel stated "I'm good at taking notes." Mikel felt that he would be viewed as doing mathematics and computational thinking (MCT) well because "I take good notes." Additionally, he stated "I think [MCT] is a part of science. Like STEM..." Mikel identified math as being something that he was good at doing. Pertaining to using models, Mikel said, "I think I do better when I'm using models," "I feel like I use models well," and "I like hands-on things." He expressed that he was confident in his ability to complete the tasks asked of him during the cells unit and because he knew what he had to do he said "it's not hard."

> An exchange between Mikel and Mrs. Sunshine during a class session also showed his confidence in his science-student self.
>
> [Mrs. Sunshine asked Mikel if he was okay.]
>
> Mrs. Sunshine: "Weekends must be rough, you're not your usual self... What does qualitative mean?"
>
> [Mikel looked at Mrs. Sunshine with a crazy expression.]
>
> He then commented that "you look at it to figure out qualitative observations." Then said "My gummy bear is green." (FN, 11/18/19).

Even though Mikel seemed to not be his usual self on that day, he was still alert and able to think as a science expert in his class and contribute to the learning within his science community. He responded to Mrs. Sunshine without much hesitation. Mikel's enacted science-student-self was also influenced by the perceptions of others within his science learning environment.

Mikel showed when he thought he did well and also hoped that his teacher and peers felt that he analyzed and interpreted data well. When asked he said, " I hope she [Mrs. Sunshine] think I do good." Regarding his peers he said, "I hope they know that I'm good at taking notes." He felt similarly about their perceptions about his MCT abilities. "I take good notes" is why he guessed that his fellow classmates would say that he does well in MCT. He recalled a more specific encounter with Mrs. Sunshine concerning MCT. Mikel was confident in saying "I feel like she does" when asked if he felt that Mrs.

Sunshine believed that he did well at MCT. He recalled, "I feel like she does, because like when she came over there she's like, yes, that's good...". He was recalling a time during the gummy bear lab where students were gathering information to later discuss osmosis versus diffusion. Pertaining to using models, he first stated, "I don't know" to what his peers may think of how he used models. Then he said "I guess they do" to seeing him as a student who uses models well. He believed that Mrs. Sunshine felt that he used models well during the cells unit but when asked why he felt that way he said "I don't know." Mikel expressed that it mattered to him how his enacted science-student-self was viewed by his peers and his teacher.

Mikel's ability and desire to acquire scientific knowledge and skills was also expressed via a physical display of his emotions. Mikel showed that he thought he was doing well by sometimes doing a dance in class. "It's my emotions coming out" he said. When he felt like he was doing well he would (while clapping his hands and rubbing them together) say "Like let's go!" and "Like, yes sir!" His energy level increased when he did well in class. Mikel went up to Mrs. Sunshine to check on his grades on the cells vocabulary game, read and response, and quiz, he got a 100, 88, and 100. He did a dance after seeing his grades (FN, 11/13/19).

Being able to use models in science during the cells unit allowed him to "feel excited" about being in his science class. Counter to his excited mood he said, "I'm in a good mood sometimes when I'm using models." "Sometimes I'm just like, okay I'll do it but sometimes I'm excited and I actually work better than I do taking notes." He garnered access into the world of science via his opportunity to use models and because of the practices that he engaged in as a science-student. Mikel's intrapersonal and interpersonal behavioral expressions were also part of his enacted science-student-self.

Behavioral Expressions

Mikel showed that he was determined to gain scientific knowledge and that he would do what was necessary to get the work done. When asked about analyzing and interpreting data, Mikel stated "I feel like it's like I know what I gotta do" and "I gotta figure out". He positioned himself as a science-student who put effort into working things out for his good and for his science-student success. While working in a group Mikel expressed, "I had to do it by myself" and "I had to do all the measurements by myself." He expressed some frustration with his group members during this session but he still did not let the group dynamics interfere with his completion of the task. Mikel showed his ability and determination to do the science work expected of him during the cells unit.

Mikel described his science-student-self via the actions he engaged in doing during the cells unit. Mikel stated that he thought analyzing and interpreting data during the cells unit looked like using the microscope to view the onion cell and "we had to like draw whatever the cell looked like." Analyzing and interpreting data also looked like "taking notes," "we had to analyze the data off the internet and then make our slides" and "writing it down I think."

Mikel described MCT as "[l]ike taking measurements and helping you get down your notes. Like when we wrote down how long the gummy bear it was on our paper." MCT was linked to taking notes for Mikel. He also voiced that "when we did the gummy bear we had to measure like how tall it was, how long it was, and I think that's like mathematics and like you had to think about it." In addition to these works, Mikel stated that, "I'm up talking, asking questions and like responding to questions that the teacher are asking. And like making good grades." Some of his interpersonal actions mirrored his intrapersonal actions.

The group dynamics Mikel experienced and the behaviors Mikel used to describe what it looked like to be a good science student in his class were the primary themes that emerged regarding his interpersonal behavioral expressions. Mikel would "take turns" with his group members looking at the microscope, but there were times when he said "if I want to do it by myself, I just...". He displayed his determination to get the work done while working in his group. However, he would not always do the task with members of his group. Mikel stated, "we didn't do it like a group." He was observed as being frustrated with his group members when asked to engage in MCT.

The gummy bear lab allowed Mikel to work with three of his classmates. However, he said "he's trippin" about one of his group members during the gummy bear measurements and volume computation portion of the lab (FN 11/18/19). When asked about how he was feeling at that time, Mikel said that his group member was "in a bad mood" and chose to "... go on the other side of the table and just like help them out. And I had to do all the measurements by myself...". He was frustrated with his group member but he still performed the MCT practice as he was instructed. This behavioral response seemed to show that Mikel believed that completing the work expected of you was characteristic of being a good science student.

Mikel and his peers showed their good student traits in varied ways. "We just tell if we got A's and B's" was Mikel's response to how he and his peers show how they use models well. "They show it when they get good grades in their Powerschool." This sharing of grades occurred with only some of his peers. When he was asked to rank himself, out of three, in comparison to his peers that do well at analyzing and interpreting data, Mikel ranked himself third. The two classmates that he listed before himself would "pay attention" in class and were "quieter" in class. He felt that he analyzed and interpreted data well because "I think I take good notes that I can read and study overnight. When it comes to the test, I know what it is that I had in my notes to help me out." Although he would take good notes, study and know where to find information needed for his test, he still felt that paying attention and being quiet positioned you as a better science student. The thoughts that Mikel had related to why he enacted his science-student-self as he did during the cells unit are discussed below.

Cognitive Expressions

Mikel believed that there were things that he did well, that his top three practices helped him learn science and that there were consequences when you didn't engage in the practices expected of you. Mikel's confidence in saying "I know what I gotta do" showed his desire to do what he needed to do to be successful at analyzing and interpreting data. He believed that this practice helped you have the information that you needed to do well on a test, which he considered important. His view of MCT fit well with his belief in himself, "I'm good at math!" and "I have an A in math." MCT allowed Mikel to enter into the culture of science during the cells unit. MCT did not hinder his engagement in class, it helped him. He had similar feelings toward the utility of using models and analyzing and interpreting data.

Mikel verbally explained that using models "helps you." "It helps you to see something better, feel something, it helps you... do something." His science identity was visible when engaging in the practice of using models. He stated, "It [using models] helps me figure out things better." His belief that taking notes was part of analyzing and interpreting data led him to say that "I think taking notes in class is like gonna help you in the long run." Mikel thought that engaging in these practices was helpful and that when you did not engage in these practices it would interfere with your success in class.

Mikel said, "If you don't have notes you're not gonna know what's gonna be on the test when you get there, like when you get to the test." He wanted to have the information that he would need to do well on his test. Additionally, if a student chose not to engage in MCT in class Mikel stated that "they just won't have good notes" and "they won't get it". His ability to use models to see science better was important to him, he wanted to "get it". "Like when you know you can't see nothin but if you use this model you know you can see it. Yeah, makes me excited." Mikel believed that the consequences for not engaging in the practices expected of you would result in not having the information needed to understand the content being taught. Mikel, Kyle, Jay and LT expressed his beliefs in his enacted science-student-self in comparable and contrasting ways.

Section Summary

This section summarizes the beliefs that Jay, Kyle, LT and Mikel had concerning their enacted science-student-selves. After experiencing certain normative scientific practices, the following themes presented for Jay, Kyle, LT and Mikel with regard to their affective expressions, behavioral expressions and cognitive expressions. The affective expressions centered around confidence, the utility of the practices, outward expressions of his emotions toward the practices or after success with the practices, and perceptions of his science-self. Intrabehavioral expressions were situated in confidence, his science-student actions, notions of grit, and sometimes being a quiet student. Interbehavioral expressions included working together with his peers to achieve, perceptions, and engaging in acceptable science-student behaviors. Lastly, the cognitive expressions pointed to a desire to do well, the ability to do the work, the utility of the practices and negative consequences being the things that they thought governed the way in which they enacted their science-student-selves during the cells unit.

Affective Expressions

Confidence in his science-student abilities presented as a theme for Mikel, Kyle, and LT. LT continually expressed the idea that sometimes he is confident in his science-student abilities and sometimes he is not confident, "I am a little bit good at it.". His way of framing this duality occurred when he was referencing his usage of scientific equipment. He was not always confident when he would use scientific equipment during the cells unit. However, he was confident in his knowledge of the science content, in his ability to obtain information, and in his inclination to answer science questions asked by

Mrs. Sunshine. Mikel and Kyle both felt that they had the ability to succeed in their science class during the cells unit. They shared that they believed in their ability to do the science practice expected of them and to do it well. Like LT, Kyle stated that there was a time that he did not feel confident. Unlike LT, Kyle only stated this once in reference to when he felt that he did not have enough information to understand the science content. As implied by Kyle, he found obtaining information to be useful in his pursuit of success as a science student during this study.

Jay and LT explicitly said that there was purpose for them in engaging in normative scientific practices during the cells unit. Jay noted that it would "be more fun" for him, and "more entertaining" if he could engage in using models more in class. This practice was not one of the practices that Jay identified as his top three but it was one that he felt would benefit his science-student-self. Moreover, LT noted using models as one of his top three practices and he felt that using models during the cells unit helped him. He felt that when he was able to use models it helped him to understand science content and to remember science vocabulary and content. LT's ability to remember information was part of how he described his science-student-self. Therefore, using models helped to sustain the growth of his science-student-self. Although LT and Jay spoke to the utility of normative scientific practices, they also mentioned being bored at times when they were expected to engage in these practices.

LT, Jay and Mikel each expressed outward emotions in response to participating in the practices that they experienced during the cells unit. Mikel's emotional responses were mostly positive, which was counter to LT and Jay's emotional responses. Mikel would be "smiling," he would be excited and in his words said, "it's my emotions coming out" when he described when he would make statements like "let's go!" and "yes sir!". Mikel iterated that he would sometimes be in a good mood. He was observed dancing after receiving high scores on assignments during the cells unit. Mikel also noted that sometimes he would not be in a good mood. This was in reference to working in a group with students he said that he was not friends with. Mikel did not let his not being in a good mood interfere with his completion or engagement in the practices expected of him. The same was observed for Jay and LT.

Jay also expressed a notion of not being in the mood to do the work expected of him. He stated, "I don't feel like doing all of it" when asked about how he felt about obtaining information during the cells unit. He was bored when expected to just obtain information and communicate information. LT was also bored while using models because he had already completed the task asked of him. Similar to Mikel, Jay nor LT allowed these moments of being bored or not being in the mood to do the work in class to keep them from actually doing the work. This was part of who they were as science-students. They did their work. Kyle and Mikel's affect during the cells unit was also influenced by perceptions.

Pertaining to Kyle, it was his awareness to his personal wants and desires for success as a science student that influenced how he felt toward engaging in the practices that he experienced. Kyle explained that he wanted to do well in class and that he wanted to get good grades. He was also sensitive toward his peers experiencing success during the cells unit. Mikel's focus was on the perceptions of others toward his science-student-self. He hoped that his peers and Mrs. Sunshine would see his science-student actions as that of a good science student. What others in his science community thought of his enacted science-student-self mattered to him. Kyle cared about his perceived success as a science-student and the perceived success of his peers as science-students. Kyle, Mikel, LT and Jay also displayed his science-student-self via his personal actions in class and by way of the social interactions with others in his class.

Intrabehavioral Expressions

The actions displayed by Jay, LT, Kyle and Mikel centered around his confidence in himself, in his science-student works, in his grit and for Kyle and LT, in his ability to be a quiet student. Confidence appeared in the actions of Jay and Kyle. LT continued to show a duality with regard to his actions in class. He mentioned times when he would try to remember science content, he would try to find the information needed to complete the task, and that he could use his math skills in science. He believed that he was good in math. Counter to this position, LT said that there were times when he would forget things and he would get confused. He noted the areas that he felt he struggled in as a science student. Jay and Kyle made comments phrased as an "I can" statement. They believed in their abilities to obtain information and communicate information. Jay and Kyle were confident in what they knew they could do in class and in what they would choose to do in class as they enacted their science-student-selves.

The science-student actions that Kyle, LT, Mikel and Jay displayed were in response to the normative scientific practices that they experienced. Kyle stated that he would decode information, analyze information, look for clues, study, evaluate information, and answer questions in class. Jay said that he would find information, he communicated with his group, he drew diagrams and science representations, he would answer questions, and he would look for evidence. LT would answer questions, obtain information, search for articles and skim read to find the information that he needed for a task. Mikel drew diagrams and science representations, he took good notes, he studied overnight, he answered questions and would ask science content questions in class. Each participant enacted his science-student-self by carrying out the practices that he believed were expected of him as a science student in Mrs. Sunshine's science class. This inclination to do the work that was expected him was explicit in the interviews conducted with Kyle and Mikel.

Kyle and Mikel spoke of their determination or grit to be successful science students. Mikel stated boldly that he knew what he had to do and that he would do it. He would do the work even if he had to do it by himself when given the instruction to work with a group. Kyle made efforts to try and focus and engage in cell unit tasks in order to help himself be successful in his science class. They iterated their determination to gain and dispense science knowledge to be successful as a science student within their science classroom context. Kyle and Mikel showed their positive beliefs in their science-student-selves through their determination to learn science content. The last intrabehavioral expression spoken of by Kyle and LT was in reference to being quiet in class.

Kyle's notion of being quiet in class was different from LT's notion of being a quiet science student. Kyle stated that he was quiet because it helped him to focus. It was part of what allowed him to gain the information that he needed in class to feel comfortable and confident while enacting his science-student-self. LT framed being quiet in a "traditional student behavior" way. Although he would readily and eagerly answer questions in class, he highlighted that his propensity toward being a quiet student who does not get in trouble qualified him to be considered as a "good science student". Mikel spoke of his affective expressions being opposite LT's notion of a quiet science student. Mikel not always being quiet was his outward expression of him being a good science student who got good grades in his science class. Jay, LT, Kyle and Mikel also showed their science-self through the interactions that they had with their peers and Mrs. Sunshine.

Interbehavioral Expressions

The social interactions between Kyle, LT, Jay and Mikel and his peers and teacher provided another level of description for their enacted science-student-selves during the cells unit. Kyle, LT, Jay and Mikel showed that working with their peers to achieve as a science student, perceptions, and acceptable behaviors were actions that illustrated aspects of their science-student-selves. Working with his peers was something that LT and Kyle expressed as something that they did and that they enjoyed doing. LT experienced some contention while working in groups but he still believed that he had positive exchanges with his group members that benefitted each of them. Kyle also believed that working with his peers was mutually beneficial to his science-student success and to the science-student success of his peers. Kyle made a point to help his peers and he wanted to be considered as someone that his peers could depend on for help in their science class. Kyle cared about the perception that his peers held toward him and his science-student abilities.

Peer and teacher perceptions were influential in how Kyle, LT and Jay described their science-student environments. During the cells unit, Kyle, LT, and Jay shared that they believed that their peers and teacher would say that they did well while engaging in some of the practices that they experienced during the cells unit. Jay, LT, and Kyle ultimately believed that his peers saw him act in acceptable science-student fashion. Kyle and LT were the only two who also believed that Mrs. Sunshine would also perceive them as being good science students based on their displayed abilities while engaging in their experienced practices. There were instances when LT and Jay expressed that they were not certain about how Mrs. Sunshine might see their abilities as science students. Jay expressed being certain when Mrs. Sunshine could see that he was collecting evidence to evaluate information. He had to produce a product that Mrs. Sunshine could see to believe that she would view his science-student actions in a positive light. He believed in the products that he produced. There were acceptable behaviors that Jay and Mikel noted as being part of their science-student-selves.

Jay and Mikel spoke of these acceptable behaviors when speaking about themselves and their peers. Jay agreed that he and his peers did well with his identified practices because they would talk a lot, they would communicate within their group and conduct the research needed to complete the task. Similarly, Mikel credited himself and his peers with paying attention in class, taking good notes, and showing when they got A's and B's on assignments during the cells unit. Jay and Mikel also stated that being quiet science students meant that you were a student who did a normative scientific practice well. The actions described above relate how the cell unit interactions between Jay, LT, Mikel and Kyle and their peers and teacher shaped their science-student experiences. These experiences influenced how each participant viewed his science-student-self. He viewed himself through his lens, the lenses of his peers and his teacher, and through the lens of acceptable behaviors in his science classroom. The next section will discuss the cognitive expressions of Jay, LT, Kyle and Mikel.

Cognitive Expressions

The cognitive thinking that governed the science-student expressions of Jay, LT, Kyle and Mikel centered around a desire to do well, the ability to do well, the utility of the practice, and the perceived consequences for not engaging in the normative scientific practices expected of them. Kyle and Jay were the two study participants who explicitly stated that he wanted to do well in his science class. Jay had a desire to get the scientific information needed to complete the cell unit tasks. Kyle stated that he wanted to do well in his science class for himself. He wanted to be successful as a science-student. This desire influenced how he enacted his science-student-self. Although Mikel and LT were not explicit in stating a desire to do well, they expressed their abilities to do well in their science class.

Jay, LT, Kyle and Mikel all expressed confidence in their ability to do the science work expected of them during the cells unit. Mikel believed that he took good notes, he studied, he used models well, he would answer questions in class and engage in other ways. Jay believed that he possessed the skills to do the work. He believed that he knew how to obtain information, look for evidence, and do the research to find the information that he needed to successfully complete the task. Kyle stated multiple times that he knew that he could do the work via "I can" statements. Kyle believed that he could remember science content, obtain information, answer science questions, ask scientific questions, study hard, analyze information and communicate information. LT differed slightly in this area in that he believed that he could obtain information, sometimes use models well, analyze information, remember science content, and do well in math. LT stated that he thought that he was sometimes good at using models and that there were times that he was not good at using models. LT and Mikel believed that engaging in the practices expected of them was beneficial to their success as a science student.

LT had this duality in thought pertaining to his abilities but he believed that the practices that he experienced helped him to understand the science content better. Mikel also believed that the practices helped him learn. He stated that using models helped him to be able to see something better or to be able to feel something. LT believed that obtaining information and using models would help him remember content. He also believed that if he used models well it could help him do the work of a scientist. He related the utility of engaging in the practice with science careers. Counter to the positive benefits of the practices, Jay, Kyle, LT and Mikel all thought that not engaging in these practices would result in negative consequences.

The possibility of failing in science, getting an F, not having the information that you needed to answer questions, not being able to understand the content and ultimately not succeeding in class all influenced how Kyle, LT, Mikel and Jay enacted his science-student-self. The four study participants wanted to do well and chose to engage in the practices that they experienced because they did not want to experience any of these consequences. Jay, Kyle, LT, and Mikel each stated that they wanted to make good grades and not fail. They wanted to understand the content and to be able to actively participate in their science learning community. The normative scientific practices that Jay, LT, Kyle, and Mikel experienced in his science class influenced the affective, intrabehavioral, interbehavioral, and cognitive beliefs that each student held about his enacted science-student-self.

Chapter Summary

This chapter reported the findings for this study concerning the science-student beliefs held by Jay, LT, Kyle, and Mikel during a cells unit in a seventh-grade science class. Table 4.11 shows the results for each research question and each study participant.

Table 4.11

Study Findings for Jay, LT, Kyle, and Mikel

	Jay (1st period)	**LT (1st period)**	**Kyle (2nd period)**	**Mikel (2nd period)**
RQ1	1. Confidence in his abilities as a science student 2. Behavior matters	1. Confidence in his abilities as a science student 2. Behavior matters	1. Confidence in his abilities as a science student 2. Behavior matters 3. Expectations influence his science self	1. Confidence in his abilities as a science student 2. Expectations influence his science self
RQ2	• Obtain information • Evaluate information • Communicate	• Use models • Obtain information • Analyze and interpret data	• Obtain information • Evaluate information • Communicate	• Analyze and interpret data • Use models • Mathematics and

	information		information	computational thinking
RQ3	**Affective** 1. Utility of the practice 2. Emotional reactions	**Affective** 1. Confidence 2. Utility of the practice 3. Emotional reactions	**Affective** 1. Confidence 2. Perceptions	**Affective** 1. Confidence 2. Perceptions 3. Emotional reactions
	Intra-behavioral 1. Confidence 2. Science-student actions	**Intra-behavioral** 1. Confidence (counter) 2. Science-student actions 3. Quiet student	**Intra-behavioral** 1. Confidence 2. Science-student actions 3. Grit 4. Quiet student	**Intra-behavioral** 1. Science-student actions 2. Grit
	Inter-behavioral 1. Perceptions 2. Acceptable science-student behaviors	**Inter-behavioral** 1. Perceptions 2. Working together to achieve	**Inter-behavioral** 1. Perceptions 2. Working together to achieve	**Inter-behavioral** 1. Working together to achieve (counter) 2. Acceptable science-student behaviors
	Cognitive 1. Capabilities 2. Desire to do well 3. Consequences	**Cognitive** 1. Capabilities 2. Utility of the practice 3. Consequences	**Cognitive** 1. Capabilities 2. Desire to do well 3. Consequences	**Cognitive** 1. Capabilities 2. Utility of the practice 3. Consequences

The findings answered the three research questions for this study: 1) What beliefs do Black male middle grades students have about their science-student-selves at the start of a unit of study in a rural school setting? 2) What normative scientific practices do Black male students in a rural middle school classroom experience during a unit of study? and 3) How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a unit of study in a rural middle grades science classroom?

Jay, LT, Mikel, and Kyle held beliefs at the start of the cells unit that were sustained throughout their experiences engaging in normative scientific practices. The themes of confidence and capabilities, behaviors matter, and perceptions and expectations existed prior to the cells unit and were present as beliefs that the student participants held after the cells unit. The utility of the practice emerged as an additional belief that Jay, LT, and Mikel held after the cells unit. The utility of the practice influenced how each student enacted his science-student-self. These themes provided Jay, LT, Mikel and Kyle with access into their science learning community. The afformentioned factors also shaped how the science identity of each student was sustained. The above aspects of their science learning experiences also revealed the important factors in being a science student in their two science classes.

Jay, LT, Mikel and Kyle each shared the three practices that they experienced most during the cells unit. Jay and Kyle experienced obtaining information, evaluating information and communicating information the most during the cells unit. LT also experienced obtaining information the most during the unit. LT and Mikel experienced using models and analyzing and interpreting data. Mikel also noted mathematics and computational thinking as a practice that he experienced most during the cells unit. Jay and Kyle's experiences matched the researcher's observations during the study observational period. The experiences of each participant also differed from Mrs. Sunshine's overall thoughts on the practices that the students experienced most during the cells unit. This reported difference revealed the contrast between the lived science learning experiences of the four study participants compared to the desired instructional experiences designed by Mrs. Sunshine. Specifics about the four themes mentioned above will be discussed in the following sections.

Confidence and Capabilities

The confidence and capabilities of Jay, Kyle, LT and Mikel were visible at the start of the unit on cells. Their confidence in themselves as science-students and their confidence in their abilities to do the work expected of them was observed in the way that Jay, Kyle, LT, and Mikel expressed themselves as science-students. All four participants expressed the cognitive notion that he was capable of engaging in the practices that he experienced most during the cells unit. This confidence allowed the participants to access science learning within their science classroom communities. The affective expressions, intrabehavioral expressions and the interbehavioral expressions also showed their confidence in their science-student-selves. LT would occasionally express that he was not fully confident in his ability to do a practice well. He equated using science equipment with the practice of using models. Kyle stated once that he was uncomfortable if he did not obtain the information that he needed to understand a science topic. Engaging in their experienced practices allowed for their confidence in their science-student-selves and abilities to be sustained during the cells unit.

Behaviors Matter

Behaviors for Jay, Kyle, LT, and Mikel varied for the cells unit. Behaviors for the study participants started as what Jay, LT, and Kyle mentioned as being a quiet student.

At the start of the cells unit, being a quiet student was associated with being a good science student. This idea was maintained by LT and mentioned by Kyle as a way for him to focus in class. Additionally, Jay noted being bored at the start of the unit, he and LT maintained this feeling of being bored at times while obtaining information, communicating information and while waiting during a task that allowed them to use models. However, their enacted behaviors were expanded after engaging in their experienced practices.

At the start of the unit Kyle expressed the notion of not wanting to show emotions about being a good science student. This lack of emotions was not maintained during the unit. Kyle, LT, Jay, and Mikel showed his science-self and his science identity through his science-student actions. Mikel's outward affective expressions extended to dancing, being loud, and smiling when he did well during the unit. Jay and Mikel's interactions while engaging in their experienced practices with their peers revealed their belief in the existence of acceptable science-student behaviors. Their outward expressions were also part of their science identity within their classroom context. Some of these behaviors included taking notes, paying attention, obtaining information, helping classmates, communicating information, and conducting research. All four participants believed that there were consequences if they did not participate in the normative scientific practices that took place during the cells unit. Their behaviors as science-students mattered regarding their overall science class success. The behaviors mentioned by Jay, Kyle, LT and Mikel showed what the participants considered important as they enacted their science-student-selves.

Jay, LT, Kyle, and Mikel wanted to do well in class and they believed that if they did not engage in their experienced practices they could fail, get a bad grade, or get a grade that they did not want. Kyle also believed that if he did not obtain the information that he needed then he would not understand the science content being taught in his science class. LT believed that he would not be able to respond to a question correctly if he did not participate. He also believed that he could remember and/or believe the wrong information if he did not analyze and interpret information well. They all believed that it benefited their science-self to engage in the practices that occurred for them during the cells unit.

Perceptions and Expectations

The perceptions and expectations of self and others was evident for Kyle and Mikel at the beginning of the cells unit. Kyle believed that Mrs. Sunshine would expect to see skills in science students that went beyond a student being good in science. He thought that being good in other things like music or sports would also qualify as being a good science student. Mikel verbalized that it mattered to him that his Mother and teachers would see him as a good student. He also wanted to see himself as a successful science student. The theme of perceptions and expectations persisted during the cells unit.

Kyle and Mikel continued to have feelings about the perceptions of others toward his enacted science-student-self. Their social interactions framed aspects of their beliefs in their enacted science-selves. Kyle wanted to be viewed by his peers as a science student that they could depend on to help them understand science content. He believed that he could be a helpful science student. Mikel hoped that Mrs. Sunshine and his peers would view his performance of his experienced practices positively. Jay, LT, and Kyle each stated that they believed that their interbehavioral actions in some way would show their peers and/or Mrs. Sunshine that they do well when engaged in normative scientific practices. The final theme that emerged during the study pertaining to the science-student beliefs of Jay, LT, Kyle, and Mikel was the utility of the practices.

Utility of the Practice

The utility of the practices was not referenced by the study participants at the beginning of the cells unit. Jay and LT felt that engaging in the practices that they experienced influenced their enacted science-student-self; they considered the utility of the practice important. LT and Mikel's cognitive expressions also indicated that they believed that engaging in the practices was beneficial to their science-student-selves. Jay felt that he could have more fun in class if he was able to use models. LT's feelings and thoughts were that using models was going to help him do well. He reasoned that using models would help him remember content which he identified as part of his science identity at the start of the cells unit. He said that he had a good memory. LT thought that using models would help him to be able to perform as a scientist would perform their tasks. Similarly, Mikel thought that using models and being good in math helped him to learn as a science student. He stated that using models helped him to be able to see something and feel something that he was not able to see or feel while just taking notes. Jay, LT, and Mikel were able to access the culture of science within their science learning community when engaged in normative scientific practices.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

This chapter will discuss the themes that were supported by the data collected during the cells unit in Mrs. Sunshine's seventh-grade science classes. The data served to answer the three research questions for this study: 1) What beliefs do Black male middle grades students have about their science-student-selves at the start of a unit of study in a rural school setting? 2) What normative scientific practices do Black male students in a rural middle school classroom experience during a unit of study? and 3) How and to what extent are Black male students' beliefs about their science-student-selves influenced by the normative scientific practices that take place during a unit of study in a rural middle grades science classroom? Following this discussion will be a summary and conclusion to how the data from this study contributes to the educational literature pertaining to the science-student beliefs of Black male science students in rural middle school science classroom contexts. Given that the research in this area is minimal, this study's findings show how the expected normative scientific practices in a classroom influence what four Black male students believe about themselves as science students.

Discussion

Parsons, Travis, and Simpson (2005) stated that "... ways of knowing and interacting as well as norms, beliefs, and values are required in learning science..." (p. 187). At the beginning of this study, Jay, Kyle, LT and Mikel each expressed what he believed about his science-student-self. It seemed that the positive aspects of each student's science and school identity already existed prior to the start of the cells unit. No matter the cells unit assignment, they would still complete the work, pay attention in class and work to get good grades that might be noticed by their peers and teacher.

The four science-student belief themes that emerged during this study were related to the study propositions laid out in the research design (Table 3.1) and sociocultural theory chosen for this study. Within the emergent four themes, the science identity of each participant, what the participants felt were important within their science learning context, how they accessed the culture of science, and the influence of their social interactions on their enacted science-selves were revealed. These study findings highlight the relevance of the science student achievement goals posited in *A Framework for K-12 Science Education* (*Framework*). The *Framework* is the most recent shift pertaining to science education and student expectations, an extension of doing science that focuses on scientific practices as a means of aiding students in constructing and applying scientific knowledge (Berland et al., 2016). Jay, Kyle, LT and Mikel believed in himself as a student and science student at the beginning of the cells unit and the *Framework* practices that they experienced influenced these beliefs in mostly positive ways. The use of ethnographic tools such as interviews and classroom observations in this qualitative study allowed for student voice and actions to be highlighted and attention to be given to the examples of student access, science identity and classroom social interactions within this rural science classroom context.

The science-student beliefs that Jay, LT, Kyle and Mikel expressed during this study revolved around the four themes of confidence and capabilities, behaviors matter, perceptions and expectations, and lastly the utility of the scientific practice. Each student verbalized his confidence in his science-student abilities at the start of the unit. Behavior and expectations were also voiced as factors in their science identity at the beginning of the cells unit. Within these themes, the participants' voices were heard pertaining to their science community access and actions, their existing and developing science identity and their social interactions in the classroom, as a result of the normative scientific practices that they experienced during the cells unit.

Science Classroom Culture

As emphasized by Carlone (2012), the science culture and science performance expectations for students vary from classroom to classroom. Being a science expert in either class period that Jay, Kyle, LT or Mikel were in, looked like a student who would pay attention, communicate the knowledge that they had about the material in written or verbal form and show their teacher and peers what they knew about the topics discussed during the cells unit in verbal form. The expectations in Mrs. Sunshine's seventh-grade science classroom were that students obtained information via listening to the teacher provide vocabulary terms and notes and using the information they taped into their science notebooks to find the answers to complete notes sheets and/or answer content questions posed by Mrs. Sunshine (31.6%, 33.5%). Students also obtained information by watching video clips from internet sources and conducting lab exercises during the cells unit. Students in Mrs. Sunshine's class communicated their answers to teacher questions and daily science questions in verbal and written form (35.8%, 33.2%). It was also expected that students take information from their teacher or external resource and evaluate that information to make sense of the material and then answer class questions, discussion questions, and/or activity questions (12.5%, 11.1%). The normative scientific practices that they identified as occurring the most during the cells unit ultimately influenced how they chose to continue to enact their science-student-selves in class.

Jay and Kyle agreed that obtaining information, communicating information, and evaluating information were the most frequently occurring practices, LT also felt that obtaining information occurred frequently and Mrs. Sunshine felt that students were expected to communicate information frequently during the cells unit. Additionally, Mrs. Sunshine felt that the instruction that she gave students during the cells unit required them to analyze and interpret data and carry out investigations. LT and Mikel felt that they experienced analyzing and interpreting data and using models during the cells unit. Mikel also stated that he experienced mathematics and computational thinking often. These select experiences with practices resulted in the representation of enacted versions of their science-student-selves.

Science Community Access and Actions

Jay, Kyle, LT and Mikel each expressed feeling like they could contribute to the science learning community in Mrs. Sunshine's classroom. The expectations stated above for their science classroom gave each student access into science. Each student made the choice to engage and enact their science-student-selves in response to the practices expected of them. According to Carlone (2012) and Kelly (2007) the normative scientific practices of a science classroom are gatekeepers for some students to gain access (or not) into the culture of science at large. Obtaining information gave Jay, Kyle and LT access into their science community. They each stated that they were able to gather information well: "I can easily find information." "I am good at obtaining information." and "I can obtain information very well." Listening to the teacher, reading, and/or watching a science content video clip to gather information helped LT to figure out the "difference [between] eukaryotic and prokaryotic" and helped him with his "memory capacity". LT said "[w]ell sometimes I forget things and then when a certain time comes I remember them." He highlighted the utility of obtaining information to help him remember and recall scientific knowledge. He also believed that using models helped him "to like remember" information. LT's ability to remember science information was part of how he described his science-self.

Using models helped LT to get enough information so that he could better understand the content. Even though LT said that using models got a "bit hard" for him, it was the use of the science apparatus that caused him to have "a little bit of tiny issues". Which is sometimes an expected byproduct of introducing new science technology, learning styles, or instruments to students (Harris & Rooks, 2010). However, using models like the microscope to gather information to answer discussion questions or whole-class questions was not an aspect of using models that LT struggled with. LT's beliefs about the usefulness of using models during the cells unit extended to the thought of careers that might require the use of a triple-beam balance. He thought that if he worked as a merchant (like in the animations he watched) or a scientist then he would need to be good at using models like the triple-beam balance and because of that, he wanted to be better at using models. LT's experience with these practices were influenced by a notion posited by Avery (2013) that rural students may do better in science if they find utility in science knowledge and skills that extends beyond building student interest in a science career. If like LT, students can be exposed to science in a way that helps them see how scientific knowledge and skills can be applied to things in their everyday lives they may develop a genuine interest in science.

Kyle's access into his science classroom culture was connected to things he did outside of school and the open discourse culture created in his science classroom which gave him the freedom to ask a science question during a class session on plants. During a notes discussion of plants, Kyle said to Mrs. Sunshine, "I was watching National Geographic about ants. Would a plant ever have a defense system in it so things wouldn't eat it?" (FN, 11/25/19). Kyle was comfortable sharing his question aloud in class and he knew that it would be acknowledged and respected by Mrs. Sunshine. Kyle used the practice of communicating information to help him better understand the science content. Kyle felt that if he did not know something then communicating that information could help him to get the help that he needed so that he would gain new knowledge. This fit in well with his expressed desire in the beginning of the unit to "learn new things".

Analyzing and interpreting data helped Mikel and LT feel like part of their science classroom community. Mikel believed that he was good at taking notes and LT felt that he did well with choosing answers based on information that he researched and analyzed. However, Mikel and LT had a different interpretation of what it meant to analyze and interpret data. Mikel felt that he was required to take notes and write things down. LT felt that he was required to search for information and interpret that data to help him choose to agree or disagree with a given statement. The importance of soliciting student voice in better understanding how students view the practice of analyzing and interpreting data is displayed in the different ways that Mikel and LT interpreted this practice (Brand, Glasson, & Greene, 2006). The lenses through which teachers and students view classroom instruction differs but the lenses through which each student views classroom instruction may also differ (Love, 2014).

There were times when the practices expected of LT, Kyle and Jay frustrated their entry into their science classroom community. LT had trouble using the triple-beam-balance at times and thus concluded "I think I am good" and "I'm not sure I'm that good" at using models. Again, he was connecting his understanding of how to use the science apparatus with his ability to use models. Kyle stated, "I used to get really confused" before he decided to evaluate information that was given to him by his teacher. However, Kyle did not let his confusion interfere with his science learning. During a notes session on mitochondria, Kyle used another practice, communicating information, and chose to "evaluate what [Mrs. Sunshine's] saying... so I could understand it my way so I could get it." to help himself better understand the content.

Jay's actions sometimes reflected his description of how he felt when expected to obtain and communicate information, "bored". He felt that if he was doing something like using models more often in class then he wouldn't be as bored. Although Jay completed his work, sometimes after the initial due date, if this were not already part of his science identity, he showed that he would opt out of doing the assignment even though he was capable of doing the work. He showed his capabilities when he completed the cell organelle analogies project soon after Mrs. Sunshine told him that he would have to stay for CATS cafe if he did not complete it. Jay completed this assignment using only his notes in his science notebook. He stated multiple times that he was comfortable being asked to obtain or communicate information because "[he] can easily find information" and "[he] know[s] how to communicate". These practices did not challenge Jay outside of his original science identity which aligns with (Atwater, Lance, Woodard, & Johnson, 2013) who iterated that Black students need a challenging science curriculum.

Jay, Kyle and LT each mentioned that their grades might suffer if they chose not to obtain information as instructed by their teacher: "You'll probably get an F." "Possibly fail. Not get a good grade as I want." and "I'd get like a zero." Doing well in their class mattered to each of them (Fuqua Films, 2005; National Black Programming Consortium, 2013; Wildseed Films, 2013). They would pay attention and do their work to avoid getting poor grades in their science class. This sentiment about doing the work to get the grade you want was also expressed when evaluating information and communicating information were discussed with Kyle and Jay, respectively. Moreover, Jay expressed that evaluating information to find the evidence needed to answer a question was most important to him. He was more focused on the science skills associated with research and data interpretation. It was important to Jay to have the evidence to support your answer. The practices that Jay, Kyle, LT and Mikel felt were important to engage in during the cells unit reflected aspects of their science identity.

An Existing and Developing Science Identity

As previously mentioned in this chapter, Jay, Kyle, LT and Mikel started the cells unit with an existing ability and desire to do the work expected of them in their science class. Jay, Kyle, and Mikel each believed that he was a good science student. LT believed that sometimes he was good at science and sometimes he was not good at science. His belief about his lack of science skills was related to his challenge with using the microscope to consistently find a specimen and using the triple-beam-balance to accurately weigh the gummy bear during the gummy bear lab. LT, Jay, Kyle and Mikel each displayed their abilities and/or desire to acquire science knowledge and skills during the cells unit. Their science identity was linked to their school identity (Carlone et al., 2011; Kane, 2012a; NRC, 2012), they chose to do the work expected of them.

The six *Framework* practices that were experienced by the study participants helped each student to access his science identity and enabled him to perform scientific activities. Jay, Kyle, LT and Mikel experienced these two science-identity stabilizing factors via their engagement in the normative scientific practices that they experienced; which have been noted to aid in the development of a person of color's science identity (Carlone & Johnson, 2007). It was observed that Jay's desire to acquire scientific knowledge and skills was positively influenced when he was expected to evaluate and communicate information.

Evaluating information seemed to garner the most passion from Jay. He said, "Like we can have the answer but we still have to have the evidence..." and "The evidence shows that you actually have researched it." He emphasized that just getting the answer was not enough. Collecting data to support your answer was important. In reference to communicating information Jay said, "a lot of people are like, they'll know it [an answer] but they won't really say it, they'll be quiet." He responded, "I know how to communicate" and "I do a lot of talking". Jay was comfortable with performing in his science class. However, when Jay was expected to obtain information he was "bored" and would be observed to be off-task. This practice did not help Jay to engage in his science learning environment. Whereas, Kyle's engagement in obtaining information influenced his science identity.

Kyle's science identity was positively influenced by obtaining, evaluating, and communicating information. Kyle stated early in the study that he liked "learning new things" and he was interested in learning about animals. The cells unit instructional activities gave him an opportunity to develop in both of these areas. Kyle believed that paying attention in class helped him to learn new things. He confidently stated, "I am good at obtaining information because when it comes to science I can like know these certain things and I can like adapt to it quickly." Kyle said that obtaining information during the cells unit looked like "when [Mrs. Sunshine's] explaining something I'd try to get what she's saying and like try to remember the things and like clues that you can use." Kyle was evaluating the information that he was obtaining to help himself better understand science content. He utilized the practices that he was expected to engage in to become a more knowledgeable science student. LT and Mikel's science identity formation also benefitted from the practices that they experienced during the cells unit.

Using models was helpful to LT and his science learning. He felt that when he used models well, it helped him to remember science content. His memory was mentioned at the start of the unit as being part of his science identity. Mikel also believed that using models helped him to see content better and that he was able to use models well. Mikel expressed that he got excited in class when he was expected to use models. He voiced that he enjoyed doing hands-on things in his science class. Using models helped LT and Mikel access their science identity. Analyzing and interpreting data was viewed as a practice that required them to do a little bit more work.

Mikel viewed analyzing and interpreting data as a practice that required him to write things down. He felt that because he knew what he had to do, he did well at analyzing and interpreting data. LT believed that analyzing and interpreting data required him to conduct research to be able to make an informed decision about a given statement. LT felt that this was something that he did well during the cells unit. Although LT and Mikel interpreted this practice differently, their understanding of the practice did not prevent them from engaging in their science learning community. Lastly, Mikel believed that he was good in math so he was in his element when expected to engage in mathematical and computational thinking. He believed that mathematics was part of science, therefore his understanding matched the performance expectations placed on him. He recognized his ability to do well in science when mathematics was included as part of the instructional tasks. Jay, Kyle, LT and Mikel recognized their own abilities to perform in their science class and capable science students and they also recognized to some degree how their science-student-selves were viewed by their peers and teacher.

Social Interactions in the Classroom

Sociocultural perspectives in science education research refer to the social interactions that occur within varied institutions and cultures (Lemke, 2001). When viewed through the lens of the normative scientific practices experienced by Jay, Kyle, LT and Mikel, peer interactions in their classroom context positively influenced and sometimes attempted to disrupt the development or enactment of their science-student-selves. When Kyle was expected to obtain information and communicate information he felt that he was a science student who could help his peers and that his peers could help him. Kyle believed that when they helped each other they could both be a "good studying student". LT also expressed that he was helped by one of his lab partners when he was obtaining information via skim reading. LT viewed his ability to skim read as a positive aspect of his science identity. His lab partner highlighted some information that he "accidentally passed". LT was grateful that his lab partner pointed this out to him. This freedom to interact within their science learning context and the respect they possessed for the knowledge of their peers helped shape LT and Kyle's beliefs about their science-student-selves (Scott and Palincsar, 2013).

Mikel and some of his peers would brag about their minor science grades. Mikel said that this bragging was not intended to make anyone feel bad. Essentially this was a way that he bonded with his peers over what he believed was a representation of his and their success in their science class. However, Mikel did not always have positive experiences with his peers during the cells unit.

Mikel stated that he did not get to work with his friends on projects during the cells unit. He said that during the gummy bear lab this resulted in his frustration with a fellow lab partner. As a result, Mikel completed the gummy bear measurements on his own. He did not depend on another student to get his work done. Jay sometimes worked alone on projects as well. He completed the cell organelle analogies project alone which allowed him to complete the project quickly and in the way that he wanted to complete the project. Having the option to work in a group or as an individual helped Jay and Mikel to continue to access their science identity and engage in the expected normative science practices in their class. Jay, Kyle, LT and Mikel were able to provide examples of how they interacted with their peers and thus saw their science-student-selves. They did not have clear examples when probed about their interactions with Mrs. Sunshine.

What revealed itself most about the way that Jay, Kyle, LT and Mikel interacted with their teacher was that on multiple occasions they expressed not knowing how their teacher might view their abilities to do well in the practices that they experienced the most during the cells unit. This immediately highlights the gap between what teachers might hope to communicate to students about their abilities and what students interpret about their interactions with their teacher about their abilities. Mikel noted that he hoped that Mrs. Sunshine felt that he did well at analyzing and interpreting data. Mikel placed value on the perceptions of Mrs. Sunshine in characterizing who he was as a science student in his science classroom community (Moore, 2006).

The times that Jay, Kyle, LT or Mikel mentioned with certainty that Mrs. Sunshine saw their science student potential was during class sessions when they were expected to analyze and interpret data (LT), evaluate information (Jay and Kyle), conduct mathematics and computational thinking (Mikel), obtain information (Kyle and LT) and communicate information (Kyle). Jay, Kyle, LT and Mikel each stated that Mrs. Sunshine could see something tangible about his science-student-self. Each student performed his science-self in a visible form (Rivera Maulucci, Brown, Grey, & Sullivan, 2014). Kyle knew that because he was "normally answering questions" that Mrs. Sunshine believed in his science-student abilities to obtain and communicate information. Mikel recalled Mrs. Sunshine saying "[y]es, that's good" to him about his measurements during the gummy bear lab. LT and Jay referenced Mrs. Sunshine being able to see the evidence of their ability to perform well in a cells unit artifacts. Mrs. Sunshine had a role in shaping how Jay, Kyle, LT and Mikel viewed his science-student-self when engaged in the identified normative scientific practices (Weissglass, 2002). As seen in the Carlone and Johnson (2007) study, Jay, Kyle, LT and Mikel showed that their competence, performance, self-recognition and recognition by their peers and teacher when engaging in their experienced normative scientific practices influenced their beliefs about their science-student-selves.

Significance of the Study

Immediate implications for this study include the consideration of the current racial climate in the United States and the influence of the current narratives of Black males on the science identity works of Black male students and on the beliefs that teachers have concerning their Black male students. As Love (2014) states, the way that Black male students are perceived in society, outside the classroom, plays a role in how teachers see them, teach them and sometimes treat them in the classroom. These narratives of Black males also influence what Black male students believe about themselves and their abilities inside the classroom (Mutegi, 2013). Specifically, Mutegi states that Black students in general deal with this notion of "inferior others" (p. 88). Where the long-standing deficit framed literature and perceptions of Black people as inferior others remains a part of the Black student psyche today. This notion of "inferior others" was not displayed by Jay, Kyle, LT or Mikel. Each student showed an existing confidence and willingness to perform the practices expected of him in his science learning environment. In this study, the cultural influences from the science classroom context provided Jay, Kyle, LT, and Mikel the freedom to engage in science learning and to continue to develop and express their science identity. The social interactions they experienced with their peers revealed that peer interactions could benefit their success at being a "good science student". It was also revealed that peer interactions through engaging in normative scientific practices could frustrate but not impede their enactment of their science-student-selves. Student-teacher interactions in this study showed that sometimes the four Black male students recognized the beliefs their teacher had about their science-student-selves. Thus, the classroom behaviors, practices, and interactions of Black male students and their teachers can be shaped, whether positively or negatively, by varied cultural, social, institutional, and historical structures.

Knowledge of how and to what extent certain normative scientific practices influence what Black male students believe about their science-student-selves and the influences of accepted science and social norms on science classroom culture may help aid in re-evaluating or restructuring teacher education programs. What was learned from this study was that Jay, Kyle, LT and Mikel felt empowered in their science class through the employment of varied normative scientific practices. Grimberg and Gummer (2013) report that student learning is positively influenced by better understanding the students in a classroom, the norms that dictate the daily interactions within the classroom and the beliefs held by those who teach a particular student group. The restructuring of these teacher education programs would be to more overtly address how the normative scientific practices valued most within a science classroom can be structured to have a more positive influence on the science-student-self beliefs held by students. This knowledge can assist teachers of Black male students in becoming more aware of the complexities involved in teaching Black male students and more broadly in teaching all students.

Additionally, much of science education research literature speaks of motivating students to like or show interest in science using the attainment of a science career as incentive. I agree with Avery (2013) that it might prove more beneficial to students if science education is framed differently for students in order to help them realize that science knowledge can lead to a science career but more importantly, that quality science content knowledge and science process skills can help them in pursuing any career option and better understand aspects of life in general. LT's experience using a triple-beam balance, Mikel's recognition that mathematics is part of science and Kyle's experience evaluating information during a cells unit lesson on plants to make sense of what he saw on a National Geographic episode display that exposing students to the utility of scientific knowledge and skills can enhance their beliefs in their science and overall student abilities. Making shifts in how we as science educators position the versatility of science to students can enable students to broaden their view of science and to see themselves as science experts and performers of science. Further research that illuminates aspects of the topics mentioned in this chapter would positively add to the body of knowledge concerning Black male students and their science education experiences.

Limitations and Future Research

This qualitative study was conducted in two middle grades science classrooms taught by Mrs. Sunshine in a rural school in the southeastern region of the United States. Therefore, the findings of this study are specific to this particular context and the four Black male students who participated in this study. The findings are not broadly generalizable to every rural context (Merriam, 1998). Data were also collected from a small sample size of students, four, in two science classrooms, which provided insight into how the normative scientific practices within the specific classroom context influenced the beliefs of the Jay, Kyle, LT and Mikel. The findings did not provide an explanation for every Black male student in a middle grades science classroom.

The selection of one unit of study taught by Mrs. Sunshine provided a narrow view of the general normative scientific practices that the students might have experienced in their science class. Different science topics and science standard objectives require different performance expectations for students. A unit of study like the cells unit required that students be introduced to a large number of new vocabulary terms within the timeframe outlined by the school district's pacing guide. Conducting this study over an entire semester or school year would provide a clearer picture of the normative scientific practices that students experience in a science learning environment.

Additionally, conducting this study revealed that Jay, Kyle, LT and Mikel had an existing school and science identity that supported each other. The inclusion of data to address how these identities started for the four participants could reveal if aspects of rurality inspired their identity formations or whether the science learning environment foundations established by Mrs. Sunshine played a role. A curiosity pertaining to Mrs. Sunshine and her level of disappointment when shown that the two most frequently occurring normative scientific practices expected of students during the cells unit were obtaining and communicating information motivates the following research suggestion.

After forty years in education, Mrs. Sunshine's teaching philosophy included being a reflective practitioner who was willing to respond immediately to research data collected that pertained to her classroom instruction. The first assignment for the next study topic on human body systems was changed to include a wider array of normative scientific practices that extended beyond students primarily obtaining information and communicating that information onto a notes sheet. She researched a different way to teach new vocabulary content based on the research data presented to her. Mrs. Sunshine also included the normative scientific practices that students would experience on her daily lesson objectives and tasks slide for students. She wanted students to be able to recognize the normative scientific practices that they were engaging in during the lesson. A study designed to explore how the inclusion of these instructional changes might influence the science identity works of Black male students would continue to add to the body of knowledge pertaining to students within this context. This study direction may indicate that the act of a teacher giving students an explanation of performance standards or lesson objectives and a rationale for the lesson tasks may not be enough to get them to engage in the practices expected of science students in their class. Continued studies conducted in rural middle school science classrooms are needed to expand the body of knowledge pertaining to the lived science learning experiences of Black male students.

Conclusion

The current study provided insight into how the existing school and science-student beliefs of four Black male middle school students can be influenced by the normative scientific practices that they experience in their science class. Some of these practices more than others have the potential to broaden the concept of science for Black male students, to enhance the development of their science identity, to make science more accessible to them, and to expose them to a more challenging and social science curriculum. Situating this study in a middle grades science classroom shed light on what happened for four Black male students in their science class during these critical years of schooling (Mickelson & Greene, 2006).

The four Black male students in this study shared the same race but had different lived experiences in their science classrooms. Their individual voices deserved to be heard, as do the collective voices of Black male students. The overlap seen in their experienced practices suggests that although there are similarities between student experiences, Black students in the same space can have a different way of viewing their science learning context and expectations. Therefore, it is important to explore the thoughts and beliefs of all students if we aim to broaden the scope of science knowledge and science skills for Black male students and students in general. It is also important that classroom educators provide intentional and explicit explanations regarding not only the state standards and lesson objectives but also the scientific practices that students will perform. In that students will hopefully have a better understanding of the utility of scientific practices.

Jay, Kyle, LT and Mikel believed in their ability to perform well as science students in their rural middle school science classroom. Their beliefs sometimes had to endure the strain of insecurities pertaining to using science equipment, working in groups and feeling bored when instructed to engage in non-challenging normative scientific practices. Research states that adolescents make lasting decisions about their science interests during their middle school years (Calabrese-Barton et al., 2013). Jay, Kyle, LT and Mikel were making decisions to pay attention in their class, do the work expected of them to get good grades, help their peers better understand science content and help themselves to better understand science content through engaging in specific normative scientific practices. Therefore it can be concluded that the intentional and effective implementation of normative scientific practices within a rural middle grades science classroom can assist in the development and sustainability of positive science-student beliefs for Black male students in particular and all students in general.

APPENDICES

Appendix A

Sample of Field Notes and Observations

11-04-19

Field notes and observations

8:33a started... had to fix technology issues with the dsq.

DSQ: How do each of the following protists move? A. Euglena, B. Paramecium, C. Amoeba

MS went over the homework assignments for the week.

Mon: 2 EdPuzzle

Tues:

Wed: Writing assignment

Thurs: Study for Quiz

Friday: Test (cell theory, protists, bacteria)

[After speaking with the 7th grade team teacher MS and teacher decided to get students to focus more on the content of cell theory, microscope, protists, and bacteria by assigning a test at the end of the week. They have not yet decided if it will be a quiz or a test. They will wait to see how students perform on the tasks this week]

8:44a Students working on notes sheet. Copying down major vocabulary into notes sheet

MS: (had a question posed to students) LT: "It has a nucleus", MS: yes, it has a nucleus.

LT and Jay both working through the notes as instructed.

8:52a Students finished notes sheet. Instructed to draw a KWL chart in their science notebook.

[MS moved the two male students from Jay's group to another group and placed two girls from another table. Jay got up to move too. MS told him that he was not moving, he was staying right where he was. I believe Jay may have been upset by this move.]

[MS started moving another set of groups, two males were exchanged with two female students, disappointment was expressed by the girls. Changes to the classroom community.]

As LT watched the video on bacteria, he made adjustments to his K of the KWL chart. This is what MS had suggested to students.

Jay got in trouble by MS because he did not write down his list of 3-5 things. MS said he had a 0 for the day. [MS later gave students who just wrote "list 3-5 things" in the know column until tomorrow to earn their points back and get that assignment done]

[Wondering what his thoughts were when that happened]

[There was a code red drill today. Teachers did not know if it was a drill or not. Wondering what first thoughts were about the drill by students. I was a bit nervous not knowing if it was a drill or not. Concerned for the safety of students and if this was real or not.]

Appendix B

Studenting Interview Questions

1. Describe yourself, include things you enjoy or do not enjoy. This can be outside of school and/or inside of school.

2. Describe yourself as a student.

3. Describe yourself as a science student.

4. What do you think your teacher thinks about you as a science student? Why do you think this?

5. What do you think your peers think about you as a science student? Why do you think this?

6. Describe what a "good" science student does or how a "good" science student acts in your science classroom.

7. What is a good science student not supposed to do?

8. Does being a good student look a certain way at RMS?

Appendix C

Normative Scientific Practices Observation Tool

School: ________________________________
Date/Time: _________________
Teacher: ___________________
Class: _____________________
Number of students: _____ (total); _____ (boys); _____ (girls)
Class demographics:
____

Framework practices: AQ- asking questions; DM- developing and using models; PI- planning and carrying out investigations; AID- analyzing and interpreting data; MCT- mathematics and computational thinking; E- constructing explanations; ARG- engaging in argument from evidence; OECI- obtaining, evaluating, and communicating information (O, E, C)

Based on the *Framework*, what does the science classroom context look like for students in this classroom? How often do these practices occur during varied time frames?

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<tr><th></th><th># of AQ</th><th># of DM</th><th># of PI</th><th># of AID</th><th># of MCT</th><th># of E</th><th># of ARG</th><th># of OECI</th></tr>
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Appendix D

Card Sort Interview (Carlone et al., 2011, p. 17)

In this science class, we are expected to: **Ask Questions** -YOU come up with your own scientific questions. -YOU ask questions about the science topics that you can explore in class.	In this science class, we are expected to: **Develop Models** -YOU design a scientific model that you then use to better understand a topic.
In this science class, we are expected to: **Use Models** -YOU use a model to better understand a topic. -Examples: a. Using the microscope b. Using 4 people to show high to low concentration c. Cell analogy project	In this science class, we are expected to: **Planning investigations** -YOU create a lab investigation on your own or with your group to conduct.
In this science class, we are expected to: **Carrying out investigations** -YOU do a lab investigation. -Examples a. Microscope onion slide lab b. Protists lab c. Bacteria helpful and harmful	In this science class, we are expected to: **Analyze & Interpret Data** -YOU collect information and try to make sense of it. -Examples a. You analyze your gummy bear lab data b. You watch Amoeba sister video and answer questions based on what you watched. c. You read and watched articles and videos on bacteria.

In this science class, we are expected to: **Using Mathematics and Computational Thinking** -YOU work with numbers and use them to better understand a topic. -Example a. Measurements you collected during your gummy bear lab.	In this science class, we are expected to: **Constructing explanations** -YOU use scientific words to explain why something happens. -YOU explain using scientific evidence why you think something happened.
In this science class, we are expected to: **Engaging in Argument from Evidence** -YOU use scientific evidence to justify why you believe something about a topic you are studying. -Example a. Bacteria is harmful and Bacteria is helpful project	In this science class, we are expected to: **Obtain information** -YOU get information from your teacher, a video, a slide, an article, or some other source. -Examples a. Class notes b. Reading an article c. Amoeba sister video d. Flocabulary games
In this science class, we are expected to: **Evaluate information** -YOU analyze text and/or data to get meaning from the text or data to help you better understand a topic. -Examples a. Flocabulary read and response b. Flocabulary quiz and game c. Amoeba sister video viewing sheet	In this science class, we are expected to: **Communicate information** -YOU verbally explain, or write, or draw, or use numbers, or create slides to explain what you know or understand about a topic. -Examples a. DSQ b. Answering teacher questions c. Lab sheets

Appendix E

Semi-Structured Interview Questions

1. Why did you select practice (X) to be important in your classroom during the cells unit?

    a. Can you give me an example of when this happened?

    b. How do you feel when practice (X) happens?

2. What does being (X) mean in your class?

    a. What does doing practice (X) mean in your class?

3. Do you think you are expected to (X) in your classroom?

    a. How often?

    b. Do you do (X)? Did you do (X) during your last unit?

    c. What if you do not do (X) what happens?

    d. How do you feel when (X) happens in your classroom?

4. Write down on this post-it note who you feel are the top three students in your class who do (X) (you may include yourself if it applies)?

    a. What happens in class that makes you feel that way about student A?

5. Are you good at doing or being (X) in this class? Why or why not?

    a. Would you want to be good at doing or being (X)? Why or why not?

    b. Do you think your teacher feels that you do (X) well?

    c. Do you think other students feel that you do (X) well?

6. On day (A) I noticed you did practice (X) really well, were you comfortable doing (X)?

Are there times when you are not comfortable doing practice (X)?

7. If you could add anything else (other practices/values) to a science class, what would it be? Why?

a. How would that make you feel if it happened more often in your class?

b. Do you think that you would do better in class? Why? or Why not?

8. Do you do practice (X) in any of your other classes well?

a. Why do you do practice (X) more/less in class A than in science class?

Appendix F

Descriptive Coding for Research Question One (Studenting Interview)

	Mikel	Kyle	Jay	LT
OUTDOORS	1	3	1	1
LOCAL COMMUNITY	1			
PARENT(S)	2			
SILENT	4	2	3	4
ENDURE	2			
ENJOY SCHOOL	1	1	1	
NON-SILENT	1		1	1
PLAYFUL	1			
HARD SUBJECT	4			1
ENJOY SCIENCE	1	2	1	
SCIENCE CHANGED	2			
GOOD STUDENT	3	2	3	2
PERFOMANCE BRAGGING	2			
SOCIAL INTERACTIONS	2			
BEHAVIOR	3	1	5	3
BAD BEHAVIORS			1	
EXPECTATIONS	4			1
SCHOOL EXPECTATIONS			1	
PROTECTION	2			
FUTURE PLANS	3			
OUTSIDE INFLUENCES	2	2		
CARE	3			
MORNING CLASSES	1			
LOCAL TEACHERS				
SELF-EXPECTATIONS	1			
NOT AN EXCEPTION		1		
INCLUSIVITY		1		
ENGAGED		1		
FAMILY TRAVELS		2		
FAMILY		1	1	
FAMILY TIME			1	
NEW EXPERIENCES		4		

ANIMALS		1		
MARINE LIFE		3		
AVERAGE STUDENT		5		
FRIEND		1		1
GOOD SCIENCE STUDENT	3	2	2	3
NOT A NERD		1		
LOSE FRIENDSHIPS		1		
FOCUS(ED)		1	3	
NO EXPECTATIONS		1		
GOOD GRADES		1		1
SCIENCE EXPERIENCES		1		
SPORTS			3	
SOLVING PROBLEMS			1	
HAPPY SCIENCE STUDENT			1	
PARTICIPATION			1	
GROUP PARTICIPATION			1	
CREATIVE IDENTITY			3	
ANALYTICAL IDENTITY			1	
SCIENCE IDENTITY		1	2	2
AT SCHOOL			2	
AT HOME			1	
SCHOOL SCIENCE			2	
IMPROVE SCHOOL			1	
ENJOYMENT				2
DISTINCTION IN ENJOYMENT				2
MANGA				3
PLAYING GAMES				4
GETS HELP				1
CHALLENGING SELF				2
NOT A FAN				1
ENGAGE IN QUESTIONING				1
STUDYING				2
FORGETFUL				3
MEMORY (CAPACITY)				9
CROSS-DISCIPLINE CONNECTION				4
XBOX PLAY				1
ANNOYED				1

LATE WORK	1
ADVANCED CLASSES	1
EARLY SCHOOLING	1

Appendix G

Descriptive Coding for Research Question One (Field Notes and Observations I)

Jay

Date(s)	Descriptive Code
10/23, 10/28 (2), 10/31 (2), 11/01, 11/04, 11/05 (2), 11/06	Doing the work
10/28	Mischievousness
10/28	Movement
10/29, 10/30 (2), 11/04, 11/06	Off task
10/29	Poor drawing
10/30	Quiet
10/31	Incomplete homework
11/01	Teamwork
11/01	Slow to complete work

LT

Date(s)	Descriptive Code
10/8, 10/28, 10/8 (2), 11/06	Sleepy
10/8, 10/23, 10/31 (2), 11/04, 11/05 (2),	Doing the work
10/23	Considerate
10/28, 10/30 (3), 11/05	Answering questions
10/30	Raising hand
10/30, 10/31	Ownership
10/31	Asks for help
11/04	Reevaluated work
11/05	Memory
11/06	Humor
11/06	Helper

Kyle

Date(s)	Descriptive Code
10/23 (2), 11/06	Raising hands
10/23 (2), 10/25, 10/28 (2), 10/31 (2), 11/01, 11/04 (4), 11/05	Answering questions
10/25 (2), 11/06	Doing the work
10/25 (2)	Team/working together
10/28	Early science school experience

10/31	Analyzing information
10/31	Curious
10/31	Connecting home to school science
10/31	Smart
10/31	Minimizes peer compliment
11/01	Team leader
11/01	Helper
11/04	Recalling prior knowledge
11/05	Completed homework
11/06	Excited about the work

Mikel

Date(s)	Descriptive Code
10/8, 11/01	Helps friends/peers
10/8	Classroom helper
10/8	Distracted
10/8	refocused
10/23	Raising hands
10/23, 10/28, 11/04, 11/05	Answering questions
10/25(3), 10/31, 11/01	Doing the work
10/25, 11/01	Leading in a group
10/25	Working together
10/25	Seek teacher approval
10/30, 11/06	Movement
10/30	Curious
10/31 (2), 11/01	Quick worker
11/04, 11/06	Quiet
11/04	Recalling prior knowledge
11/05	Proud of self
11/05	Expressive

Appendix H

In Vivo Coding for Studenting Interview

#IV code	Mikel		Kyle	
1	I like to go fishing		Why is it only Black people	
2	play sports		I like to skateboard	
3	I go with my parents		I like to go to aquariums	A
4	In some subjects, I'm quiet		On my vacation	
5	I like school		I like to go to zoos	
6	Sometimes you joke around		It's like a different experience	
7	It used to be my favorite subject	A	I got to study sea turtles	
8	It's gotten harder	A	to see how we like it	
9	It's not interesting anymore	A	I like to be able to learn new things	A
10	I like it	A	I like to study animals	A
11	It's getting harder	A	I really like marine life	A
12	It got harder	A	discover new things	A
13	I lost interest in it	A	third grade	
14	I'm used to hands-on stuff	A	average student	C
15	Now we gotta write	A	they don't really focus on you	
16	Like it's cool but I don't like it	A	higher education	
17	I hope she think I'm good	C	talents in them	C
18	I hope they think I'm a good student	C	not particularly in like science	
19	Into science		like music or sports	
20	Get an A	B	like a friend	C
21	Brag to students	B	knows how to work and focus	C
22	I brag to students	B	make good grades	C
23	I got good grades	B	I could help them	C
24	Misbehave		they could help me	C
25	Getting bad grades		don't wanna show their emotions	D
26	Stay focused		keeping quiet	
27	A lot of expectations	C	really really good at science	
28	Get good grades	C	feel like such a nerd	D
29	Stay focused	C	you want to learn more	
30	Don't worry		don't want people talking behind your back	D

31	Protect your future	C	their behaviors, their actions	
32	to not give your future away	C	stay silent	
33	It's like a guide		focus on the teacher	
34	Don't like to talk		I can be a good student	B
35	I just be annoyed		I didn't really like science	B
36	The right way		I like it more	B
37	Don't be annoying		I can make better grades	B
38	ROAR		hands-on learning	A
39			dissecting things	A
40			finding out how frogs work	A

Note. Mikel: (A) "Now we gotta write"; (B) "I brag to students"; (C) "A lot of expectations". Kyle: (A) "I like to be able to learn new things"; (B) "I can be a good student"; (C) "Talents in them"; (D) "Don't wanna show their emotions"

#IV code	**Jay**		**LT**	
1	I like to play football		Reading Manga	
2	Figuring out solutions		Combined a chapter book with comic books	
3	I like playing basketball		Playing video games	
4	Go to the gym		Kinda all over the place	
5	My uncle		adventurer games	
6	kind of quiet		it's like competition	
7	I like all my subjects except SS and ELA		find the real fun in it	
8	I talk sometimes		I'll just play it even more	
9	Sometimes I like quiet		Balanced	
10	Happy		This game's really fun	
11	Like doing projects	A	The losing keeps me motivated	
12	Creative person	B	I watch anime and Manga	
13	I like to draw	B	Not a big fan	
14	Showing what I'm talking about	B	I prefer the books	
15	I don't know		I forget some things	B
16	That I do my work	C	You forget it	B

17	I'm used to like answering questions all the time		Sometimes I remember	B
18	I can make my answer better		I see the homework	
19	Does their work	C	Flashes of memory	B
20	Pay attention	D	Silent type of student	C
21	Not bad		I'm like silent	C
22	Too talkative		Questions I know	A
23	Won't be able to listen		I raise my hand	A
24	Not be too talkative		I don't think I'm good at it	A
25	Pay attention	D	I'm good at it	A
26	Do their work	C	It's kind of mixed	A
27	I'm not as talkative	D	I'm completely lost	
28	Sometimes quiet	D	I kind of understand it	A
29	Able to do my work	C	I kind of know the vocabulary	A
30	Pay attention	D	I kind of understand it	A
31	We could be better too		A little bit confusing	
32	Be respectful		I learn more	
33	Pay attention	D	Past years in school	
34	Do your work	C	triggers in my brain	B
35	Would do what they want		make me remember	B
36	A lot of trouble		History about the scientists	
37	A lot of stuff going on		vocabulary of science	
38	bad things		quiet student	C
39	I pay attention	D	not really that quiet	C
40	Do my work	C	rarely gets in trouble	C
41	I like projects	A	like a friend	
42	Working on interesting things	A	that quiet type	C
43	I like animals		play with my friends	
44	Like projects	A	play with my friends	
45	Figuring things	A	helpful	
46			study's for tests	
47			high expectations	
48			a B or higher	
49			not talk so much	
50			get annoying	
51			turning in your work super late	
52			GREAT grades	
53			Behavior is great	
54			advanced classes	

55	I can be a good student	B
56	Silence thing on lock	C
57	jog my memory	B
58	get my memory capacity up	B
59	a good science student	
60	I got a C on the test	
61	I should have studied before	

Note. Jay: (A) "I like working on interesting things"; (B) "I like to draw"; (C) "I do my work"; (D) "I'm not as talkative". LT: (A) "Questions I know"; (B) "Sometimes I remember"; (C) "I got the silence thing on lock!"

Appendix I

Descriptive Codes with In Vivo Code Designations (Field Notes and Observations I)

Jay

Date(s)	Descriptive Code	2nd round
10/23, 10/28 (2), 10/31 (2), 11/01, 11/04, 11/05 (2), 11/06	Doing the work	C
10/28	Mischievousness	D
10/28	Movement	BCE
10/29, 10/30 (2), 11/04, 11/06	Off task	C
10/29	Drawing	B
10/30	Quiet	D
10/31	Incomplete homework	C
11/01	Teamwork	C
11/01	Slow to complete work	C

*Note. BCE represented codes that could be categorized under the descriptor of Black cultural ethos.

LT

Date(s)	Descriptive Code	2nd round
10/8, 10/28, 10/8 (2), 11/06	Sleepy	B
10/8, 10/23, 10/31 (2), 11/04, 11/05 (2),	Doing the work	A
10/23	Considerate	personality
10/28, 10/30 (3), 11/05	Answering questions	A
10/30	Raising hand	A
10/30, 10/31	Ownership	A
10/31	Asks for help	A
11/04	Reevaluated work	A
11/05	Memory	B
11/06	Humor	personality
11/06	Helper	A

Kyle

Date(s)	Descriptive Code	2nd round
10/23 (2), 11/06	Raising hands	B
10/23 (2), 10/25, 10/28 (2),	Answering questions	B

10/31 (2), 11/01, 11/04 (4), 11/05		
10/25 (2), 11/06	Doing the work	B
10/25 (2)	Team/working together	C
10/28	Early science school experience	_
10/31	Analyzing information	A
10/31	Curious	A
10/31	Connecting home to school science	A
10/31	Smart	D
10/31	Minimizes peer compliment	D
11/01	Team leader	C
11/01	Helper	C
11/04	Recalling prior knowledge	B
11/05	Completed homework	B
11/06	Excited about the work	A

Mikel

Date(s)	Descriptive Code	2nd round
10/8, 11/01	Helps friends/peers	C
10/8	Classroom helper	C
10/8	Distracted	A
10/8	refocused	A
10/23	Raising hands	B
10/23, 10/28, 11/04, 11/05	Answering questions	B
10/25(3), 10/31, 11/01	Doing the work	B
10/25, 11/01	Leading in a group	B
10/25	Working together	C
10/25	Seek teacher approval	C
10/30, 11/06	Movement	BCE
10/30	Curious	personality
10/31 (2), 11/01	Quick worker	B
11/04, 11/06	Quiet	BCE
11/04	Recalling prior knowledge	A
11/05	Proud of self	B
11/05	Expressive	BCE

*Note. BCE represented codes that could be categorized under the descriptor of Black cultural ethos.

Appendix J

Semi-Structured Interview: InVivo and Pattern Coding

In Vivo Code (Jay)	A	SI	CI	SoI P	SoI T
You have to build information up					
We have to get information to like do projects and stuff	1	1	1		
You're not gonna know what the information is	1	1	1		
Talking					
Like communication					
That's all I used					
Bored	1	1			
I don't feel like doing all of it	1	1			
I'm still sleepy					
I'm still sleepy though					
A lot					
You have to figure out the information		1	1		
You'll probably get an 'F'			1		
They're always the first one's to answer questions			1	1	
In the middle		1			
I can easily find information	1	1	1		
I know what page it is	1	1			
I don't know					1
I don't know					1
They're always like "how did you already finish"		1		1	
I don't know					1
Be more fun	1		1		
More entertaining	1		1		
We would be making models then actually doing it	1				
More entertainment			1		
I would have something to entertain me	1		1		
Fun			1		
You could actually see					
Bored	1				
Less work					
Someone to talk to					

I didn't realize					
Let me see your paper					
I heard Hakeem say that					
I was just zoned out					
Practice 1 Count:	**11**	**9**	**11**	**2**	**3**
You have to communicate with your group	1	1	1		
Write like what the protists and cells look like	1		1		
We were supposed to draw	1				
I used to like to draw	1				
It don't really mean nothing to me		1			
Boring		1			
Like draw protists					
I been raising my hand	1	1			
You'll probably get an 'F'			1		
You didn't finish the assignment					
You have to like figure out on your own	1	1			
Communicate with people in your group	1	1	1		
To help you	1		1		
Find answers	1	1	1		
They all like to talk a lot			1		
They like to research	1		1		
I know how to communicate	1	1			
They'll know it but they won't really say it			1	1	
They'll be quiet				1	
Speak up louder			1		
I don't know					1
I do a lot of talking	1	1			
We all communicate well	1	1	1		
We like to talk in a group	1	1	1		
I don't know				1	
I'm always like the first one or second one finished	1			1	
Practice 2 Count:	**15**	**11**	**12**	**4**	**1**
We still have to have the evidence	1	1	1		
From the evidence					
I already know where to find it	1	1			
It's in my notes	1				
You probably wouldn't find the right answer	1		1		

You just wrote a random answer down			1		
The evidence shows that you actually have researched it	1		1		
You looked for it	1		1		
They can find information fast			1	1	
They don't like talk too much			1	1	
I'm good at finding information	1	1			
You have the notes					
It'll be easier to look for					
They finish it but they wouldn't have the evidence			1		1
I could have the evidence	1	1			1
I do the most searching	1	1		1	
Practice 3 Count:	**9**	**5**	**8**	**3**	**2**
Total Counts:	**35**	**25**	**31**	**9**	**6**

In Vivo Code (Kyle)	**A**	**SI**	**CI**	**SoI P**	**SoI T**
If you don't pay attention		1	1		
You won't obtain as much information	1	1	1		
Get the material			1		
They are giving you					
You won't understand	1		1		
Will not do good	1		1		
You can succeed	1	1	1		
Getting the good grade	1	1	1		
Something that you want		1	1		
I'd try to get what she's saying	1	1			
Try to remember	1	1			
Like the clues	1	1			
It could be like a door					
Like a security guard					
I can obtain that information	1	1			
Remember a clue	1	1			
That can help me	1		1		
I'm just trying to focus		1	1		
Concentrate					
Being quiet		1	1		

Looking for clues	1	1	1		
The teacher gives you					
Study really hard			1		
Focus on what she's saying	1		1		
Easier for you to understand	1				
Possibly fail	1				
Not get a good grade	1		1		
As I want	1		1		
I should be focusing on					
They really really want to learn				1	
Want to like succeed				1	
Focus on school more				1	
To get a good grade			1	1	
You didn't really like			1		
You could succeed even more	1		1		
Try to like focus					
Get the grade					
Succeed in class and other things					
I am good at obtaining information	1	1			
I can know these certain things	1	1			
I think she does					1
I'm normally answering questions					1
Master it					1
Learning new things		1			
If I focus on that one thing					
Focus on school					
I can get like the good grades					
I can learn new things					
It's easier					
I don't really know				1	
A good student or a good person			1	1	
Study hard				1	
Help them or something		1		1	
We could help each other		1		1	
I can help them		1		1	
They could help me				1	
If I can be a good studying student				1	

They could be one too				1	
We could all help each other				1	
I feel comfortable	1	1			
It can be like easy for me	1	1			
It can be kind of uncomfortable	1	1			
Hard for me to understand	1	1			
I really just focus on having the info			1		
Solve the test questions			1		
Get good grades			1		
Asking questions			1		
Some people probably are afraid to ask questions					
They could probably be wrong					
Afraid to get laughed at					
Embarrassed					
They don't really understand that information					
You're not really understanding					
They're thinking different					
It's kinda hard					
I can focus					
I can understand					
Make better hypothesis		1			
Better questions		1			
So you can understand		1			
Practice 1 Count:	**24**	**26**	**24**	**14**	**3**
Not the grade that you want			1		
You won't understand the material	1		1		
Paying attention			1		
Studying hard			1		
I used to get really confused	1	1			
I analyzed information	1				
I didn't really know it that well	1	1			
A good time to like analyze					
I just like study	1	1			
See how other people can explain it	1				
Evaluate what she's saying	1	1			
So I could understand it my way	1	1			
So I could get it	1		1		

I just know that I should like focus	1		1		
Not like talk or anything			1		
I could make like a bad grade		1	1		
I don't want to make		1	1		
Like master it like 100%	1	1	1		
I would evaluate the information	1				
I'm just making sure that I really know it	1	1	1		
They really want to know this material				1	
So they can get like an A or B				1	
So they could understand the information				1	
They're really focusing				1	
Taking in that information					
Decode it somehow	1	1			
So I can understand how it works	1	1	1		
She knows that I'm like a good student					1
She knows that I pay attention					1
I can make good grades					1
I'm not really sure				1	
Maybe or maybe not				1	
Practice 2 Count:	**15**	**11**	**12**	**6**	**3**
If you communicate what you don't know	1	1	1		
Can come and help you	1		1		
She can't explain it			1		1
In a way that you could understand			1		1
He was kind of confused				1	
I had shared my notes with him	1	1		1	
I had like talked to him so he could understand		1	1	1	
Photosynthesis it requires the sun					
It takes place in like the chloroplasts					
They couldn't make the good grades			1		
If they study a lot	1		1		
Good potential to do things in science	1		1		
I think I would	1	1			
He always wants to stay on the top					
He wants to make his Mom proud					
He's just trying to accomplish that, his goals					
I could be like talkative	1	1			

I could probably like tell them	1	1			
I don't really know					1
Communicate to him in a way that he could understand					1
She knows that I can succeed in like science					1
It could probably be right					
I study a lot		1			
Solve what she's saying		1			
They know that they could depend on me				1	
Practice 3 Count:	8	8	8	4	5
I know that I can think like a scientist		1			
I can learn new things		1			
Know how to answer questions		1			
I can use the new words					
I think it was good					
I know that I could help		1		1	
They could help me				1	
It could be their emotions	1				
They could make good grades			1		
They don't really want it to show	1				
Maybe they're shy	1				
They could show it maybe verbally					
Not really showing anyone	1				
But getting good grades		1	1		
They might be like shy	1				
I wouldn't say that I hide it	1				
I raise my hand	1	1	1		
Study	1	1	1		
Write notes all the time	1	1	1		
I wouldn't say that I hide it	1				
Post-Practice Count:	**10**	**8**	**5**	**2**	**0**
Total Counts:	**57**	**53**	**49**	**26**	**11**

In Vivo Code (LT)	**A**	**SI**	**CI**	**SoI P**	**SoI T**
More hard	1		1		
Sometimes that doesn't work					
Helpful for osmosis and diffusion	1		1		

This is gonna help me	1	1	1		
It helped me last year					
It's gonna help me out	1	1	1		
It helps me					
To like remember	1	1	1		
We use it often	1				
Don't have enough information			1		
So you use models			1		
You wouldn't have the right data					
To understand					
He was like really good at that				1	
Use the scales					
I used the scale		1			
I am a little bit good at it		1			
I got bored	1	1			
I studied almost everything					
This is balancing right here					
I think I am good	1	1			
I'm not sure I'm that good	1	1			
It just weighs out					
If I have like a job			1		
Like on those movies and TV shows			1		
Like those merchants			1		
If you're like a scientist			1		
I don't really think so					1
I don't really look up and around					1
Kind of like a yes				1	
A tiny bit of no				1	
Hey Ned let me do it				1	
I was trying to find it				1	
I can find it					
But then it gets a bit hard	1				
I have a cartography memory		1			
I was playing video games					
I learned I could read maps		1			
A little bit of tiny issues				1	
He's a helpful person as well				1	

I was trying to find an article		1			
I like skip read		1			
I accidentally passed some useful information				1	
I was trying to find an article					
He just highlighted it				1	
Thank you man!				1	
We do almost everything					
Mathematics and computational thinking			1		
I could use my math skills for other than math	1	1	1		
I do like it		1			
But a little bit of not really		1			
Some things I get confused on	1	1			
It kind of goes both ways					
If you do like those mathematic problems					
To help our science					
It's helping me in my math class	1		1		
It's helping me in my science class	1		1		
I felt like it got a bit confusing	1				
Like I don't really like doing the work		1			
But I kind of like doing work		1			
I really don't like to do that					
I thought I had to make a really long paragraph	1				
It's still gonna take a long time					
It only took like a couple of minutes	1	1			
Thirty-five percent of that was like long questions					
Not getting in trouble		1			
Nothing else to talk about		1			
Hitting it with your hand					
I can't find my ID					
I can't go out at recess					
Practice 1 Count:	**17**	**21**	**15**	**10**	**2**
To know what you're dealing with	1		1		
Going on your chromebook to look up	1				
What a bacteria does	1				
Difference from eukaryotic and prokaryotic	1				
I really don't feel anything					
I'm just getting information		1	1		

If I don't receive the information I'd put down random information			1		
I'd get it wrong	1		1		
I'd get like a zero	1		1		
Sometimes I forget things		1			
I remember them					
It's useful	1				
When I forget them the memories come back		1	1		
Skim read		1			
Me going through the passage very fast					
Find what matches					
I answered the questions correctly	1	1			1
I can obtain information very well	1	1		1	
They see me reading through the passage				1	
I'm feeling very tired and um, sick					
I get headaches a lot					
My Mom put a bedtime for us at ten o'clock					
I'm up for like eleven					
I didn't know what time it was					
I was watching Anime Oragame					
I don't feel like going to bed					
I feel like I want to stay up and just play some games					
On school days It's just like so much work is happening					
Practice 2 Count:	**9**	**6**	**6**	**2**	**1**
You have to be careful in moving the weights	1				
It's a little bit of work	1				
But like it's expected	1		1		
This character is powerfuller than this other character		1	1		
You searched it up	1	1	1		
You'll agree with the wrong statement	1		1		
We just switched it up				1	
We'd choose another one				1	
If it's true then we put it down				1	
She can see that we analyzed and interpreted the data					1
Practice 3 Count:	**5**	**2**	**4**	**3**	**1**
Total Counts:	**31**	**29**	**25**	**15**	**4**

In Vivo Code (Mikel)	A	SI	CI	SoIP	SoIT
I was overwhelmed	1				
He was like in a bad mood				1	
I had to do all the measurements by myself	1	1		1	
We didn't do it like a group				1	
I had to do it by myself		1		1	
I was overwhelmed	1				
I don't know					
Yeah, it's crazy			1		
My Dad had some gummy bears			1		
I told my little sister			1		
I just told him			1		
Like he probably didn't believe it			1		
I'm gonna try		1	1		
Pre-Practice Count:	**3**	**3**	**6**	**4**	**0**
We had to like draw	1				
We had to draw it in the little circle		1	1		
I know what I gotta do	1	1			
I gotta figure out	1	1			
It's like notes					
you gotta like write it down	1	1	1		
taking notes					
writing it down I think			1		
we analyze the data and put it on our paper	1	1			
we had to analyze the data off the internet	1	1			
we wouldn't know as much			1		
taking notes is gonna help you in the long run	1	1	1		
help you in the long run					
you're not gonna know	1				
Third		1			
I just think he pays attention			1		
She's just quiet			1		
I take good notes	1	1	1		
Study overnight			1		
I know what it is	1				
I hope she think I do good					1

I hope					1
I take good notes	1	1			
She'll know that I took good notes	1				1
to help me out					
I think so					
if you're passing a class, you know you're taking good notes			1		
I hope they know				1	
I'm good at taking notes	1			1	
It's my emotions coming out			1		
I guess smiling			1		
Sometimes being loud			1		
Dancing			1		
Like let's go!	1	1			
Like, yes sir!	1	1			
Quizlett	1				
You can study on it	1		1		
If she really wanted us to get it	1		1		
I say evaluate more information	1		1		
Like the teacher have worksheets and quizlett	1				
Like more teaching	1		1		
Then we write it on the next worksheet	1				
We already know the answer like from our notes	1		1		
You would know it					
You'll know it more	1		1		
Not really					
It was like the start of science					
It's not hard	1	1			
I feel normal	1	1			
I get what's going on	1	1			
I didn't think she was gonna go that far					
Uh, advanced!					
I didn't know I was that smart		1			
Uh, yeah I didn't					
Sometimes					
My grades					
I got good grades but like… no		1			

Practice 1 Count:	**27**	**17**	**20**	**2**	**3**
Sometimes I feel excited		1			
It helps you	1				
It helps you see something better	1	1	1		
Feel something	1				
It helps you	1				
If you use this model you know you can see it	1		1		
Yeah, makes me excited	1				
The students and I will take turns		1		1	
It depends on how I'm feeling		1	1		
If I want to do it by myself	1	1	1		
Them not getting good data	1				
How's he supposed to know what it'd look like			1		
Sometimes their feeling it sometimes they're not					
They show it when they get good grades				1	
We just tell if we got A's and B's		1		1	
I feel like I use models well	1	1			
I think I do better when I'm using models	1	1	1		
I like hands-on things	1	1	1		
Just writing					
I don't know					1
I don't know				1	
I guess they do				1	
I'm in a good mood sometimes when I'm using models	1	1			
Okay I'll do it					
Sometimes I'm excited	1				
I actually work better	1	1			
I'm up talking, asking questions		1			
Responding to questions		1			
Making good grades		1			
Getting sleep					
Not having sports practice					
I don't even watch TV					
I don't know why I do that					
I know it helps me in school					
It helps me focus					
Practice 2 Count:	**41**	**32**	**27**	**7**	**4**

You had to think about it	1				
I think it's a part of science	1		1		
Like STEM					
Like taking measurements	1				
We had to take notes from the measurements		1	1		
They just won't have good notes			1		
They won't get it	1		1		
They wouldn't have the right answers			1		
I don't ever work with none of my friends				1	
Like we so so					
I don't talk to them				1	
I'm good at math!	1	1			
I have an A in math	1	1			
It used to be my favorite subject					
Social studies					
It's just like interesting					
It's interesting					
Like how it made a drastic change					
I feel like she does					1
She's like, yes, that's good					1
Uh, I guess				1	
I take good notes	1	1		1	
To me, I take good notes	1	1	1		
I hope we use more models			1		
I like hands-on things	1	1			
Whenever we use hands-on I get excited	1	1	1		
I just get excited	1				
If we're taking notes, okay I get it	1	1			
Whenever we're using models it helps me more	1	1	1		
It helps me figure out things better	1	1	1		
Practice 3 Count:	**14**	**10**	**10**	**4**	**2**
Total Counts:	**85**	**62**	**63**	**17**	**9**

Appendix K

Field Notes and Observations III Attitude Categories

Jay

In Vivo Code (Jay)	Affective	Behavior-Inter	Behavior-Intra	Cognitive	N/A
You have to build information up					
We have to get information to like do projects and stuff				1	
You're not gonna know what the information is				1	
Talking					
Like communication					
That's all I used					
Bored	1				
I don't feel like doing all of it	1				
I'm still sleepy					
I'm still sleepy though					
A lot					
You have to figure out the information				1	
You'll probably get an 'F'				1	
They're always the first one's to answer questions		1		1	
In the middle				1	
I can easily find information			1	1	
I know what page it is				1	
I don't know				1	
I don't know				1	
They're always like "how did you already finish"		1		1	
I don't know				1	
Be more fun	1				
More entertaining	1				
We would be making		1		1	

models then actually doing it				
More entertainment	1			
I would have something to entertain me	1			1
Fun	1			
You could actually see				
Bored	1			
Less work				
Someone to talk to				
I didn't realize				
Let me see your paper				
I heard Hakeem say that				
I was just zoned out				
Practice 1 Count:				
You have to communicate with your group		1		1
Write like what the protists and cells look like				1
We were supposed to draw		1		
I used to like to draw			1	
It don't really mean nothing to me	1			1
Boring	1			
Like draw protists			1	
I been raising my hand			1	
You'll probably get an 'F'				1
You didn't finish the assignment				
You have to like figure out on your own				1
Communicate with people in your group		1		1
To help you		1		1
Find answers				1
They all like to talk a lot		1		1
They like to research		1		1
I know how to communicate	1			

They'll know it but they won't really say it	1		1
They'll be quiet	1		
Speak up louder	1		
I don't know			1
I do a lot of talking		1	
We all communicate well	1		1
We like to talk in a group	1		1
I don't know			1
I'm always like the first one or second one finished		1	1
We still have to have the evidence	1		1
From the evidence			
I already know where to find it		1	
It's in my notes			1
You probably wouldn't find the right answer			1
You just wrote a random answer down			1
The evidence shows that you actually have researched it		1	1
You looked for it		1	1
They can find information fast	1		1
They don't like talk too much	1		
I'm good at finding information		1	1
You have the notes			
It'll be easier to look for			
They finish it but they wouldn't have the evidence	1		
I could have the evidence		1	1
I do the most searching		1	

Total Counts:	**11**	**18**	**12**	**39**	**0**

Kyle

In Vivo Code (Kyle)	Affective	Behavior-Inter	Behavior-Intra	Cognitive	N/A
If you don't pay attention				1	
You won't obtain as much information				1	
Get the material					1
They are giving you					
You won't understand				1	
Will not do good				1	
You can succeed	1			1	
Getting the good grade				1	
Something that you want	1			1	
I'd try to get what she's saying			1		
Try to remember			1		
Like the clues			1		
It could be like a door					
Like a security guard					
I can obtain that information			1	1	
Remember a clue			1	1	
That can help me	1			1	
I'm just trying to focus			1		
Concentrate					
Being quiet			1	1	
Looking for clues			1	1	
The teacher gives you					
Study really hard			1		
Focus on what she's saying			1		
Easier for you to understand	1			1	
Possibly fail				1	
Not get a good grade				1	
As I want	1				
I should be focusing on					
They really really want to learn		1		1	
Want to like succeed		1		1	

Focus on school more		1		1	
To get a good grade				1	
You didn't really like	1				
You could succeed even more	1			1	
Try to like focus					
Get the grade					
Succeed in class and other things					
I am good at obtaining information	1		1	1	
I can know these certain things			1	1	
I think she does	1			1	
I'm normally answering questions			1	1	
Master it	1		1		
Learning new things					1
If I focus on that one thing					
Focus on school					
I can get like the good grades					
I can learn new things					
It's easier					
I don't really know	1				
A good student or a good person	1	1			
Study hard			1		
Help them or something		1		1	
We could help each other	1	1		1	
I can help them		1		1	
They could help me		1		1	
If I can be a good studying student	1	1		1	
They could be one too	1	1		1	
We could all help each other		1		1	
I feel comfortable	1				
It can be like easy for me				1	
It can be kind of uncomfortable	1			1	
Hard for me to understand				1	
I really just focus on having the info			1		
Solve the test questions			1		
Get good grades			1		
Asking questions					1
Some people probably are afraid to ask questions					

They could probably be wrong				
Afraid to get laughed at				
Embarrassed				
They don't really understand that information				
You're not really understanding				
They're thinking different				
It's kinda hard				
I can focus				
I can understand				
Make better hypothesis				1
Better questions				1
So you can understand				1
Not the grade that you want	1			1
You won't understand the material				1
Paying attention				1
Studying hard				1
I used to get really confused			1	
I analyzed information			1	
I didn't really know it that well				1
A good time to like analyze				
I just like study			1	
See how other people can explain it			1	
Evaluate what she's saying			1	
So I could understand it my way			1	1
So I could get it			1	1
I just know that I should like focus			1	
Not like talk or anything			1	
I could make like a bad grade				1
I don't want to make	1			
Like master it like 100%			1	1
I would evaluate the information			1	
I'm just making sure that I really know it			1	1
They really want to know this material		1		1
So they can get like an A or B		1		1

So they could understand the information		1		1	
They're really focusing		1			
Taking in that information					
Decode it somehow			1		
So I can understand how it works				1	
She knows that I'm like a good student	1	1		1	
She knows that I pay attention		1	1	1	
I can make good grades		1	1	1	
I'm not really sure	1				
Maybe or maybe not	1				
If you communicate what you don't know				1	
Can come and help you				1	
She can't explain it				1	
In a way that you could understand				1	
He was kind of confused					1
I had shared my notes with him		1	1		
I had like talked to him so he could understand		1	1		
Photosynthesis it requires the sun					
It takes place in like the chloroplasts					
They couldn't make the good grades		1		1	
If they study a lot		1		1	
Good potential to do things in science				1	
I think I would	1			1	
He always wants to stay on the top					
He wants to make his Mom proud					
He's just trying to accomplish that, his goals					
I could be like talkative			1	1	
I could probably like tell them			1	1	
I don't really know	1				
Communicate to him in a way that he could understand			1	1	
She knows that I can succeed in like science		1		1	

It could probably be right					
I study a lot			1	1	
Solve what she's saying			1		
They know that they could depend on me	1	1		1	
Total Practices Counts:	**25**	**24**	**40**	**68**	**4**
I know that I can think like a scientist	1		1		
I can learn new things	1		1		
Know how to answer questions	1		1		
I can use the new words					
I think it was good					
I know that I could help			1	1	
They could help me		1		1	
It could be their emotions				1	
They could make good grades				1	
They don't really want it to show				1	
Maybe they're shy				1	
They could show it maybe verbally					
Not really showing anyone				1	
But getting good grades				1	
They might be like shy				1	
I wouldn't say that I hide it	1				
I raise my hand			1	1	
Study			1	1	
Write notes all the time			1	1	
I wouldn't say that I hide it	1				

LT

In Vivo Code (LT)	Affective	Behavior-Inter	Behavior-Intra	Cognitive	N/A
More hard	1				
Sometimes that doesn't work					
Helpful for osmosis and diffusion				1	
This is gonna help me	1			1	
It helped me last year					
It's gonna help me out	1			1	

It helps me					
To like remember			1	1	
We use it often					1
Don't have enough information				1	
So you use models				1	
You wouldn't have the right data					
To understand					
He was like really good at that		1			
Use the scales					
I used the scale			1		
I am a little bit good at it	1			1	
I got bored	1				
I studied almost everything					
This is balancing right here					
I think I am good	1			1	
I'm not sure I'm that good	1			1	
It just weighs out					
If I have like a job				1	
Like on those movies and TV shows					1
Like those merchants				1	
If you're like a scientist				1	
I don't really think so		1		1	
I don't really look up and around			1		
Kind of like a yes	1	1			
A tiny bit of no	1	1			
Hey Ned let me do it		1			
I was trying to find it			1		
I can find it					
But then it gets a bit hard	1				
I have a cartography memory				1	
I was playing video games					
I learned I could read maps			1		
A little bit of tiny issues		1			
He's a helpful person as well	1	1			
I was trying to find an article			1		
I like skip read			1		

I accidentally passed some useful information			1		
I was trying to find an article					
He just highlighted it		1			
Thank you man!	1	1			
We do almost everything					
Mathematics and computational thinking					1
I could use my math skills for other than math			1	1	
I do like it	1				
But a little bit of not really	1				
Some things I get confused on			1	1	
It kind of goes both ways					
If you do like those mathematic problems					
To help our science					
It's helping me in my math class				1	
It's helping me in my science class				1	
I felt like it got a bit confusing	1			1	
Like I don't really like doing the work	1				
But I kind of like doing work	1				
I really don't like to do that					
I thought I had to make a really long paragraph			1	1	
It's still gonna take a long time					
It only took like a couple of minutes			1		
Thirty-five percent of that was like long questions					
Not getting in trouble			1		
Nothing else to talk about			1		
Hitting it with your hand					
I can't find my ID					
I can't go out at recess					
To know what you're dealing with				1	
Going on your chromebook to look up			1		

What a bacteria does					1
Difference from eukaryotic and prokaryotic					1
I really don't feel anything					
I'm just getting information			1	1	
If I don't receive the information I'd put down random information			1	1	
I'd get it wrong				1	
I'd get like a zero				1	
Sometimes I forget things			1	1	
I remember them					
It's useful				1	
When I forget them the memories come back				1	
Skim read					1
Me going through the passage very fast					
Find what matches					
I answered the questions correctly			1		
I can obtain information very well	1		1		
They see me reading through the passage		1	1		
I'm feeling very tired and um, sick					
I get headaches a lot					
My Mom put a bedtime for us at ten o'clock					
I'm up for like eleven					
I didn't know what time it was					
I was watching Anime Oragame					
I don't feel like going to bed					
I feel like I want to stay up and just play some games					
On school days It's just like so much work is happening					
You have to be careful in moving the weights					1
It's a little bit of work	1				
But like it's expected				1	

This character is powerfuller than this other character				1	
You searched it up			1		
You'll agree with the wrong statement				1	
We just switched it up		1			
We'd choose another one		1		1	
If it's true then we put it down		1		1	
She can see that we analyzed and interpreted the data		1			
Total Counts:	**19**	**14**	**22**	**33**	**7**

Mikel

In Vivo Code (Mikel)	Affective	Behavior-Inter	Behavior-Intra	Cognitive	N/A
I was overwhelmed	1				
He was like in a bad mood		1		1	
I had to do all the measurements by myself			1		
We didn't do it like a group		1			
I had to do it by myself	1		1		
I was overwhelmed	1				
I don't know					
Yeah, it's crazy					1
My Dad had some gummy bears					1
I told my little sister			1		
I just told him			1		
Like he probably didn't believe it				1	
I'm gonna try			1		
Pre-Practice Count:					
We had to like draw			1		
We had to draw it in the little circle			1		
I know what I gotta do	1		1	1	
I gotta figure out			1	1	
It's like notes					
you gotta like write it down			1	1	

taking notes					
writing it down I think				1	
we analyze the data and put it on our paper			1		
we had to analyze the data off the internet			1	1	
we wouldn't know as much				1	
taking notes is gonna help you in the long run				1	
help you in the long run					
you're not gonna know				1	
Third	1				
I just think he pays attention		1		1	
She's just quiet		1		1	
I take good notes			1	1	
Study overnight			1	1	
I know what it is					1
I hope she think I do good	1				
I hope	1				
I take good notes			1		
She'll know that I took good notes			1	1	
to help me out					
I think so					
if you're passing a class, you know you're taking good notes				1	
I hope they know	1	1			
I'm good at taking notes	1	1	1		
It's my emotions coming out	1				
I guess smiling	1		1		
Sometimes being loud			1		
Dancing			1		
Like let's go!	1				
Like, yes sir!	1				
Quizlett					1
You can study on it				1	
If she really wanted us to get it				1	
I say evaluate more information				1	
Like the teacher have worksheets and				1	

quizlett				
Like more teaching	1			1
Then we write it on the next worksheet				1
We already know the answer like from our notes				1
You would know it				
You'll know it more	1			1
Not really				
It was like the start of science				
It's not hard	1			1
I feel normal	1			
I get what's going on	1			
I didn't think she was gonna go that far				
Uh, advanced!				
I didn't know I was that smart	1			1
Uh, yeah I didn't				
Sometimes				
My grades				
I got good grades but like… no	1			1
Sometimes I feel excited	1			
It helps you				1
It helps you see something better				1
Feel something				1
It helps you				1
If you use this model you know you can see it				1
Yeah, makes me excited	1			
The students and I will take turns		1		
It depends on how I'm feeling	1	1		1
If I want to do it by myself	1		1	
Them not getting good data				1
How's he supposed to know what it'd look like				1
Sometimes their feeling it sometimes they're not				
They show it when they get good		1		1

grades					
We just tell if we got A's and B's		1			
I feel like I use models well	1		1		
I think I do better when I'm using models	1			1	
I like hands-on things	1				
Just writing					
I don't know	1			1	
I don't know	1			1	
I guess they do	1			1	
I'm in a good mood sometimes when I'm using models	1			1	
Okay I'll do it					
Sometimes I'm excited	1				
I actually work better			1	1	
I'm up talking, asking questions			1		
Responding to questions			1		
Making good grades			1		
Getting sleep					
Not having sports practice					
I don't even watch TV					
I don't know why I do that					
I know it helps me in school					
It helps me focus					
You had to think about it			1	1	
I think it's a part of science				1	
Like STEM					
Like taking measurements				1	
We had to take notes from the measurements		1	1	1	
They just won't have good notes				1	
They won't get it				1	
They wouldn't have the right answers				1	
I don't ever work with none of my friends					1
Like we so so					
I don't talk to them		1			

I'm good at math!	1			1	
I have an A in math				1	
It used to be my favorite subject					
Social studies					
It's just like interesting					
It's interesting					
Like how it made a drastic change					
I feel like she does	1				
She's like, yes, that's good		1			
Uh, I guess	1				
I take good notes			1	1	
To me, I take good notes			1	1	
I hope we use more models	1				
I like hands-on things	1				
Whenever we use hands-on I get excited	1				
I just get excited	1				
If we're taking notes, okay I get it			1	1	
Whenever we're using models it helps me more	1			1	
It helps me figure out things better	1			1	
Total Counts:	**38**	**11**	**26**	**54**	**3**

Appendix L

Field Notes and Observations III Pattern Coding with Associated Practices

Jay

Number	Note/Observation	Associated Pattern	Practice
2	Jay missed 1 question on the quiz, got a 95. [I asked him and he said that he did study for his quiz]	A, CI, SI	
7	Jay was completing the task yet, is quiet.	CI	
8	Jay and LT copying down text from video screen where MB stopped the video to review cell theory. The place to write the info was at the bottom of the sheet.	A, CI	OI, EI, CI
11	Jay quietly listening and writing down what he was being told.	CI	OI
12	Jay and other students started to pack up at bell. MB stopped them and reiterated the rules of the classroom.	SOI-T	
17	8:38a Students started the Amoeba sister video again. MB started it from the beginning. At this point, 8:40a Jay and LT were both not looking at the video. Jay was looking away from the screen. LT was looking at his chromebook [almost in a daze].	CI, SI	OI, EI, CI, AID
18	8:50a Students instructed to pull out their diagram sheet from today that has both an animal cell and plant cell with organelles. Students are following along with the teacher to complete the labeling of the organelles of the cell. Both LT and Jay following along as instructed.	CI	OI
19	8:59a Jay is looking at something on his chromebook. His chromebook is slightly folded down, but just enough so what he was looking at could still be seen. The screen is now on the Google classroom page.	A, CI, SI	CI

30	Jay had his head folded into his chest and once MB wrote an analogy down then he picked up his head to write it down	CI, SI	CI
31	8:53a watched video together before starting Flocabulary. Rap song discussing cell features was part of the video. Both LT and Jay are watching the video.	A, CI, SI	OI
32	MB gave a list of the students that had to come to CATS cafe to finish their h.w from last night. Jay has to come to MB for CATS cafe today. Jay said that he would finish his h.w. during CAT class so he doesn't have to come during his lunch period.	SOI-T	
40	Jay "Can I get a snack?" MB: No you cannot get a snack until I get your bacteria paragraph from you. Jay: I did that. MB: Then turn it in. Jay: I turned it in The above conversation happened before the class started. MB said to Jay to come up and let's look at your assignments. [That way they could check that he had submitted his work.]	SOI-T	
42	8:40a Both LT and Jay working on their Flocabulary tasks now.	A, CI, SI	OI, EI, CI, AID
43	Jay was Googling something when he was supposed to be working on flocabulary screen [not sure what he was looking up. Seems he might be looking up cell info]	A, SI	OI, EI, CI, AID
47	9:03a Jay still working on Flocabulary.	A, CI, SI	OI, EI, CI, AID
55	Jay socialized with Tariq, Blake and Austin before the bell sounded. He also asked MB if he could buy a snack.	SOI-P	
56	Jay was watching the video and still doing something else on his chromebook.	A, SI	OI

BCE	Today Jay has been transitioning btwn a lab bench with his chromebook charging and his desk in the 4-desk pod.		
58	Jay diligently working to finish his project. No additional features are being added to the slides.	A, CI, SI	OI, CI
63	MB: "And it dawned on me at 4'oclock in the morning when I wake up and think about you." [Jay smiled after MB made this statement]	SOI-T	
65	You should not be eating candy in this class. ... see me after class." [MB made this statement to Jay	SOI-T	
66	Today he seemed to be playfully interacting with one of his old group mates, Austin]	SOI-P	
77	Jay was moved by MB to a new table to sit with other male students because he got written up yesterday for watching Youtube videos when he was supposed to be finishing the IXL substitute assignment from Nov. 21st.	CI, SoI-T	
83	Jay is socializing with his group mates.	SOI-P	
86	While MB is doing the mitochondria diagram sheet for the foldable Jay is using tape to put other papers into his notebook. He is not yet copying down the required terms on the mitochondria. He is now (8:51a) copying down the terms.	A, CI	OI, CI
87	Jay started with cutting the notes sheets before he started on the orange paper. He then asked one of his group mates (Tariq) to help him fold the orange paper into the foldable.	SOI-P	
88	9:03a MB had to call Ja'Ree's name to get him back on course.	SOI-T	
89	[Jay is laughing and socializing with Tariq.]	SOI-P	
90	MB using candy to ask questions. Jay raised his hand high and was shaking it to try and answer a question.	CI, SI	CI
96	8:55 Jay and LT paying attention, focused and following along.	CI	OI, CI

97	[Jay had multiple squares empty on his flow chart by the time MB finished filling in the sheet. One of his groupmates chuckled and said, why do you have so many empty? Jay then looked at another groupmate's (elbow buddy) sheet to fill in more squares.]	CI, SOI-P	

Kyle

Number	Note/Observation	Associated Pattern	Practice
5	During the quiz Kyle put his hands over his face. 9:06a [After talking with Kyle, he said he put his hands on his face because he was upset with his grade. He didn't like what he got. He said that he did study for the quiz. He missed questions on the bacteria]	A, CI, SI	CI, AID
13	MB went over to Kyle and helped him submit work in Google classroom. [I think this may have happened bcse on a previous class period, Kyle mentioned that he didn't have wifi at home.]	SOI-T	
14	Kyle: "The cell membrane it lets things in and out"	A, SI	E
15	[After the positive recognition of Kyle's response, Mikel then attempted to respond to the next question]	SOI-T	CI

16	MB asked "Kyle did you go to sleep" Kyle was just leaning his head on his arm at this point. His eyes were open and his top of hoodie was up the side of his head, not completely covering his head. He turned a bit agitated bcse he wasn't sleeping and said no, he just had his arm like this	SOI-T	
23	MB: what does the nucleus do in the cell? Kyle raised his hand to respond. "It is the main part of the cell"	SI, SOI-T	CI
24	9:26a Watching the Amoeba sister video from where they left off. Both paying attention to the video playing.	A, CI, SI	OI, EI, CI, AID
33	Kyle is on the list of students who have to come to MB for CATS cafe.	SOI-T	
34	MB had to review the dsq submission procedure. MB asked Chester if he could help Kyle work through fixing his dsq issue where he couldn't write on the document.	SOI-T, SOI-P	
35	Kyle and Mikel focused and copying down the analogies that MB had written down on the sheet from 1st period.	A, CI, SI	OI, CI
37	Kyle: "MB, I have a 93 out of 100" MB: I'm not looking at that right now.	CI	
38	[Kyle and Mikel are focused and working. Possible question to ask them: is how they feel about assignment tasks like this... working on their flocabulary assignments.]	CI	

50	Kyle and Mikel have both completed their bacteria paragraphs. They did not have to come up when MB called up the group of students who did not submit their paragraphs.	A, CI, SI	
51	Kyle first said he would work by himself. But then he decided to work with the two classmates who he sits with at the lab tables. [It seems like Chester is a prized group member, Mikel also wanted to work with Chester but ended up working with his elbow 4-desk mate.]	SOI-P	
53	Kyle brought his chromebook up to ask MB about one of his slides. She commented that it looked really good. He commented that he had done the slide himself. MB affirmed Kyle again that it looked really good.	SOI-T	OI, CI, AID, CoI, DM
54	Kyle came up to ask about if adding a euglena picture on one of his slides. MB: "What cell organelle would you put a euglena on to represent?" [MB and Kyle had a conversation on organelles, on why euglena is green, chloroplasts and what they do and solar panels to help Kyle make sense of his thought about using euglena as a picture for a slide. Ultimately he decided that the chloroplast slide would be the best slide.]	A, SI, SOI-T	EI, E, AID
68	Kyle: fine answering questions asked by MB.	SI	CI
69	Kyle and Mikel watching video	A, CI, SI	OI
79	Kyle is working and focused on following MB's prompts.	CI, SI	OI, CI
80	9:51a Kyle: "This s cool, I like this foldable"	SI	OI, CI
81	Kyle is answering questions.	A	CI

91	Kyle readily responded to MB's starting questions about photosynthesis. MB: What do we call that food?" Kyle: "Glucose"	A, SI	CI
92	Kyle: "I was watching National Geographic about ants. Would a plant ever have a defense system in it so things wouldn't eat it?" [he asked a question to MB about plants and she answered it (can use audio if needed)]	A, SI	AQ
93	Kyle: "That's a pretty tough thing to remember Chester. Good job!" [MB and I ended up laughing because of how he said it. How he was giving his classmate praise.]	CI, SOI-P	OI, CI
98	Kyle: "That is a big word." MB: (with a chuckle) "That IS a big word."	A, SI	CI
100	Kyle is listening and copying down the notes as instructed and when he can communicate what he knows to one of MB's questions, he has done that in class today.	A, CI, SI	OI, CI
101	Kyle: "I think I like cellular respiration more than photosynthesis." MB: Why? Kyle: "So you know like in a factory, it's like a machine and it functions and it keeps on going?" (9:36a) [He spoke these words when MB was going over the cellular respiration notes in their science notebooks.]	A, SI, SOI-T	E, CI

103	Kyle: "It was hard when I tried to pronounce mitochondria." MB: "But now you've got it"[check audio] Kyle shook his head yes and pronounced mitochondria well.	A, SI	

LT

Number	Note/Observation	Associated Pattern	Practice (if applicable)
1	LT is falling asleep as he is supposed to be completing tasks	SI	
3	LT got an 85% and said that he didn't even study once for his quiz. "I guess my memory capacity is" [getting better]...	SI (memory capacity)	
6	[LT was comfortable raising his hand to respond to question asked by MB again. Jay was completing the task yet, is quiet.]	A, SI	
8	Jay and LT copying down text from video screen where MB stopped the video to review cell theory. The place to write the info was at the bottom of the sheet.	A, CI	OI, CI, EI
9	LT's analogy: the filter of the air conditioner	A, SI	CI, E
10	LT: Like the air conditioner. The filter keeps the dirt and stuff from coming in and lets the clean air through.	A, SI	E
17	8:38a Students started the Amoeba sister video again. MB started it from the beginning. At this point, 8:40a Jay and LT were both not looking at the video. Jay was looking away from the screen. LT was looking at his chromebook [almost in a daze].	CI, SI	OI, EI, CI, AID
18	8:50a Students instructed to pull out their diagram sheet from today that has both an animal cell and plant cell with organelles. Students are following along with the teacher to complete the labeling of the organelles of the cell. Both LT and Jay following along as instructed.	CI	OI

20	Timothy, cell wall, what does that do? LT: It... MB: in case you're not sure, it's number 35 on the other sheet. LT didn't have that answer so MB called on another student.	SOI-T	AID
21	MB then went back to LT and asked another question about the cell wall being in a plant or animal cell. LT: Both... Oh, no plant. [MB didn't hear him correct himself. She then asked him again after a different student responded plant cell. LT responded with a bit of exasperation at what was happening. Another classmate said he [LT] is sleepy.]	SI, SOI-T	CI
31	8:53a watched video together before starting Flocabulary. Rap song discussing cell features was part of the video. Both LT and Jay are watching the video. Video: LT laughed at the last part of the video.	A, CI, SI	OI
41	LT: What ed puzzle? [after MB told him that he needed to get things done and get started on finishing his flocabulary and completing the ed puzzle homework.	A	
42	8:40a Both LT and Jay working on their Flocabulary tasks now.	A, CI, SI	OI, EI, CI, AID
44	LT did not start the paragraph so he has to go to CATS cafe.	A	OI, CI
45	LT: Uh, how do I start my bacteria paragraph? MB then had LT pull up his info on his chromebook so she could show him the bacteria paragraph rubric. LT: Uh, I think I'm gonna use this one. [while pointing at the topic sentence that he has decided to use.] MB typed the topic sentence for LT. Then explained the 2 for helpful, 2 for harmful and your opinion.	SOI-T	ARG
46	LT working on paragraph.	A, CI, SI	OI, CI
48	LT said he was done with his bacteria paragraph and asked MB if he needed to turn it in. MB showed him what he needed to get that submitted. [this happened after class was over]	SOI-T	
57	LT has to come to CATS cafe to finish the Protists ed puzzle.	A	
62	LT has his chromebook out and is looking up information in his science notebook.	CI, SI	OI, CI

64	MB: Does anyone know the process that converts light into energy? LT: "That process is photosynthesis." [MB asked LT to answer this question, he was still writing down his homework for the week. But he popped his head up, repeated the question that MB asked and then provided the correct answer.]	A, SI, SOI-T	CI
67	LT seems quiet and sleepy today. MB instructed on the IV and DV and when DV was written down, LT was sitting in a daze. [LT is left handed, Jay is right-handed] MB came next to LT to instruct him to write down his prediction. She walked away after he did that.	SOI-T	OI, CI
72	LT: raised his hand after another student answered the first question incorrectly. LT: mitochondria. [correct answer]	A, CI, SI	CI
73	LT: "Because it absorbed all the water."	A, SI	E, CI
76	LT communicated that his prediction was not correct. He expressed to MB when she asked him directly what his prediction was. LT said that he did write that his prediction was not correct and backed it up with evidence to support it.	A, CI, SI, SOI-T	EI, CI, AID
84	MB said to LT, "Yes, you owe me alot of assignments.	CI, SOI-T	
85	LT:"Mitochondria" MB: [LT: "ATP energy" [LT was comfortable responding (communicating) responses to questions about	SI	CI
94	LT has been answering science questions correctly this morning.	CI, SI	CI
95	LT is steadily copying down the notes/flow chart [LT seems a bit sleepy or bored]	CI	OI, CI
96	8:55 Jay and LT paying attention, focused and following along.	CI	OI, CI
104	LT answering questions if asked.	CI, SI	CI

Mikel

Number	Quote	Associated Pattern	Practice

4-BCE	Mikel came in and said "I've started on my paragraph" [the bacteria paragraph] Mikel was laughing. MB stopped and asked him why he was laughing. He said no reason. She then instructed him to get focused and finish his quiz.	BCE	ARG, CI
15	[After the positive recognition of Kyle's response, Mikel then attempted to respond to the next question]	CI, SI	E, CI
15	[After the positive recognition of Kyle's response, Mikel then attempted to respond to the next question]	SOI-T	E, CI
22	MB: My grandmother used to say, you reap what you sow Mikel said "I know what that means."	SOI-T	
24	9:26a Watching the Amoeba sister video from where they left off. Both paying attention to the video playing.	A, CI, SI	OI, EI, CI, AID
25	Mikel: I think that the rectangular one MB: Yeah, yawll are smart. You have your moments, that's true.	SOI-T	
26	MB intentionally called on Mikel: " Mikel, what do you think this is right here [while pointing to the cell wall]" Mikel: The cell wall. MB: exactly [Intentional opportunity given to Mikel to experience success in giving the correct answer to the diagram organelle question]	A, SI, SOI-T	CI
27	[Mikel yelled out flagellum... realizing it was wrong, he covered his lips and looked across at me and smiled. I then looked at him and mouthed that it was okay.. while smiling.]	A, CI, SI	CI
28	Mikel helped to speak up for Owen (who quietly answered a question that MB asked concerning cytoplasm) "He said yes"	SOI-P	CI
29	Mikel: "And the one in the plant cell is bigger"	A, SI	CI
35	Kyle and Mikel focused and copying down the analogies that MB had written down on the sheet from 1st period.	A, CI, SI	OI, CI
36	Mikel has headphones on already. (9:28a) video still playing but he wasn't looking at the side TV screen with other students.	A, CI, SI	

38	[Kyle and Mikel are focused and working. Possible question to ask them: is how they feel about assignment tasks like this... working on their flocabulary assignments.]	CI	
39	Mikel came up to check on his grades 100, 88, 100 on the vocab game, read and response, and quiz. He did a dance after seeing his grades.	CI	
49	Mikel yelled out: "I finished my homework!" MB praised him for doing it.	A, CI, SI, SOI-T	
50	Kyle and Mikel have both completed their bacteria paragraphs. They did not have to come up when MB called up the group of students who did not submit their paragraphs.	A, CI, SI	
52	Mikel called MB over and asked if we are supposed to do it like this? MB walked over and told him, yes. She then clarified the issues that they might be having with the lines on the slides.	SOI-P	OI, CI, AID, CoI, DM
59	MB: "Rafael, put that in your bookbag, it is not that cold in here. Besides, we want to see your beautiful face." [Mikel had a pull over cap pulled over his face]	SOI-T	OI
60	Mikel has already finished his project.	CI, SI	OI, EI, CI, CoI, AID
61	[MB told Mikel to add some color to his presentation. He said why. MB emphasized excellence.]	SOI-T	
69	Kyle and Mikel watching video	A, CI, SI	OI
70	MB asked Mikel if he was okay. MB: "Weekends must be rough, you're not your usual self" What does qualitative mean? [Mikel looked at MB with a crazy expression. He then commented that you look at it to figure out qualitative observations. Then said "My gummy bear is green"]	SI, SoI-T	EI, CI
71	Mikel was frustrated with his group. He just wrote down the measurements given to him by another group member. Mikel: "He's trippin". I'm not sure what caused him to feel this way about Oscar specifically. I went ahead and worked with them to get the correct measurements. Oscar was not reading the ruler correctly.]	SOI-P	MCT, CoI, OI, EI, CI

74	Mikel took lead today. He went ahead and dumped out the water from the beaker and put the gummy bear on the triple beam balance. Once on the balance he started to weigh out the bear. He didn't have it in the groove and Oscar said it has to sit in the groove. They then worked together briefly to figure out the new mass for their gummy bear.]	SOI-P	MCI, CoI, OI, EI, CI
75	MB asked Mikel if he had it written down. He said, yes. He already did write his evidence sentence. MB: "With numbers?" Mikel: "Yes"	A, CI, SI, SOI-T	CI, AID
78	[Mikel seems very bored right now (9:33a), he is copying down each part of the drawing that MB puts on paper for the students to draw and write and he finishes quickly.]	CI, SI	OI, CI
82	Mikel got a piece of candy for answering a question correctly.	A	CI
BCE	During this time, Mikel was shimming and dancing himself to his desk and to his seat. [I laughed and said that you've got more energy today, he said "yes" (while smiling brightly)] MB then let Mikel move so that he can see the black screen which is where they will be taking notes today. (the projector blew a breaker) He gladly moved.		
99	Mikel kicked something up and caused a distraction. His name was the first to be put on the discipline/distraction board. [MB let him know that he was still okay because he didn't have a check mark. As long as he didn't get a check mark next to his name then he was okay.]	SOI-T	
102	MB: Mikel, you're not playing? [In reference to the thumbs up/thumbs down game] Mikel: Umm, I'm playing (said in a low disengaged way) [The previous question that MB asked Mikel did not show his thumbs up thumbs down selection. This reminds me of when he said that he waits for the answers before he responds because he doesn't know if what he thought was correct or not. I'm also wondering if he is bored or also upset that his name is on the discipline board]	SOI-T	

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